Syllabus
Post Graduate Diploma in Geo-informatics
Semester I

	Credits	Paper Code	Subject
Core Papers	**4**	DGI-C101	Introduction to Remote Sensing
	4	DGI-C102	Fundamentals of GIS and GPS
	4	DGI-C103	Cartography and Mapping
Elective Papers (Select Any one From)	**4**	DGI-E101	Computer applications, Programming and Geo-statistics
		DGI-E102	Spatial Analysis
		DGI-E103	Advances in Remote Sensing and GIS
Core Paper	**2**	DGI-C104	Practical based on Paper C101
	2	DGI-C106	Practical based on Paper C102
	2	DGI-C106	Practical based on Paper C103
	2	DGI-C107	Practical based on Paper Elective Paper
	1	DGI-C108	Soft Skill/ Seminar/ MOOCS/SWAYAM/NPTEL etc
Total Credits = 25			

Semester II

	Credits	Paper Code	Subject
Core Papers	4	DGI-C201	Applications of GIS in Water Resource Management
	4	DGI-C202	Applications of GIS in Urban Development
	2	DGI-C203	Practical based on Paper C201
	2	DGI-C204	Practical based on Paper C202
	4	DGI-C205	Field work/ Training
	8	DGI-C206	Dissertation/ Project Work
	1	DGI-C207	Soft Skill/ Seminar/ MOOCS/SWAYAM/NPTEL etc
Total Credits = 25			

DGI-C101: Introduction to Remote Sensing **4 Credit**

Pre-requisite(s): Any M. Sc. Geology/Environmental Science/Geophysics/Physics/Agri., M. A. Geography

Course Objectives: This course aims to:

1. Disseminate basic concepts and applications of Electromagnetic Spectrum in Remote Sensing, Energy Balance and Data acquisition platforms, sensors and their characteristics

2. Disseminate the knowledge about Visible, Infrared, Thermal and Microwaves based Remote Sensing

3. Applications for solving real life problems

4. Introduce students to digital image processing tools and techniques.

Course Outcomes (CO): On completion of this course, students should be able to:

1. Explain physical principles and sensing process in remote sensing.

2. Explain different type of sensors (Visible, Infrared, Thermal and Microwaves) and their characteristics.

3. Describe preprocessing requirements and discuss various Digital Image Processing techniques.

4. Classify Satellite Images with different classification approaches for diverse applications.

5. Apply the knowledge of remote sensing in various thematic studies

Unit I **15**

Introduction and Aerial Photography: Introduction to Remote Sensing, Definition, Characteristics of EMR, Platforms, Fundamentals of Aerial Photography, History of Aerial Photographs, Types of Aerial Photographs- Vertical and Oblique Photographs, Aerial Cameras, Flying Plan

Unit II **15**

Photogrammetry: Basic Geometric Characteristics- Scale, Overlap, Tilt, Distortion and Displacement of Aerial Photographs, Advantages and Disadvantages of Aerial Photographs,

EMR and its interaction with matter, Reflection, Absorption, Transmission, Scattering. Concept of Signatures- Photo Interpretation Elements.

Unit III **15 Lectures**

Satellite Remote Sensing:

Principles of Remote Sensing, Process of Remote Sensing, Indian Remote Sensing Programme, Types of Satellites- Sun-synchronous and Geostationary Satellites, Launch Vehicles- PSLV, GSLV, Payloads, Active and Passive Remote Sensing, Classification of Remote Sensors, Resolution- Spatial, Spectral, Radiometric, Temporal, Microwave Sensors, SLAR

Unit IV **15 Lectures**

Digital Image Processing: Image Rectification and Restoration, Image Enhancement, Image Manipulation, Filtering, Image Classification, Supervised and Unsupervised Classification, PCA etc.

Text Books:-

1) Photogrammetry – Miller & Miller

2) Remote Sensing & Image Interpretation – Lillesand, T. M. & Ralph, W. K.

3) Image Interpretation in Geology – Drury

4) Remote Sensing in Gelogy – Siegal

5) Principles & Applications of Photogeology – Pande S. N.

6) Fundamentals of Remote Sensing-- Joseph,George and Jeganathan

7) Remote Sensing of the Environment – An Earth Resources Perspective-- Jensen, J.R.

Reference Books:-

1) Remote Sensing: Principles and Interpretation—Sabins, F. F.

2) Introductory Digital Image Processing A remote sensing perspective-- Jensen, J.R.

3) Manual of Remote Sensing, Vol. I, American Society of Photogrammetry and Remote Sensing-- Reeves, Robert G.

Program : Post Graduate Diploma in Geoinformatics (PGDGI)

Course: DGI-C102: Fundamentals of GIS and GPS (Theory);

Course code: DGI-C102

Credits: 04 credits;

Instructor: Dr. Yogesh P. Lolage, Assistant Professor, School of Earth Sciences

Contact details: email: lolage.yogesh@gmail.com; Mobile: 9552545248

Semester: I Semester (Winter Session)

Teaching hours: 4 hours/week

Assessment:

Continuous Internal Assessment (CIA) - 50 % - During the semester
End Semester Assessment (ESA). - 50 % - At the end of the semester

Salient features of this Course:
GIS is a map-based decision support system that related the geographic data for various applications. The students will learn about spatial and non spatial data and mapmaking techniques using GIS softwares. Currently, it is one the most important and job giving sector for GIS trained persons both in government and private field.

Perquisites:

Basic understanding about Surveying, Geography and Cartography is required..

Utilities/Learning outcomes:
After successful completion of this course, a student should know

1. Differentiate between different data types in GIS.
2. Georeference the spatial data and work on spatial and nonspatial database
3. Describe various GIS tools and techniques
4. Explain the fundamental principles behind GPS technology
5. Visualize GIS outputs in different dimensions
6. Create digital GIS maps
7. Apply spatial data analysis for various applications to deal with natural and environmental problems.

Objectives:
This course aims to:

1. Introduce the students to the fundamental concepts of GIS and GPS

2. It will make them familiar with the most essential techniques with hands on practical experience.
3. Students will learn about creation and organization of spatial and non spatial data.
4. Learn different GIS based techniques to identify and solve the actual natural, environmental and community problems.
5. Learn application of GIS and GPS.

DGI-C102: FUNDAMENTALS OF GIS AND GPS (4 CREDITS)

Unit I:

Introduction to GIS, Definition, History and Importance of GIS, Development, Components of GIS, Hardware and Software components, GIS diversity, Data, primary and secondary data, Spatial and non spatial data, Raster and Vector data, other forms of data, data models in GIS, Representation of geographic features with point, line and polygon, Editing in GIS, arc, node and vertices

Unit II:

Map Projection, Types and Need of projection system, Acquisition of spatial data: Scanning, Georeferencing, concept of layer, digitizing, error detection and correction, Data Base Management System: Concept, types of DBMS, Hierarchical, Network and relational data, advantages and disadvantages, Mapping and layout, General processes involved in image processing, mosaic, subset, Point interpolation techniques: Krigging, IDW, Introduction and Methods of Interpolation, Data analysis, network analysis, DEM and DTM, Thematic maps.

Unit III:

Global Positioning Systems, History and developments, types of GPS, navigation systems, Trilateration process, GPS Surveys, Applications of GPS technology

Unit IV:

Introduction, Digital Image Processing- Image Classification, Supervised and Unsupervised Classification, Applications of GIS in agriculture, Land use Land Cover mapping, disaster ,anagement, Water resources, Snow and glaciers studies, Coastal zone management.

Reference Books

Ahmed, E. L. Rabbany (2002): Introduction to Global Positioning Systems, Artech House, Boston

Anji Reddy, M. (2008): Textbook of Remote Sensing and Geographic Information System, B.S. Publication, Hyderabad

Burrough, P. A. and McDonnell, R. A. (2000): Principles of Geographical Information Systems, Oxford University Press, New York

Campbell, J. (2002): Introduction to Remote Sensing, Taylor & Francis, London

Chang, K. T. (2008): Introduction to Geographic Information Systems, Avenue of the Americas, McGraw-Hill, New York

Demers, M. N. (2000): Fundamentals of Geographic Information Systems, John Wiley and Sons, New Delhi

Drury, S. A. (2001): Image Interpretation in Geology, Blackwell, Oxford

Heywood, I., Cornelisus, S., Carver, S. (2011): An Introduction to Geographical Information Systems, Pearson Education, New Delhi

Jensen, J. R. (2005): Introductory Digital Image Processing, Prentice Hall, New Jersey

Joseph, G. (2004): Fundamentals of Remote Sensing, Universities Press, Hyderabad, India

Korte, G. B. (2001): The GIS Book, Onward Press, Bangalore

Lillesand, T. M., Kiefer, R. W. and Chipman, J. W. (2008): Remote Sensing and Image Interpretation, John Wiley & Sons, New Delhi

Lo, C. P., Yeung, A. W. (2002): Concepts Techniques of Geographical Information Systems, Prentice-Hall of India, New Delhi

Longley, P. A., Goodchild, M. F., Maguire, D. J., Rhind, D. W. (2002): Geographical Information Systems and Science, John Wiley & Sons, Chichester

Sabins, F. F. (1996): Remote Sensing: Principles and Interpretation, W. H. Freeman and Company, San Francisco

DGI-C103: Cartography and Mapping

Credits - 4 : Theory Paper

- **Pre-requisite:**

  The candidate should know the basic concepts from physical set-up, topographical changes and background of natural movements, which are the basics of maps. The candidate should familiar to the basic concepts, types of maps, SOI Topo-Sheet maps and given information about the topographical features.

- **Course Objectives**:

  The objectives of this paper are to understand the basic concepts of maps.

- **Course Outcomes:**

  After completion of the paper / course, the students will get capabilities and skills to prepare regular and digital maps

- **Mode of Assessment**

  1. Tutorial examination
  2. Home assignments
  3. Field studies
  4. Mid-term practical examination
  5. End-term practical examination

Course Contents

Unit	Teaching and Learning points	Periods
I	**Basics of Maps** Map Projections, Types of Maps, Map scales, types and conversions of scale, symbolization, enlargement and reduction, Representation of statistical data on maps	12
II	**SOI Maps** Introduction to SOI topographical maps, Indexing & numbering, scale, grid reference, Signs & Symbols, color system etc. Contouring, Survey techniques	16
III	**SOI Maps and Data** Relief representation techniques Identification of land forms from toposheets, Profiles land use and land cover changes SOI Map Reading SOI Map Interpretation	18
IV	**Various types of Maps and Digital Maps** Available various types of maps Information / Data and its need for any type of work Conversion of Data from hard to soft / digital maps Identification of ground truth locations on digital map / Google image / satellite imageries	14

Reference Books:

1. Thornbury, W. D. (I960): Principles of Geomorphology, John Wiley and Sons, New York.
2. Chorley, R. J., Schumm, S. A. and Sugden, D. E.(1984): Geomorphology, Methuen, London.
3. Kale, V. S. and Gupta, A. (2001): Introductionto Geomorphology, Orient Longman, Calcutta.
4. Savindra Singh (2002): Geomorphology, Prayag Pustak Bhawan, Allahabad
5. Spark B. W. (1972): Geomorphology, Longman, NewYork
6. Steers, A. (1958). The Unstable Earth, Methuen,London
7. Ollier, C. D. (1981) Tectonics and Landforms, Longman , London
8. Strahler A. H and Strahler, A. N. (1992) : Modern Physical Geography, John Wiley, New York
9. Wooldridge and Morgan: Geomorphology
10. Holmes: Physical Geology
11. Fairbridge, R. W. (1968): Encyclopedia of Geomorphology, Reinholdts, New York.

Program: **PGDGI Geoinformatics**
Course: **Computer applications, Programming & Geo-Statistics** (**Theory**)**;** Course code: **DGI-E101** Elective
Instructor: **Dr. T. Vijay Kumar/Guest faculty**, **School of Earth Sciences**
Contact details: **email:** vijay.srtmu@gmail.com**; Mobile: 08087912034**
Semester: **II Semester (Summer session)**
Credits: **4 credits;** Course duration: **One semester (15 weeks of 6 day week)**
Teaching hours: **4 hours/week**

Required Basic knowledge of student:

- Basic knowledge about computer and Programs, how they work, basic statistics

Objective:

1. This course aims to enable the students to gain knowledge in operating Computer applications and Programming and statistics.

Course outcomes

1. On successful completion of these modules, students should be capable of operating Computer Applications like MS Office and networking concepts, C Programming
2. Students would be able to use computers for computing statistics and plotting data.

Assessment:

Continuous Internal Assessment (CIA) - 50% - During the semester

End Semester Assessment (ESA). - 50% - At the end of the semester

DGI-E101: Computer applications, Programming & Geo-Statistics

Module 1: Computer Applications

Definition, Scope of computers, Components of computer, Types of computer, Computer generations, Computer concepts, Concept of OS -Windows.

Module 2: Geostatistics

Computer Data collection and Sampling, Central Measures of Tendency, Dispersion of Data, Types of data, Population density function, Exact tests, Chi-square test, confidence levels, Analysis of Variance and Time Series, Introduction to trend analysis, correlation and Regression

Module 3: C-Programming

Preprocessor statements and headers, Data types, conditions, Algorithm – flowcharts, Functions, Arrays, Pointers and Structures.

Module 4: Applications

Application of computer like Office, Surfer, Database management, concepts of networking, communications, Email, LAN

Books:

1. Computer Fundamentals by Pradeep Sinha, BPB publications
2. Handbook of computer fundamentals by NS Gill,
3. Let us C by Yeshwant Kanitkar, BPB publication
4. Basic Computation and Programming with C Subrata Saha and Subhodip Mukherjee.
5. Fundamentals of Computers by Rajaraman V, PHI publications
6. Geostatistics with Applications in Earth Sciences by D.D. Sarma, Springer Publications
7. Introduction to Geostatistics with Applications in Hydrogeology, by P. K. Kitanidis, CUPS
8. Taylor D.R.F., G.I.S.: The Micro Computer and Modern Cartography, Pergamon Press, Oxford.

Program : Post Graduate Diploma in Geoinformatics (PGDGI)

Course: DGI-E102: Spatial Analysis (Theory);

Course code: DGI-E102

Credits: 04 credits;

Instructor: Dr. Yogesh P. Lolage, Assistant Professor, School of Earth Sciences

Contact details: email: lolage.yogesh@gmail.com; Mobile: 9552545248

Semester: I Semester (Winter Session)

Teaching hours: 4 hours/week

Assessment:

Continuous Internal Assessment (CIA) - 50 % - During the semester
End Semester Assessment (ESA). - 50 % - At the end of the semester

Salient features of this Course:

It is advanced course in GIS and Remote sensing, primarily focusing on techniques and practices for spatial analyzing methods. It will be highly useful for addressing societal issues using digital mapping technologies. It aims to facilitate students with the skills and necessary acquaintance to explore the spatial patterns. It includes spatial modeling, network analyses, raster overlay, 3D spatial data visualization etc. Lab course will mainly focus on the applications of ArcGIS's software tools (extensions) like Spatial Analyst, 3D Analyst and Network Analyst.

Perquisites:

Basic understanding about GIS, Remote sensing and GPS technologies.

Utilities/Learning outcomes:

After successful completion of this course, a student should know

- Differentiate between different data types in GIS.
- Georeference the spatial data and work on spatial and nonspatial database
- Describe various GIS tools and techniques
- Construct a file geodatabase model
- Explain the fundamental principles behind GPS technology
- Visualize GIS outputs in different dimensions
- Create digital GIS maps
- Apply spatial data analysis for various applications to deal with natural and environmental problems.

Objectives:

This course aims to:

- Introduce the students to the fundamental concepts of GIS and GPS
- It will make them familiar with the most essential techniques with hands on practical experience.
- Students will learn about creation and organization of spatial and non spatial data.
- Learn different GIS based techniques to identify and solve the actual natural, environmental and community problems.
- Learn application of GIS and GPS.
- Demonstrate Spatial Analyst, 3D Analyst and Network Analyst extensions

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DGI-E102: SPATIAL ANALYSIS (4 CREDITS)

Module I:

Introduction and significance of Spatial analysis, tools for spatial analysis, raster and vector based spatial analysis, Overview of ArcGIS : ArcCatalog, Arcmap, ArcScene and and Arctool box.

Module II:

Data input, data updating, queries, simple and complex query, editing, line and area measurements, data attribution, GPS Survey, data import, processing and mapping, Single layer operations: Feature identification, extraction, classification, Multi-layer operation: Union, intersection, symmetrical difference, update, merge etc.

Module III:

Network analysis, Network data model, Types of network analysis: Optimum path, path determination and analysis, Point pattern analysis, Methods for evaluating point patterns: clustered and random distribution

Module IV:

Surface analysis, Trend surface analysis, Point interpolation techniques, IDW, kriging, DEM, TIN, slope, aspect, hillshade and viewshed

REFERENCE BOOKS

1. Laurini, Robert and Derek Thompson (1992). Fundamentals of Spatial Information Systems. Academic Pr., London
2. Kluwer Fotheringham A S, O'Kelly M E. (1998).Spatial Interaction Models: Formulations and Applications.
3. Thanappan Subash (2011). Geographical Information System, Lambert Academic Publishing.
4. John E. Harmon & Steven J. Anderson (2003). The design and implementation of Geographic Information Systems, John Wiley &Sons,.
5. ArcGIS Manuals

Program : Post Graduate Diploma in Geoinformatics (PGDGI)

Course: DGI-E103: Advances in Remote Sensing and GIS (Theory);

Course code: DGI-E103

Credits: 04 credits;

Instructor: Prof. Dr. D B Panaskar and Dr. Y P Lolage

Contact details: email: lolage.yogesh@gmail.com; Mobile: 9552545248

Semester: I Semester (Winter Session)

Teaching hours: 4 hours/week

Assessment:

Continuous Internal Assessment (CIA) - 50 % - During the semester
End Semester Assessment (ESA). - 50 % - At the end of the semester

Salient features of this Course:

Advanced Remote Sensing and GIS Technology knowledge can be applied to solve various problems and issues in society. This is a practical focused subject, which will be highly useful to develop student's skills for the advanced technologies.

Perquisites: Basic understanding about Remote sensing and GIS techniques.

Utilities/Learning outcomes:
After successful completion of this course, a student should know

- Handle advanced spatial and non-spatial database.
- Describe advanced RS and GIS tools and techniques
- Visualize GIS outputs in different dimensions
- Create digital GIS maps
- Apply spatial data analysis for various applications to deal with natural and environmental problems.
- Understand principles of active sensors and platforms like LIDAR & UAV etc
- Apply advanced sensors for different applications.

Objectives:
This course aims to:

- It will make them familiar with the advanced techniques in RS and GIS with hands on practical experience.

- Introduce students about various advanced sensors and their applications
- Students will learn about creation and organization of spatial and non spatial data using advanced techniques.
- Use advanced techniques to identify and solve the actual natural, environmental and community problems.

PGDG-E103: Advances in Remote Sensing and GIS 4 Credits

Unit I 15

Introduction to Multispectral images, natural color composite, False Colour Composite, interpretation of Multispectral image, Principal Component Analysis, Thermal Imaging, Thermal properties of materials, Introduction to IR region, Characteristics and Advantages of IR images

Unit II 15

Microwave Remote Sensing, process and applications of Microwave Remote Sensing, Concept of Hyperspectral Remote Sensing, sensors, Multispectral vs. Hyperspectral Remote sensing, RADAR operating principles, Synthetic Aperture Radar (SAR), LiDAR Concepts, LiDAR sensor system, Accuracy of LiDAR measurements, High Resolution Satellites (IKONOS, Quickbird, etc.)

Unit III 15

Introduction to digital image processing, Atmospheric corrections, radiometric corrections and geometric corrections, Image rectification techniques, noise removal , Image enhancement techniques, Contrast enhancement, Spatial filtering: low frequency, high frequency, edge enhancement, band combinations, Digital image classification: Supervised and Unsupervised classification, Training sites selection

Unit IV 15

Multi-criteria decision making/analysis, Decision support systems, effectiveness of decision making, GIS server, ArcGIS Server and architecture, web application functionality, GIS web services

References

1. **Introduction to Remote sensing and Image interpretation**- Lilesand and Keifer
2. **Introductory Remote Sensing**- Paul. J. Gibson
3. **Introduction to Remote Sensing** -James B. Campbell
4. A**n Introduction to Geographical Information Systems** - Ian Heywood
5. **Geographic Information Systems: A Management Perspective** - Aronoff, S.
6. **Remote Sensing and GIS** - Bhatta, B.
7. **Geographical Information Systems** - Maguire, David J.
8. **Digital Image Processing: A Remote Sensing Perspective** - Jensen, John R.
9. **Imaging Radar for resources surveys** – Travett J W

Semester II

DGI-C201: Applications of GIS in Water Resource Management

Pre-requisites:

Basic (10+2) knowledge of Physics, Chemistry, Biology and Computer

Course objectives:

- Study of Remote Sensing and GIS reference to topography , vegetation , geological formation , occurrence of flora & fauna and ground water
- Application of GIS and Remote Sensing use in field of any kind of research
- To develop the writing skills based on research pattern/report writing which is useful in research institutes/govt. organizations/pvt. Organizations.
- To develop the skills of individual student so that he/she will be competent enough to get job in this field of specialization.

Mode of Assessment:

1. Tutorial examinations
2. Home Assignments
3. Seminars
4. Field studies
5. Quizzes
6. Oral presentations
7. Mid-term examinations
8. End-term examinations
9. Dissertation

Course outcome:

At the completion of the course student would be able to

- It is useful for geological correlation.
- It is most useful to identify ground water potential zone
- It is useful for stratigraphic correlation.

UNIT- I: Hydrological cycle; Types of water resources; Occurrence of ground water in different Geological formations; Hydrological properties of formations; Types of aquifers.

UNIT- II: Concept of watershed; Types of watershed; Watershed management; concept of water balance and water account; Available renewable resources ; water scarcity problem;

UNIT-III Introduction and fundamental concept of remote sensing; Interaction of EMR with earth surface features; Spectral signature of earth features .

UNIT-IV Application of remote sensing for identification of water bodies on surface; Identification of ground water potential zone by using remote sensing and GIS techniques. Use of Remote sensing and GIS for water resource management.

1. **GIS for Water Resources and Watershed Management** - John G Lyon
2. **Application of GIS in Hydrology and Water Resources Management** - K.Kovar
3. **Geographic Information Systems in Water Resources Engineering** - Lynn E.Johnson
4. **Developments In Water Science – Water Resources Systems Planning and Management** - Jain S.K and Singh V.P
5. **Water, Waste water and Storm Water Systems** - U.M. Shamsi
6. **Introduction to Environmental Remote Sensing** – Barrett E C
7. **Remote Sensing principles and interpretation** – Sabins F. F.
8. **Remote Sensing and Image Interpretation** – Thomas M Lillesand

DGI-C202: Application of GIS in Urban Development

Credits- 4 Theory

Pre-requisite: Basic knowledge about GIS and remote sensing and having the knowledge of GIS software handling.

Course Objectives: The objectives of this course is to develop the skill of the GIS and remote sensing application in urban development.

Course Outcomes: After completion of the course, the students get capabilities and skills on GIS and remote sensing application in the urban development, urban land use mapping and urban planning.

Mode of Assessment

- Tutorial examination
- Home assignments
- Seminar
- Field studies
- Quizzes
- Oral presentation
- Mid-term examination
- End-term examination
- Dissertation thesis

Course Contents

DGI-C202: Application of GIS in Urban Development

Unit	Teaching / Learning Points
I	**Concept of Urban Development** urbanization process, concept of urban development, indicators for urban development, , elements of urban development, urban growth trend, problems of urbanization, urban sprawl and associated problems, sustainable urban development, urban morphology, urban mapping: physical structure and composition of urban areas, smart cities.
II	**GIS Application For Urban Governance** Population growth, distribution and density map by age, gender, education, occupation, socio-economic grouping, health criteria index, crime rates and types; functional classification of towns and cities. mapping of administrative boundaries, city base map generation, property enumeration and property tax, revenue rationalization, metropolitan information management system
III	**GIS Application For Urban Land Use Planning** land utilization types; land use classifications, urban land uses and land use patterns, municipal lands and open spaces in cities and town, recreational lands, road network, Graph Theory for road network, principles of land use planning and land use management, critical issues of land use planning in India
IV	**GIS Application For Urban Ecology** GIS applications in urban mapping for water and sewage, GIS based urban water demand analysis, pipeline planning and alignment, electric and power supply, applications in telecommunication (radio coverage prediction, signal strength mapping), air quality indexing and mapping, noise pollution zonation, site suitability for groundwater recharging and rain water harvesting in urban area, urban area heat budgeting

References:

1. **Modeling in Resource Management and Environment: through Geoinformatics -** Sharma H.S. and Binda P.R
2. **Applied Remote Sensing for Urban Planning, Governance and Sustainability -** Netzband Maik
3. **Remote Sensing of Urban and Suburban Areas** - Tarek Rashed, Carsten Jürgens
4. **Remote sensing and urban analysis -** Jean-Paul Donnay, Michael John Barnsley
5. **Urban Remote Sensing** - Qihao Weng, Dale A. Quattrochi
6. **Radar Remote Sensing of Urban Areas, Remote Sensing and Digital Image Processing** - Soergel Uwe
7. **Analysis of Urban Growth and Sprawl from Remote Sensing Data** - Basudeb Bhatta
8. **Application of GIS in Hydrology and Water Resources Management -** .Kovar
9. **Remote Sensing principles and interpretation** – Sabins F. F
10. **Developments In Water Science – Water Resources Systems Planning and Management** - Jain S.K and Singh V.P
11. **Sustainability and Cities. Overcoming Automobile Dependence** - Newman, P. and Jeffrey.