

Centre for Geoinformatics

Ph.D Course Work

Core Courses

| Semester | Paper Code | Course Title | Credits | Total | |
|----------------------------|--|---|---------|-------|----|
| I | 17GEOR0101 | Remote Sensing, Digital Image Processing and Global Navigation Satellite System | 4 | 24 | |
| | 17GEOR0102 | Geographic Information System | 4 | | |
| | 17GEOR0103 | Natural Resource Management | 4 | | |
| | 17APRR0101 | Research Methodology | 4 | | |
| II | Seminar (3) Term paper / Topical Research | | | | 24 |
| | 17GEOR0204 | Geo-Statistics | 4 | | |
| | 17GEOR02SX | Specific course to be prescribed by the Doctoral Committee | 4 | | |
| | Research Credits | | | | |
| III Semester onwards | a) Project planning including literature collection, finalization of objectives and methodology | | 4 | | |
| | b) Field / Lab Studies, Data collection, compilation of results, statistical analysis, results and final conclusion. | | 32 | | |
| End of Program | Synopsis and Thesis submission, final viva | | 6 | | |

List of courses that are candidate centric (17GEOR02SX)

| | |
|------------|-------------------------------------|
| 17GEOR02S1 | Natural Disaster Management |
| 17GEOR02S2 | Climate Change and Environment |
| 17GEOR02S3 | Development Planning and Monitoring |
| 17GEOR02S4 | Spatial Decision Support System |

| 17GEOR0101 | <p style="text-align: center;">Course - 1</p> <p style="text-align: center;">Remote Sensing, Digital Image Processing and Global Navigation Satellite System</p> | 2+2 |
|---|---|-----|
| <p>Objectives:</p> <ol style="list-style-type: none"> To learn the basic principles, components and types of Remote Sensing, Aerial Photography and Photogrammetry. To understand the characteristics of digital data, digital image processing and basic models of GNSS surveying and To understand case studies and policy issues in satellite image processing. <p>Learning Outcome:</p> <ol style="list-style-type: none"> A good level of understanding of the concept of remote sensing and optical remote sensing. Acquire and interpret digital data and process the digital images. Gain mastery over GNSS surveying and its applications. | | |
| <p>UNIT 1 Remote Sensing</p> | <p>Remote sensing: History and development - components of remote sensing – platforms Terrestrial, aerial, satellite, ground penetrating RADAR, Drone etc. – Electro Magnetic Spectrum - Energy interaction with atmosphere and Earth (Rocks, Soil, Water, Vegetation etc.) Resolutions (Spectral, Spatial, Temporal & Radiometric) - Optical Remote Sensing: Basic concepts - Optical sensors and scanners.</p> | |
| <p>UNIT 2 Aerial Photography & Photogrammetry</p> | <p>Aerial photography: Historical development – definition, types of aerial photography and uses, Planning and execution. Photogrammetry: Definition, history of Photogrammetry - Geometry of vertical aerial photograph, scale of vertical aerial photograph, relief displacement.- Stereoscopic parallax - Aerial triangulation - Digital Photogrammetry-use of GPS in Photogrammetry.</p> | |
| <p>UNIT 3 Digital data & Image Processing</p> | <p>Digital Data: Basic Characteristics of digital image - data type and file format.- Data acquisition and interpretation. Digital Image Processing: Introduction - stages in digital image processing - Preprocessing: geometric correction, atmospheric correction and radiometric correction Image Enhancement Image classification: Supervised – unsupervised – Hybrid- Fuzzy Classification - Hyperspectral Image Processing - post classification smoothing - data merging - change detection procedures.</p> | |
| <p>UNIT 4 GPS Surveying & Applications</p> | <p>Basic modes of GNSS surveying: Differential GNSS surveying, static surveying. Rapid static positioning technique - Reoccupation technique - Stop & go technique Kinematic positioning technique - Relative advantages and disadvantages - Data transfer and analysis GNSS applications - Siting and routing - surveying - navigational application - vehicle tracking - mobile computing - military application - Location Based Services.</p> | |
| <p>UNIT 5</p> | <p>Case studies Policy issues in satellite image processing.</p> | |

Text books

- Lillesand M.Thomas and Ralph W.Kiefer, Remote Sensing and Image Interpretation, John Wiley & Sons, New York, 2007.
- Satheesh Gopi, Global Positioning System Principles and Applications, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005.

Reference Books

1. Sharma V.K., Remote Sensing for Land Resources Planning, Concept Publishing Company, New Delhi, 1991.
2. Paul J. Curran, Principles of Remote Sensing, English Language Book Society, Longman, 1985.
3. Hofmann-Wellnhof.B, Lichtenegger.H, and Collins.J, GPS theory and Practice, Spinger (India) Private Limited, New Delhi, 2007.

Journals

1. Remote Sensing of Environment, <https://www.journals.elsevier.com/remote-sensing-of-environment/>
2. ISPRS Journal of Photogrammetry and Remote Sensing, <https://www.journals.elsevier.com/isprs-journal-of-photogrammetry-and-remote-sensing/>
3. *Remote Sensing* — Open Access Journal, <http://www.mdpi.com/journal/remotesensing>
4. GISciences & Remote Sensing, <http://www.bellpub.com/msrs/>
5. Journal of Applied Remote Sensing, <https://www.spiedigitallibrary.org/journals/journal-of-applied-remote-sensing?SSO=1>
6. Journal of the Indian Society of Remote Sensing, <http://www.springer.com/earth+sciences+and+geography/journal/12524>
7. International Journal of Applied Earth Observation and Geoinformation, <https://www.journals.elsevier.com/international-journal-of-applied-earth-observation-and-geoinformation/>
8. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, <http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?reload=true&punumber=4609443>

E-Books

1. *Principles of Remote Sensing – An Introductory Textbook*, www.gdmc.nl/oosterom/PoRSHyperlinked.pdf
2. *Remote Sensing and Geographical Information System*, www.gisresources.com/wp-content/uploads/2013/09/anji-reddy_GIS.pdf
3. *Fundamentals of Remote Sensing*, sesremo.eu/downloads/.../gis.../ebooks/Fundamentals%20of%20Remote%20Sensing.pdf
4. *Satellite Positioning: Methods, Models and Applications*, <https://www.intechopen.com/books/satellite-positioning-methods-models-and-applications>

| 17GEOR0102 | Course - 2 Geographic Information System | 2+2 |
|--|--|-----|
| <p>Objectives:</p> <ol style="list-style-type: none"> To impart knowledge in the basic components and approaches to GIS, Database Management system and data input and editing. To expose the scholars to analysis of spatial data, basics of GIS modeling and output. <p>Learning Outcome:</p> <ol style="list-style-type: none"> Upon completion, the learners would have gained mastery over the data use in GIS and the dimensions of databases management system. Gained skills in data input and editing and analyzing spatial data and networks. Conversant with GIS modeling and mapping and apply these skills in developing a mini project. | | |
| <p>Unit 1 Basics of GIS</p> | <p>Map– computer assisted mapping – GIS -components of GIS – Data used in GIS characteristics of Spatial Data – sources of spatial and attribute data - data structure - raster and vector - GIS approach: Layer – tile – object oriented; Modeling third and fourth dimensions - Database Management system: Disadvantages of traditional DBMS – relational database model - integrated spatial and attribute data</p> | |
| <p>Unit 2 Data input & editing</p> | <p>Encoding methods: Keyboard – digitization – electronic data transfer - Data editing: checking and correcting errors in spatial and attribute data - transformation – generalization – edge matching - rubber sheeting – building integrated database – cloud computing - big data analysis</p> | |
| <p>Unit 3 Spatial data analysis</p> | <p>Measurements of length, perimeter and area - queries – reclassification – buffering - overlay - spatial interpolation – surface analysis - network analysis – geo-statistics</p> | |
| <p>Unit 4 GIS Modelling Basics & GIS output</p> | <p>Models: Natural and Scale Analogue Models - Conceptual Models – Mathematical Models - Process Modeling and GIS - Modeling the Decision Making Process - Visualization of Model – TIN – DEM –DTM - Problems in using GIS to model spatial process. Modeling: project cycle in modeling - goals and structures - model calibration, testing and validation Maps as output – Thematic Maps - non-cartographic outputs – spatial multimedia – delivery mechanism.</p> | |
| <p>Unit 5</p> | <p>Real world case studies/ best practices. Mini projects using open source software – policy issues in geospatial technology</p> | |

Text Book

- Ian Heywood, Sarah Cornelivs and Steve Carver, An Introduction to Geographical Information System, Pearson Education Pvt .Ltd., New Delhi, 2010.

Reference Books

- Peter A. Burrough and Rachael A. McDonnell, Principles of Geographical Information Systems, Oxford University Press Inc., New York, 2004.
- M. Anji Reddy, Geoinformatics for Environmental Management, BS Publications, Hyderabad, 2004.
- David Martin, Geographic Information Systems, Routledge, London,2002.
- Kang-tsung chang, Introduction to Geographic Information Systems,Tata McGraw – Hill Publishing

Company Limited, New Delhi, 2006.

5. C.P.LO and Albert K.W.Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall of India, New Delhi – 2006.

Journal

1. Journal of Geographical Sciences,
<http://www.springer.com/earth+sciences+and+geography/geography/journal/11442>
2. Chinese Geographical Science,
<http://www.springer.com/earth+sciences+and+geography/geography/journal/11769>
3. Geoforum, <https://www.journals.elsevier.com/geoforum/>
4. Computers & Geosciences, <https://www.journals.elsevier.com/computers-and-geosciences/>
5. Journal of Spatial Science, <http://www.tandfonline.com/toc/tjss20/current>
6. GeoInformatica, <http://www.springer.com/earth+sciences+and+geography/geography/journal/10707>

E-Books

1. GIS Commons: An Introductory Textbook on Geographic Information Systems,
<http://giscommons.org/>
2. Nature of Geographic Information, <https://opentextbc.ca/natureofgeographicinformation/>
3. Spatial Thinking in Planning Practice: An Introduction to GIS,
<http://pdxscholar.library.pdx.edu/pdxopen/4/>
4. Principles of Geographic Information Systems,
http://itc.nl/library/papers_2009/general/PrinciplesGIS.pdf
5. Essentials of Geographic Information Systems, v. 1.0,
<https://catalog.flatworldknowledge.com/catalog/editions/campbell-essentials-of-geographic-information-systems-1-0>
6. A Gentle Introduction to GIS, http://download.osgeo.org/qgis/doc/manual/qgis-1.0.0_a-gentle-gis-introduction_en.pdf

| 17GEOR0103 | Course - 3 Natural Resource Management | 4 |
|---|---|---|
| <p>Objectives:</p> <ol style="list-style-type: none"> To know about various natural resources for conservation and management. To learn about climate change and environment To understand disaster management <p>Learning Outcome:</p> <ol style="list-style-type: none"> To apply geoinformatics tools in the management of natural resources, climate change, environment and disaster. To plan and conduct Environmental impact studies using GIS and Remote Sensing techniques. | | |
| <p>UNIT 1 Land & Soil Resources Management</p> | <p>Land Resource – importance – problems -Land Classification System – FAO - USDA - NRSC- land capability assessment – crop suitability – Land use / Land cover – classification – change detection - land use planning: Rural and urban - Land Reclamation – Land Information System - DSS for Land use planning and management.</p> <p>Soil mapping and conservation: Introduction – Soil genesis, Soil characteristics including morphological, Soil pedology – Soil survey: Types and methods of soil surveys – Soil classification – Hydrological Soil grouping- Principle component analysis and orthogonal rotation transformation – Soil sedimentation, erosion, loss assessment and conservation – Case studies.</p> | |
| <p>UNIT 2 Water Resource Management</p> | <p>Water Resource – importance – Water Conservation - Ground water investigation - artificial recharge zone identification. Water quality monitoring - surface water harvesting structures - flood prediction model - sedimentation evaluation - watershed approach -runoff and hydrological modeling</p> <p>Ocean: chlorophyll production index – physical oceanographic parameter estimation – sea surface temperature – significant wave height – wind speed and direction – coastal bathymetry – sea level rise – Creation of CZIS – Coastal Regulation zone – Coastal aquifer modelling using GIS.</p> | |
| <p>UNIT 3 Forest mapping & Conservation</p> | <p>Forestry: Forest taxonomy – inventory of forest – forest types and density mapping using RS techniques – factors for degradation of forest and its delineation – Forest change detection and monitoring – Forest fire mapping & damage assessment.</p> | |
| <p>UNIT 4 Environmental Management & Climate Change</p> | <p>Environmental Pollution: types and components – pollution: Air – Water – Soil and Noise – Environmental Impact Assessment- impact of anthropogenic activities - Environmental Information System - GIS and RS in Environmental Studies - Environmental and ecological concerns – resource development in remote areas</p> <p>Climate change - observation of climate change - impact of climate change on various sectors - adaptation strategy/options in various sectors – green development mechanism</p> | |
| <p>UNIT 5 Disaster Management</p> | <p>Definition - Classification – Causes - Earthquakes – Landslides - Volcanism - Tsunami</p> <p>Cyclones – Floods - Drought - Forest Fire - Vulnerability – Hazard – Risk Assessment - Natural Disaster Mapping, Management and mitigation using Remote Sensing and GIS.</p> | |

Reference Books

1. Allah Brimicomber, GIS Environmental Modeling and Engineering, Taylor and Francis, 2003
2. Savigny D De and Wijeyaratne.P.GIS for Health and Environment, Stylus publication, 1994.
3. Paul A Longley, Michael F Goodchild, David J Maguire, David W Rhind, Geographical Information Systems, Volume I and II, John Wiley and Sons, Inc., 1999.
4. Van Dijk M.G.Bos, GIS and Remote Sensing Techniques in Land-And-Water-Management, Kluwer Academic Publishers, 2001.
5. Agarwal, K.C., 2001. Environmental Biology, Nidhi Publication Ltd. Bikaner.
6. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publishing House.
7. Heywood, V.H. & Watson, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press.
8. Anil Markandya, Climate Change and Sustainable Development: Prospects for Developing Countries, Routledge, 2002
9. Heal, G. M., Interpreting Sustainability, in Sustainability: Dynamics and Uncertainty, Kluwer Academic Publ., 1998
10. Munasinghe, M., Sustainable Energy Development: Issues and Policy in Energy, Environment and Economy: Asian Perspective, Kleindorfer P. R. et. al (ed.), Edward Elgar, 1996
11. Dash Sushil Kumar, "Climate Change –An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007
12. IPCC (2014) *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Journals

1. Environmental Geosciences, <http://eg.geoscienceworld.org/>
2. Environmental Science and Technology, <http://pubs.acs.org/journal/esthag>
3. Forest Ecology and Management, <https://www.journals.elsevier.com/forest-ecology-and-management/>
4. Journal of Coastal Conservation, <https://link.springer.com/journal/11852>
5. Journal of Ecosystems and Management, <http://jem.forrex.org/index.php/jem>
6. Journal of Environmental Management, <https://www.journals.elsevier.com/journal-of-environmental-management/>
7. Journal of Land Use & Environmental Law, <http://www.law.fsu.edu/co-curriculars/jluel>
8. Ocean & Coastal Management, <https://www.journals.elsevier.com/ocean-and-coastal-management/>
9. Water Resources, <https://link.springer.com/journal/11268>
10. Water Resources Management, <http://www.springer.com/earth+sciences+and+geography/hydrogeology/journal/11269>
11. International Journal of Climate Change Strategies and Management, <http://www.emeraldgroupublishing.com/products/journals/journals.htm?id=ijccsm>
12. JOURNAL OF CLIMATE CHANGE, <http://www.iospress.nl/journal/journal-of-climate-change/>

e-books

1. [Sustainable Natural Resources Management, library.umac.mo/ebooks/b28112672.pdf](http://library.umac.mo/ebooks/b28112672.pdf)
2. [Book Principles Of Natural Resource Management And Potential](#),
3. Sustainable Natural Resources Management, <https://www.intechopen.com/books/sustainable-natural-resources-management>

| 17APRR0101 | Course - 4 Research Methodology | 4 |
|--|---|---|
| <p>Objectives:</p> <ul style="list-style-type: none"> • To develop scientific skills and expertise in formulating problem for research • To evolve research designs and use of methods and techniques in conducting research, and • To develop professional skill in writing a research report <p>Learning Outcomes: Upon completion of the course, the scholars will be able to:</p> <ul style="list-style-type: none"> • Identify and formulate a problem for research • Prepare a suitable research design for carrying out the research • Choose appropriate tools and techniques for data collection • Professionally drawing of inferences • Prepare research report and disseminate research findings | | |
| UNIT I | Scientific Research – Methods of acquiring knowledge; Objectivity and Subjectivity in Research; Epistemology, Phenomenology, Positivism, Constructivism, Pragmatism – Inductive and Deductive Reasoning, Scientific Method and its applications; Research Paradigms and Ethics in Research. | |
| UNIT II | Research Process: Identification, Selection and Formulation of problem, Sources and criterion for selection; Review of literature and Summarizing, Conceptual Model; Objectives, Hypothesis formulation, Variables and its types. | |
| UNIT III | Research Designs and Methods: Experimental, explorative, descriptive and historical research; Diagnostic and Evaluation studies, Qualitative and Quantitative studies, Trend and Futuristic studies, Ethnography, Grounded Theory, Mixed Methods. | |
| UNIT IV | Sampling Techniques and Data Collection: Sampling and Sample Designs: Census Vs Sample Methods – Laws of Sampling; Methods of Sampling. Sample Size; Sampling and Non Sampling Errors; Reliability of Samples; Data – Primary and Secondary data – Data Collection Tools, Content Analysis Psychological tests and Scaling Techniques – Pre-test, Test of Validity and Reliability. | |
| UNIT V | Data Interpretation and Report Writing: Data processing – Scoring, Categorization and Coding – Draw of inferences and interpretation. Research Report – Steps in writing Research Report, Types of reports, Format of a research report; Bibliography, Webliography, Style of writing; Plagiarism check – Evaluation of a research report; Dissemination of research findings – Presentation and Publication. | |

REFERENCES

TEXT BOOKS

- Bridget Somekh and Cathy Lewin, Theory and Methods in Social Science Research, New Delhi: Sage Publication, 2012.
- Creswell, John.W. Research Design: Qualitative, Quantitative and Mixed Method Approaches (4th ed). Thousand Oaks, CA: Sage, 2014.
- Debasis Chakraborty, Research Methodology, New Delhi: Sourath Publishing House, 2012
- Deepak Chawala and Neena Sandhi, Research Methodology: Concept of Cases, New Delhi: Vikas Publication House Pvt. Ltd, 2011.
- Kenneth's Barden and Bruce B. Abbott, Research Design: Qualitative and Quantitative Approaches, Tata McGraw Hill Education Pvt, New Delhi, 2011.
- Kothari.C.R, Research Methodology (Methods & Techniques), New Delhi: New Age International (3rd ed), 2014.
- Kundra S., Reporting Methods, New Delhi: Anmol Publications Pvt. Ltd., 2005.
- 100 Questions and Answers about Research Methods, New Delhi: Sage Publication, 2012.

JOURNALS

- Economic Development and Cultural Change
- Indian Journal of Social Work
- International Journal of Applied Research
- Journal for Extension and Research
- Journal of Social Science Research
- Journal of International Development
- Journal of Social Science
- Journal of Rural Development
- Journal of Social Research and Policy
- Social Change

WEBSITES

- <https://www.socialresearchmethods.net/>
- <https://ndl.iitkgp.ac.in/>
- <http://onlinelibrary.wiley.com/journal/10.1002/%28ISSN%291099-1328/issues>
- <http://shodhganga.inflibnet.ac.in/>
- <http://onlinelibrary.wiley.com/>
- <http://www.oijrj.org/>
- <http://journals.sagepub.com/>
- <https://www.ijser.org/>
- <http://www.ierj.in/>
- <https://www.aace.org/pubs/jolr/>

Supportive Course

| 17GEOR0204 | Geo-Statistics | Credits 2+2 |
|---|---|-------------|
| <p>Objectives:</p> <ol style="list-style-type: none"> To learn about various geo-statistical methods available for spatial analysis. To understand the concepts of mapping clusters and measuring geographic distributions. To study spatial relationship in modeling and the concepts of rendering and utilities. <p>Learning Outcome :</p> <ol style="list-style-type: none"> To apply geo-spatial methods in analyzing data related to spatial problems. Gained knowledge about mapping clusters and measuring geographic distributions. Basic mastery over modeling spatial relationships, rendering and utilities. | | |
| <p>Unit - I Introduction</p> | <p>Geo-Statistics: Introduction – feature and geographic spaces – geo-statistical computing. Exploring and Visualizing spatial data: spatial structure - Regional trends – local spatial dependence - anitotrophy.</p> | |
| <p>Unit - II Analyzing Pattern</p> | <p>Analysing pattern: Average Nearest Neighbor Distance - High/Low Clustering (Getis-Ord General G) - Spatial Autocorrelation (Morans-I) - Geographically Weighted Regression - Multi-Distance Spatial Cluster Analysis (Ripley's k-function).</p> | |
| <p>Unit – III Mapping Clusters & Measuring Geographic Distributions</p> | <p>Mapping Clusters: Cluster and Outlier Analysis (Anselin Local Morans I) - Hot Spot Analysis (Getis – Ord G_i^*). Measuring Geographic Distributions: Central Feature - Directional Distribution (Standard Deviational Ellipse) - Linear Directional Mean - Mean Center - Standard Distance.</p> | |
| <p>Unit- IV Modeling Spatial Relationships</p> | <p>Spatial prediction from point sample: Moving Window Kriging - Semivariogram Sensitivity – Inverse Distance Weighting – Global Polynomial Interpolation – Local Polynomial Interpolation – Radial Basis Functions – Kriging – Co-kriging. [Modeling spatial relationships: Spatial Network: Generate Network Spatial Weights - Generate Spatial Weights Matrix - Ordinary Least Squares - Gaussian Geo-statistical Simulations.</p> | |
| <p>Unit - V Rendering & Utilities</p> | <p>Rendering: Cluster/Outlier Analysis with Rendering - Hot Spot Analysis with Rendering - Collect Events with Rendering - Count Rendering - Z Score Rendering. Utilities: Calculate Areas - Calculate Distance Band from Neighbor Count - Collect Events - Convert Spatial Weights Matrix to Table - Export Feature Attributes to ASCII.</p> | |

Web References:

- Ye Zhang Dept. of Geology & Geophysics University of Wyoming, Introduction to Geostatistics — Course Notes, <http://geofaculty.uwyo.edu/yzhang/files/Geosta1.pdf>

2. Geoff Bohling, <http://people.ku.edu/~gbohling/cpe940/Variograms.pdf>
3. Geoff Bohling, <http://people.ku.edu/~gbohling/BoiseGeostat/IntroToGeostatistics.pdf>
4. Allan A. Nielsen, Geostatistics and Analysis of Spatial Data, http://www2.imm.dtu.dk/pubdb/views/edoc_download.php/5177/pdf/imm5177.pdf
5. Andre G. Journel, Fundamentals of Geostatistics in Five Lessons, <https://www.nrc.gov/docs/ML0227/ML022770097.pdf>
6. The principles of geostatistical analysis, http://maps.unomaha.edu/Peterson/gisII/ESRImanuals/Ch3_Principles.pdf