

**Department of Geography**

**Faculty of Natural Sciences**

**Jamia Millia Islamia**

**New Delhi – 110025**

**(A Central University by an Act of Parliament)**

**Post-Graduate Diploma in Remote Sensing and GIS**

**Syllabus (w.e.f. 2019 – 2020)**

## Course Structure Post-Graduate Diploma in Remote Sensing and GIS

Paper No/Code	Title	Credit	Type
<b>Semester – I</b>			
Paper - I (PGDRS-101)	Photogrammetry	4	CC
Paper - II (PGDRS-102)	Remote Sensing & Image Interpretation	4	CC
Paper – III (PGDRS-103)	Digital Image Processing	4	CC
Paper – IV (PGDRS-104)	Geographical Information Systems and Global Positioning System	4	CC
Practical – I (PGDRS-105)	Photogrammetry and Image Interpretation	2	CC
Practical – II (PGDRS-106)	Digital Image Processing	2	CC
Practical – III (PGDRS-107)	Geographical Information Systems and Global Positioning System	2	CC
<b>Semester – II</b>			
Paper – V (PGDRS-201)	RS & GIS Application in Soil and Agriculture	4	CC
Paper – VI (PGDRS – 202)	RS and GIS Application in Water and Forest Resources	4	CC
Paper – VII (PGDRS-203)	RS & GIS Application in Urban Environment	4	CC
Paper – VIII (PGDRS-204)	RS and GIS Application in Climate Studies	4	CC
Practical – IV (PGDRS-205)	RS & GIS Application in Soil, Agriculture, Water and Forest	2	CC
Practical – V (PGDRS-206)	RS & GIS Application in Urban Environment and Climate	2	CC
Project (PGDRS-207)	Project	4	CC

**Paper - I (PGDRS-101)**  
**Photogrammetry**  
**Credits: 4**

**Unit I: Introduction to Photogrammetry**

Historical developments; Principles and Types of **Photogrammetry**; Role of photogrammetry in surveying and mapping; Recent trend in Photogrammetry; Aerial and Close-range Photogrammetry: orientation of the bundle of rays, orientation of images, geometric accuracy

**Unit II: Aerial Photography**

Fundamentals of aerial Photography: Flight planning and Resolution; Types and Geometry of Aerial Photographs; Projection of Aerial Photograph; Scale and ground coverage; Relief displacement

**Unit III: Stereophotogrammetry**

Stereoscopy and stereoscopic parallax: Parallax bar, Floating mark and Parallax Bar formula Parallax bar in height measurement; Stereophotogrammetry: Degrees of freedom in single photograph, Principle of reprojection, stereo restitution; Photogrammetric stereo plotters and mapping instruments; Control extension and aerial triangulation.

**Unit IV: Analytical and Digital Photogrammetry**

Basics of Analytical Photogrammetry: Collinearity and Coplanarity conditions, Concept of Rotation Matrix; Concepts in Digital Photogrammetry: Digital data input; satellite based digital photogrammetry; Concept of DEM, DSM and DTM and Orthoimage; Geometric accuracy; Principles of digital photogrammetry, Image measurement, Orientation procedure, Epipolar geometry, Aerotriangulation, Block adjustment, Mosaics of DTM & ortho images

**Suggested Readings:**

1. Cliff Greve and ASPRS Digital Photogrammetry: An Addendum to Manual of Photogrammetry
2. EGELS, Y. -- KASSER, M. Digital Photogrammetry London Taylor & Francis 2002 0-748-40945-9
3. GÁL, P. Fotogrametria Bratislava SNTL 1965
4. Kasser Michel and Egles Yves Digital Photogrammetry. Taylor & Francis. London & New York.
5. Mikhail Edward, Bethel James and Mcglone J Chris Introduction to Modern Photogrammetry, John Wiley & sons Inc.
6. Paul Wolf, Elements of Photogrammetry, McGraw Hill.
7. Sanjib K. Ghosh, 1979: Analytical Photogrammetry, New York: Pergamon Press

8. Sanjib K. Ghosh. 2005. Fundamentals of computation Photogrammetry. Concept publishing, New Delhi.
9. Toni Schenk: Digital Photogrammetry, Volume I., TerraScience.
10. WOLF, P R. Elements of photogrammetry: with applications in GIS. Boston McGraw-Hill 0-07-292454-3
11. ŽÁRA, J. et al. Modernípočítačovágrafika Brno Computer Press 2004 80-251-0454-0

**Paper - II (PGDRS-102)**  
**Remote Sensing & Image Interpretation**  
**Credits: 4**

**Unit I: Fundamentals of Remote Sensing**

Definition, types scope and principles of remote sensing; Stages in remote sensing data acquisition; Electromagnetic radiation and electromagnetic spectrum; Black body radiation and radiation laws; Interaction of EMR with atmosphere and Earth's surface features, spectroscopy of water, soil and vegetation.

**Unit II: Platforms, Orbits, Sensors and Data Products**

Remote sensing platforms and orbits; Types & characteristics of sensors: IRS, LANDSAT, SPOT, IKONOS, Quick Bird; Remote sensing data products.

**Unit III: Thermal & Microwave Remote Sensing**

Thermal Remote Sensing; Thermal properties of materials: emissivity of materials; thermal inertia of Earth surface features; Thermal Emission of Radiation, Radiation Principles (Plank's Law, Stephen Boltzmann law), Interaction of EMR with the Earth Surface ( Wien's displacement law; Thermal data sets: LANDSAT and ASTER; Principles of microwave remote sensing; Microwave data sets SLAR, LIDAR and SAR; Application of Thermal and Microwave data.

**Unit IV: Image Interpretation**

Factors affecting image interpretation; Image characteristics, Elements of Image interpretation; Methods and techniques of image interpretation; land use/land cover classification system; Multi concepts in image interpretation.

**Suggested Readings:**

- 1) Jensen John R. Introduction to Digital Image Processing: A Remote Sensing Perspective Prentice hall, New Jersey
- 2) Richards John A& Xiuping Xia, 2006. Remote Sensing Digital Image Analysis: An Introduction. Birkhäuser.
- 3) Lillesand Thomas M. & Kiefer Ralph: Remote Sensing Image Interpretation John Wiley and Sons, New York
- 4) Campbell John B. Introduction to Remote Sensing, Taylor & Francis, London
- 5) Sabins Floyd. F: Remote Sensing and Principles of Image Interpretation, W H Freeman, New York

**Paper – III (PGDRS-103)**  
**Digital Image Processing**  
**Credits: 4**

**UNIT I: Introduction to DIP and Digital Data**

Overview of DIP and its advantage and disadvantages, key stages; Resolutions: spatial, radiometric, spectral and temporal; Digital images and its types; Digital data formats: band interleaved by pixel, band interleaved by line, band sequential.

**UNIT II: Image Rectification & Manipulation**

Introduction-Sensor model, Pre-processing and Post processing Geometric distortion, sources and causes for distortion, rectification, GCP, Re-sampling, Image registration, transformation, Radiometric distortion, sources and causes, Computation of radiance, Computation of reflectance, cosmetic operations, Noise removal, atmospheric correction.

Multi Image Manipulation: Band rationing; Vegetation Indices: Normalized Differential Vegetation Index, Transformed Vegetation Index, and Normalized Differential Water Index , Soil Moisture index and SAVI

**Unit III: Image Enhancement**

Contrast Stretching; Linear contrast stretching, Non-linear contrast stretching, histogram equalization, Gaussian stretch, density slicing and pseudo colouring; filtering: spatial domain and frequency domain filtering; High pass and low pass filters; Linear edge enhancement filter: Laplacian filter; Non linear edge enhancement filter: Roberts filter, Sobel's filter.

**UNIT IV: Image Classification and Accuracy**

Image classification: Spatial pattern recognition, Image classification types: Supervised, unsupervised; Training site selection and analysis; Supervised image classifiers : Minimum distance to mean classifier, Parallelepiped classifier, Gaussian maximum likelihood classifier, Unsupervised image classifiers: Histogram based classification, Sequential clustering, Isodata clustering; Fuzzy classification; Classification Accuracies: Producer accuracy, User accuracy, overall accuracy and K statistics.

**Suggested Readings:**

- 1) Gonzalez Rafael C and Woods Richard E.: Digital Image Processing Addison Wesley, New York
- 2) Pratt William K.: Digital Image Processing, John Wiley and Sons, New York
- 3) Jain Anil K. Fundamentals of Digital Image Processing, Prentice Hall, New Jersey:
- 4) Jensen John R. Introduction to Digital Image Processing: A Remote Sensing Perspective Prentice hall, New Jersey.
- 5) Richards John A& Xiuping Xia, 2006. Remote Sensing Digital Image Analysis: An Introduction. Birkhäuser.

**Paper – IV (PGDRS-104)**  
**Geographical Information Systems and Global Positioning System**  
**Credits: 4**

**Unit I: Introduction to GIS**

History and development of GIS; Cartography –GIS interface; Recent trends and applications of GIS; Open source GIS; GIS Mobility; Real-Time GIS, Programming Language: Python and Java

**Unit II: GIS Database**

Geographic data: Spatial and non-spatial; Data models: Raster and vector; Database Management System (DBMS); Data Structures: Relational, hierarchical and network; spatial data types insertion and retrieval; Attribute data generation; Coordinate transformation; Big Data Analytics and Data Mining; spatial queries using extended SQL, Query optimization & index creation; Spatial database design using Unified Modelling Language, spatial database schema creation.

**Unit III: Spatial Analysis**

Spatial overlay operations, network analysis and proximity analysis; 3D models; TIN, DEM, DTM Query in GIS; Interpolation of non-spatial data; multi-criteria decision modeling; hydrological Analysis; Generalization; Map Algebra and Geostatistical Analysis

**Unit IV: Global Positioning System**

Global Positioning System: Introduction, Satellite constellation, GPS signals and data, Geopositioning-Basic Concepts. NAVSTAR, GLONASS, Indian Regional Navigational Satellite System (IRNSS), GAGAN Control Segment, Space Segments, User Segment, GPS Positioning Types- Absolute Positioning, Differential positioning, GPS Surveying Methods and Accuracy: Methods-Static & Rapid Static, Kinematic-Real Time Kinematic Survey-DGPS-GPS Data Processing and Accuracy, Factors Affecting GPS Accuracy, GPS receiver, GPS antenna. Radio and its types, Radio Antenna

**Suggested Readings:**

1. Burrough, P.A., 1986, Geographical Information System for land Resources System, Oxford Univ. Press, UK.
2. Fotheringham, S.; Rogerson, P. (ed.), 1994. Spatial Analysis and GIS. Taylor and Francis, London, UK.

3. Laurini, Robert and Dierk Thompson, 1992, Fundamentals of Spatial Information Systems, Academic Press, ISBN 0-12-438380-7.
4. Maguire, D.J.; Goodchild, M.F.; Rhind, D.W. 1991. Geographical Information System, Longman, London, UK
5. Siddiqui, M.A.; 2006, Introduction to Geographical Information System, Sharda Pustak Bhavan, Allahabad.
6. Siddiqui, M.A.; 2011, Concepts and Techniques of Geoinformatics, Sharda Pustak Bhavan, Allahabad.
7. Devillers, R. and Jeansoulin (2006). Fundamentals of Spatial Data Quality. ISTE Ltd, United States.
8. Draper, N. and Smith, H. (1981). Applied Regression Analysis. Wiley, New York.
9. Hengl, H. (2007). A Practical Guide to Geostatistical Mapping of Environmental Variables. European Commission, Italy.
10. Sen, Z. (2009). Spatial Modeling Principles in Earth Sciences. Springer.



**Practical – I (PGDRS-105)**  
**Photogrammetry and Image Interpretation**  
**Credits: 2**

**Unit I: Aerial Photography**

Introduction to aerial photographs; Numerical problems on the aerial photographs; Determination of photo scale; determination of number of Strips and total number of aerial photographs; Preparation of photo index.

**Unit II: Photogrammetry: Instruments and Data Collection**

Stereo test; Orientation of stereo pair under mirror stereoscope; Determination of heights and slopes; Preparation of base map. Familiarization with DPWS, Project creation, data input, orientation. Data integration from different sources of GPS and high-resolution satellites for large-scale mapping.

**Unit III: Digital Photogrammetry**

DEM and ortho-image generation and accuracy assessment. Feature extraction from 2D and 3D models. Use of Google Earth and Bhuvan Earth Models.

**Unit IV: Interpretation of Satellite Imageries**

Referencing and lay out of satellite images; Identification of objects/features from satellite imageries based on reflectance; Interpretation of physical and cultural features from IRS imagery; Preparation of imageinterpretation keys. Image Metadata and their use in image interpretation

**Suggested Readings:**

1. American Society of Photogrammetry, 1993, Manual of Remote Sensing, falls Church, Virginia
2. Cliff Greve and ASPRS Digital Photogrammetry: An Addendum to Manual of Photogrammetry
3. Curran, Paul J., 1995, Principles of Remote Sensing, Longman, London
4. Joseph George (2003) Fundamentals of Remote Sensing, University Press, Hyderabad.
5. Kasser Michel and Egles Yves Digital Photogrammetry. Taylor & Francis. London & New York.
6. Li,Zhilin, Chen,Jun and Baltsav,Emmanual, 2008. Advances in photogrammetry, Remote Sensing and Spatial Infomation Science: 2008 ISPRS Congress Book. / London: Taylor and Francis Group, xviii,527p ISBN : 978041547805.
7. Lillesand T.M and Keifer R.W. (2000) Remote Sensing and Image Interpretation, IVth Eds. John Wiley and Sons, New York.

8. Lo C.P. & Yeung A.K.W., (2004). Concepts and Techniques of GIS, Prentice-Hall of India, New Delhi.
9. Mikhail Edward, Bethel James and McGlone J Chris Introduction to Modern Photogrammetry, John Wiley & sons Inc.
10. Schmidt Milton O and Rayner William Horace Fundamentals of Surveying, Van Nostrand Reinhold Company

**Practical – II (PGDRS-106)**  
**Digital Image Processing**  
**Credits:2**

**UNIT 1: Image Restoration and Enhancement**

Digital images; Layer stacking, Subsetting and Band Compositions; Image enhancement techniques: Histogram equalization; Image filtering.

**UNIT 2: Image Error Rectification**

Radiometric and atmospheric error rectification, Geometric Error Rectification Exercises.

**UNIT 3: Indices Modeling**

Normalized Differential Vegetation Index, and Soil Adjusted Vegetation Index models

**UNIT 4: Image Classification**

Image classification: Unsupervised classification; Training sets and supervised classification using Maximum likelihood methods; Introduction to Earth Engine

**Suggested Readings:**

- 1) Ekstrom, M.P., 1994, Digital Image Processing Techniques, Academic Press, New York.
- 2) Hord, R.M., 1992, Digital Image Processing of Remotely Sensed Data, Academic Press, New York
- 3) Jensen, J.R., 1996, Introductory Digital Image Processing: A Remote Sensing Perspective, Printice Hall, Englewood Cliffs, New York.
- 4) Lillesand T.M and Keifer R.W. (2000) Remote Sensing and Image Interpretation, IVth Eds. John Wiley and Sons, New York.
- 5) Muller, P.J., 1996, Digital Image Processing in Remote Sensing, Taylor & Francis, London.
- 6) Nag, P. & Kudrat, M., 1996, Digital Remote Sensing, Concept Publishing Company, New Delhi.
- 7) NRSA, 1995. IRS - IC, Data User Handbook, Hyderabad.
- 8) Sabins, F.F. (2002), Remote Sensing: Principles and Interpretation, Freeman, New York

**Practical – III (PGDRS-107)**  
**Geographical Information Systems and Global Positioning System**  
**Credits: 2**

**Unit -I: Introduction to Computers & GIS**

Graphical user interface of Arc GIS; QGIS; Google Earth Engine; Open Source Geo-network metadata cataloging system

**Unit - II: Database Creation**

Spatial data input and Geo-referencing; Spatial database creation; Creation of non-spatial data sets into DBF format; Linking of Spatial data with non-Spatial data sets; Map generation at varied spatial resolutions, Spatial resolution vs. attribute uncertainty; Modifiable Areal Unit Problem (MAUP)

**Unit-III: Spatial Analysis**

GIS analysis: Proximity, Thematic mapping and Overlay; 3D modeling: DEM, Slope and Aspect; Geo-visualization of 3D geospatial data; Overlay and proximity analysis; Output and report generation; Modelling spatial structure from point samples, Assessing the quality of spatial predictions, Auto-correlation, Variogram and Semi-variogram analysis

**Unit IV: Global Positioning System**

Demonstration on GPS and DGPS; Selection of datum, units and scale; GPS measurement: Collection of GCPs; Mobile mapping; Transfer of GPS data into GIS software. Land Surveying through DGPS.

**Suggested Readings:**

1. Bernhardsen (2003) *Geographic Information Systems: An Introduction*, 3ed, Wiley India Pvt. Ltd., New Delhi.
2. Demers (2004) *Fundamentals of Geographic Information Systems*, 3ed, Wiley India Pvt. Ltd., New Delhi.
3. Joseph George (2003) *Fundamentals of Remote Sensing*, University Press. Hyderabad
4. Lillesand T.M and Keifer R.W. (2000) *Remote Sensing and Image Interpretation*, IVth Eds. John Wiley and Sons, New York.
5. Lo C.P. & Yeung A.K.W., (2004). *Concepts and Techniques of GIS*, Prentice-Hall of India, New Delhi
6. LO & YEUNG (2009) *Concepts and Techniques of Geographic Information Systems*, 2nd ed., PHI Learning Pvt. Ltd, New Delhi.
7. Downey, A. B. (2009). *Python for Software Design: How to Think Like a Computer Scientist*. Cambridge University Press.
8. Sherman, G. (2012). *The Geospatial Desktop: Open Source GIS and Mapping*. Locate Press.

9. Swaroop C. H. (2008). A Byte of Python. <http://www.swaroopch.org/notes/Python>.

### **Online Sources**

1. <http://www.python.org/>
2. <http://pypi.python.org/pypi>
3. <http://www.pythonware.com/products/pil/>
4. <http://www.opengeospatial.org/standards/kml/>
5. <http://www.gdal.org/>
6. NumPy User Guide Release 1.5.1 (<http://docs.scipy.org/doc/numpy-1.5.x/numpy-user.pdf>)
7. Python Imaging Library Overview 1.1.3 (<http://www.pythonware.com/media/data/pil-handbook.pdf>)
8. Matplotlib Release 1.0.0 (<http://matplotlib.sourceforge.net/trunk-docs/Matplotlib.pdf>)

**Paper – V (PGDRS-201)**

**RS & GIS Application in Soil and Agriculture**

**Credit-4**

**UNIT I**

Soil classifications, Soil survey, Types and methods: Hydrological Soil grouping - Factors influencing soil reflectance properties, Factors affecting Soil erosion, Major soil types of India and Spectral signatures, characteristics of saline & alkaline Soils.

**UNIT II**

Soil mapping, degradation and fertility, Application of remote sensing in soil type mapping, soil moisture assessment, erosion assessment and degradation, Soil Erosion Assessment Models, watershed management, Soil conservation.

**UNIT III**

Spectral properties of crops, crop canopy, crops identification, crop inventory, crop acreage estimation, vegetation indices and biophysical model, crop condition assessment, crop water management, command area monitoring and management,

**UNIT IV**

Agro-ecological zonation, site suitability for agricultural and horticulture crops, damage assessment due to cyclone, drought, flood and forewarning, precision agriculture, crop loss assessment, RS for crop insurance claim.

**Suggested Readings:**

1. Remote sensing applications (2009), Published by NRSC, ISRO, Hyderabad, Chapters – 1 & 13
2. Manfred Owe; Guido D'Urso (2005). Remote Sensing for Agriculture, Ecosystems, and Hydrology VII : Proceedings of SPIE Volume: 5976
3. Quantitative Remote Sensing of Land Surfaces (2005) By Shunlin Liang ), Willey Publishers
4. Applications of remote sensing in agriculture (1990) edited by M.D. Steven, J.A. Clark, Publisher – Butterworth, London
5. Ustin, S. (2001). Manual of Remote Sensing, Volume 4, Remote Sensing for Natural Resource Management and Environmental Monitoring, 3rd Edition, Willey Publishing
6. Precision Agriculture in the 21st Century - Geospatial and Information Technologies in Crop Management (1997) National Academy Press, Washington D. C.
7. Holmes M.G., 1990, Application radar in Agriculture, Remote sensing applications to agriculture, ed. M.D. Steven and J.A. Clark, Butterworhs, p. 307.
8. Encyclopedia of Soil Science - Second edition (2010) Edited by Rattan Lal, Publisher – Taylor & Francis

**Paper – VI (PGDRS – 202)**  
**RS and GIS Application in Water and Forest Resources**  
**Credits: 4**

**Unit I: Assessment of Water Resources**

Hydrological cycle and its components; concept of the watershed; Spectral reflectance of water, surface water mapping through water index; ground water: quality parameters and mapping.

**Unit II: Spatial Modelling of Water Resources**

Rainfall-runoff modelling: Hydrograph analysis, hydrograph, base flow separation, river flow measurement and flow routing; snowmelt runoff modelling; watershed prioritization: monitoring and management; Groundwater potential assessment.

**Unit III: Forest Mapping and Monitoring**

Forest cover classification scheme; Spectral reflectance properties of vegetation; mapping through vegetation indices; Hyperspectral remote sensing for vegetation species determination; LiDAR data for tree height and Forest Canopy Density mapping.

**Unit IV: Inventory and Spatial modelling**

Sampling theory and design for data collection, forest Growing stock, carbon and biomass estimation, Canopy density model, forest fragmentation, Landscape Characterization and habitat suitability in forest.

**Suggested Readings:**

1. alponete, M., Bruzzone, L., Vescovo, L. and Gianelle, D. 2009. The role of spectral resolution and classifier complexity in the Analysis of hyperspectral images of forest areas. *Remote Sensing of Environment*, 113(11): 2345-2355
2. Bala Krishnan P. "Issues in Water Resources Development and Management & the role of Remote Sensing", Technical Report ISRO-NNRMS-TR-67-86, NNRMS, ISRS, India.
3. Beven, K.J. (2001). "Rainfall-runoff modelling: the primer". John Wiley and Sons, UK.
4. Chow V.T., Maidment D.R. and Mays L.W. (1988). "Applied Hydrology", McGraw-Hill, New York.
5. Cochran, W.G. 1977. *Sampling Techniques*. John Wiley & Sons, New York.
6. Congalton, R.G. 1991. A review of assessing the accuracy of classifications of remotely sensed data. *Remote Sensing of the Environment*, 37: 35- 46
7. Constantin, Z. and Pardolos, P.M. 1998. *Managing in Uncertainty: Theory and Practice*. Kluwer Academic Publisher, Boston.

8. Engman E.T. and Gurney R.J (1991). "Remote sensing in Hydrology", Chapman & Hall, London.
9. Gregory K.J., Walling D.E. (1973). "Drainage Basin Form and Process: A Geomorphological approach", Edward Arnold Ltd., U.K.
10. Hunt, E.R., Gillham, J.H., Daughtry, C.S.T. 2010. Improving potential geographic distribution models for invasive plants by remote sensing. *Rangeland Ecology and Management*, 63(5): 505-513.
11. Isobel W. H. (2009). "Integrated watershed management: principles and practice" John Wiley and Sons, U.K.
12. Jones T.G., Coops N.C. and Sharma, T. 2010. Assessing the utility of airborne hyperspectral and LiDAR data for species distribution mapping in the coastal Pacific Northwest, Canada. *Remote Sensing of Environment*, 114(12): 2841-2852.
13. Levizzani V., Bauer P. and Joseph Turk F. (eds.) (2007). "Measuring Precipitation from space EURAINSAT and the Future", Published by Springer, P.O. Box 17,3300, AA Dordrecht, The Netherlands.
14. Maidment D.R. (ed.) (1993). "Handbook of Hydrology", McGraw-Hill.
15. Maidment D.R., (2002). "Arc Hydro: GIS for Water Resources", ESRI Press, Redlands CA, USA.
16. Michaelides S. (ed.) (2008). "Precipitation: Advances in Measurement, Estimation and Prediction". Published by Springer-Verlag, Berlin, Heidelberg.

## Online Sources

1. <http://trmm.gsfc.nasa.gov/>
2. <http://www.india-wris.nrsc.gov.in/>
3. <http://www.chikyu.ac.jp/precip/>
4. <http://www.imd.gov.in/>
5. <http://clic.npolar.no/>
6. <http://www.cwc.nic.in/>
7. <http://ladsweb.nascom.nasa.gov/data/>
8. <http://www.itc.nl/WRS>
9. <http://www.iirs-nrsc.gov.in/index.php>
10. [http://www.ats.ucla.edu/stat/examples/msm\\_goldstein/default.htm](http://www.ats.ucla.edu/stat/examples/msm_goldstein/default.htm)
11. <http://www.autonlab.org/tutorials/>
12. <http://www2.latech.edu/~strimbu/Teaching/FOR315/FOR315.html>
13. <http://www.freestatistics.info/en/stat.php>
14. <http://www.r-project.org/>
15. <http://statpages.org/javasta2.html#Biostatistics>



**Paper -VII (PGDRS-203)**  
**RS & GIS Application in Urban Environment**  
**Credit - 4**

**UNIT I**

Concept of Urbanization and Environment, Challenges and recent trends, Land use land cover mapping and classification system, Urban Sprawl, slums and squatter settlements, Suitability analysis for urban development.

**UNIT II**

Role of Geoinformatics in population estimation and updating, Land information system: revenue and tax mapping, Hot spots and Cluster Analysis for Crime mapping, Traffic and parking studies, Accident analysis.

**UNIT III**

Role of Geoinformatics to monitor the changes in local weather conditions, Air and Noise pollution, Urban Green spaces, urban heat island due to urbanization.

**Unit IV**

Urban Issues and Hazards: Monitoring of urban environment; urban facility/utility mapping, Disease Mapping: Spatio-temporal visualization of disease pattern and trends, Solid waste management, urban floods.

**Suggested Readings:**

1. Ellen M. van Bueren, Hein van Bohemen, Laure Itard, Henk Visscher. Sustainable Urban Environments: An Ecosystem Approach.
2. George Z. Xian. Remote Sensing Applications for the Urban Environment.
3. Xiaojun Yang. Urban Remote Sensing: Monitoring, Synthesis and Modeling in the Urban Environment.
4. Ian Douglas. The Urban Environment.
5. Jean-Paul Donnay, Michael John Barnsley. Remote sensing and urban Analysis.
6. Qihao Weng, Dale A. Quattrochi. Urban Remote Sensing.

**Paper – VIII (PGDRS- 204)**  
**RS and GIS Application in Climate Studies**  
**Credits: 4**

**Unit I: Introduction to Atmosphere and Climate**

Energy balance, atmospheric circulation and climate. Radiation and heat budget, Basic concepts of tropical climates: Tropical Circulations, Scale Analysis of Large-Scale Tropical Motions, Equatorial Wave Theory, etc. El Nino Southern Oscillation and Indian Monsoon

**Unit II: Principles of Atmospheric Remote Sensing**

Interaction of electromagnetic radiation (EMR) with atmosphere: absorption by atmospheric gases and emission; scattering: Mie and Rayleigh scatterings; EMR interaction with cloud; reflection from the Earth's surface

**Unit III: Meteorological satellite and Data Collection**

Characteristics of instrumentation Polar-orbiting meteorological satellite: advanced high-resolution radiometer, high-resolution infrared radiation sounder, microwave sounding unit, stratospheric sounding units, solar backscatter ultraviolet radiometer, earth radiation budget instrument, etc. Characteristics instrumentation of Geostationary meteorological satellite: GMS, Meteosat, Insat, GOES; other satellite; Meteorological measurement using interferometer, limb scanner, microwave imager etc.

**Unit IV: Application and Modelling**

Trace gases retrieval methods: Retrieval of ozone and other gases; Cloud and water vapor retrieval through remote sensing data; Retrieval of aerosol optical depth, remote sensing and rainfall estimation and prediction; Solar constant and top of the atmosphere radiation estimation; Land surface temperature and sea surface temperature estimation; micro-climate study

**Suggested Readings:**

1. Lillesand Thomas M. & Kiefer Ralph: Remote Sensing and Image Interpretation Third Edition John Wiley
2. Campbell John B.: Introduction to Remote Sensing Taylor & Francis
3. Floyd F. Sabins : Remote Sensing and Principles and Image Interpretation
4. Stanley Q. Kidder and Thomas H: Satellite Meteorology an Introduction, 1995. VonderHaar, Academic Press.
5. Geoffrey K .Vallis : Atmospheric and ocean fluid dynamics, 2006, Cambridge university Press.
6. James R. Holton : An introduction to dynamic meteorology,2004, Elsevier Academic Press.

7. C.N. Hewitt and Andrea V. Jackson: Handbook of atmospheric science, 2003. Blackwell publishing.

**Practical – IV (PGDRS – 205)**  
**RS & GIS Application in Soil, Agriculture, Water and Forest**  
**Credit - 2**

**UNIT I: Soil Resources Analysis**

Soil Moisture Assessment using Remote Sensing; Soil Erosion modeling: Sediment Yield Model

**UNIT II: Agriculture land and crop mapping and Analysis**

Site suitability analysis for agricultural land and crop acreage estimation.

**UNIT III: Water Resources Analysis**

Watershed delineation from DEM; Surface water body mapping through NDWI model.

**UNIT IV: Forest Resource Analysis**

Digital image interpretation of Vegetation & Spectral vegetation indices; Leaf Area Index; Forest Biomass estimation.

**Suggested Readings:**

1. Lillesand Thomas M. & Kiefer Ralph: Remote Sensing and Image Interpretation Third Edition John Wiley
2. Campbell John B.: Introduction to Remote Sensing Taylor & Francis
3. Bala Krishnan P. "Issues in Water Resources Development and Management & the role of Remote Sensing", Technical Report ISRO-NNRMS-TR-67-86, NNRMS, ISRS, India.
4. Beven, K.J. (2001). "Rainfall-runoff modelling: the primer". John Wiley and Sons, UK.

**Practical – V (PGDRS – 206)**  
**RS & GIS Application in Urban Environment and Climate**  
**Credit - 2**

**UNIT I: Geospatial data for Urban and Climate Studies**

Data Products Weather map; thematic maps of weather elements; IMD data products; Satellite data products: Landsat; MODIS; NOAA, INSAT series; Rainfall data analysis

**UNIT II: Suitability Analysis**

Site selection suitability for urban development.

**UNIT III: Urban Area Mapping**

Urban sprawl mapping and Normalized Differentiate Built-up Index Model using Remote Sensing

**UNIT IV: Geospatial models and Applications**

Temperature models: Land surface temperature, Model validation through in situ data, Urban heat island

**Suggested Readings:**

1. Jean-Paul Donnay, Michael John Barnsley. Remote sensing and urban Analysis.
2. Qihao Weng, Dale A. Quattrochi. Urban Remote Sensing.
3. Basudeb Bhatta. Analysis of Urban Growth and Sprawl from Remote Sensing Data.
4. Lillesand Thomas M. & Kiefer Ralph: Remote Sensing and Image Interpretation Third Edition John Wiley.
5. Campbell John B.: Introduction to Remote Sensing Taylor & Francis.
6. [Jiansheng Yang](#) (2009). Estimating Land Surface Temperature From Space: A Remote Sensing Perspective.
7. [Ayse Pamuk](#) (2006) Mapping Global Cities: GIS Methods in Urban Analysis.

