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| **Course title:** Spatial Data Modeling and Applications | | | |
| **Coursecode:**NRG163 | **No. of credits:** 4 | **L-T-P:**36-08-32 | **Learning hours:**60 |
| **Pre-requisite course code and title(if any):** NRG176 Principles of GIS and GNSS | | | |
| **Department :** Department of Natural and Applied Sciences | | | |
| **Course coordinator :**Dr.Ayushi Vijhani | | **Course instructor :** Dr.Ayushi Vijhani | |
| **Contact details :** ayushi.vijhani@terisas.ac.in | | | |
| **Course type:** Core | | **Course offered in**: Semester 2 | |

**Course Description**

The course covers fundamental aspects of spatial data modeling specifically to enhance the capability of spatial modelling, spatial data base analysis concept, design and format under different natural resource assessment planning and monitoring.It introduces the participant to the basic concepts of Matrix & PCA, map algebra,decision making criteria, spatial analysis of discrete and continuous datasets, geo-statistics,decision-making,conflict resolution. It also considers integration of nonspatial data and application developed based on the concepts by software developers, photo grammetrists, land surveyors, mapping specialists, researchers, post-graduate students, and lecturers.

**Course objectives**

1. To introduce fundamental aspects of spatial data modeling.
2. To understand the natural and social resource assessment, planning and monitoring for National development process.
3. To create a firm basis for successful integration of natural / human resources using spatial modeling in any field of application.

**Course content**

| Module | Topic | L | T | P |
|---|---|---|---|---|
| 1 | Introduction to geo spatial modeling and interpretation | 2 | | |
| | Raster data and Matrix application: Addition, subtraction, multiplication, Identity and Inverse for Spatial analysis concept; | 2 | | |
| 3 | Raster and Vector data Geometry and Intensity transformation using Principle Component Analysis: Eigenvectors and Eigen values | 2 | | |
| 4 | Applications of GIS models, case exercise | 2 | 2 | |
| 5 | Geospatial models – types and Modelling: Descriptive, prescriptive and predictive ;Normalization, level of measurement | 2 | | |
| 6 | Spatial analysis concept: Distance, Adjacency, Interaction and neighbourhood | 2 | | |
| 7 | Introduction to modeling& flowcharting, Map algebra-operators &operations, Functional operations, Spatial interaction models | 2 | | |
| 8 | Point Analysis: Coordinate, Distance – Nearest Neighbour Distance, Density– Quadrant and other methods, Clustering- K- mean, Thiessen and Buffer | 4 | 2 | |
| 9 | Address Geocoding, Optimum Routing Closest facilities, Resource Allocation, Network Analysis | 2 | | |
| 10 | Dynamic Segmentation: Route, Section, Events and its application. | 2 | | |
| 11 | Local neighbourhood operation– Reclassification, filter, slope, Aspect, curvature, view shed | 2 | | |

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| 12 | Spatial Interpolation and Geostatistics: Local and global methods, Gravity model, Regression model, Pattern analysis, Moran's I, Cluster analysis, Trend surface Analysis | 2 | 2 | |
| 13 | Thiessen polygon, Density estimation, Inverse Distance Weight(IDW),Thin– plate Spline | 2 | | |
| 14 | Kriging– ordinary and Universal, Semivariogram; Spatial Autocorrelation | 4 | 2 | |
| 15 | Single criteria vs. Multiple criteria, Decision-making, Conflict resolution and Prescriptive modeling, Model verification | 2 | | |
| 16 | Spatial decision support system and thematic areas(application of MCDM/AHP in spatial modeling) | 2 | | |
| Exp | PRACTICALS | | | |
| 1 | Lab1. Performing various actions over table | | | 2 |
| 2 | Lab2. Merging of tables by using primary key | | | |
| 3 | Lab3. Maintaining database | | | 2 |
| 4 | Lab4. Point pattern analysis | | | 2 |
| 5 | Lab5. Terrain Analysis | | | 2 |
| 6 | Lab6. Hydrological modelling | | | 4 |
| 7 | Lab7. Geostatistics (Surface generation) | | | 6 |
| 8 | Lab8. Cluster Analysis | | | 4 |
| 9 | Lab9.Site suitability analysis | | | 4 |
| 10 | Lab10. Network analysis | | | 2 |
| 11 | Lab11. Dynamic segmentation | | | 4 |
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| | **Total** | **36** | **08** | **32** |

**Evaluation criteria**

- Minor test 1: 10% [module no.s1to 5] [5-6 week]
- Minor test 2: 10% [module no.s7to11] [10-12week]
- Practical: 40% [Module no. 1-15] [End Semester]
- Major test : 40% [Experiment no. 1-15] [End Semester]

**Learning outcomes**

1. Equip with analysis, description and modeling of geospatial data. (Minor test 1, Minor test 2 and Major test)

2.The practical applications of software tools, underlying theory, and the correct application of these tools to analyze and model data (Practical, Minor test 1, Minor test 2

**Pedagogical approach**

The course will be delivered through class lectures, lab exercise and tutorials.

**Materials**

Required text


1. O'Sullivan D. and Unwin D. (2003) Geographical Information Analysis, John Wiley and Sons.
2. Verbyla D. L. (2002) Practical GIS Analysis, London and New York, Taylor and Francis.
3. Burrough P.A.and McDonnell R.A.(1998) Principles of Geographical Information Systems,Oxford University Press, Oxford, 327 pp.
4. LongleyP.A.,GoodchildM.F.,MaguireD.J.andRhindD.W.(2005)GeographicInformationSystemsand Science, Chichester, Wiley, 2nd edition.
5. LongleyP.A., Goodchild M.F., MaguireD.J. and RhindD.W. (2005) GeographicInformationSystemsand Science, Chichester, Wiley, 2nd edition.


**Suggested readings**


1. AndrewS.(2002)EnvironmentalModelingwithGISandRemoteSensing,TaylorandFrancis.
2. David W.and Mark G.(2002)SpatialTechnologyandArchaeology,TheArchaeologicalApplicationof GIS. London, New York, Taylor & Francis.
3. Goodrich M. (2000)Data Structures and Algorithms in Java, 2nd Edition Wiley.
4. MalczewskiJ.(1999)GISandMulticriteriaDecisionAnalysis,NewYork,JohnWileyandSons.
5. Michael W. and Duckham M.(2004) GIS: A Computing Perspective ,Boca Raton, CRC Press, Asrar Ghassem Theory and Applications of Optical Remote Sensing New York, John Wiley and Sons.
6. Ott T.and Swiaczny F.(2001)Time-integrative GIS, Management and Analysis of Spatio-temporal Data, Berlin/Heidelberg/New York, Springer.
7. Steven M.D.and ClarkJ.A. (1990)Applications of Remote Sensing in Agriculture London Butterworths.
8. Johnson L.E(2009)Geographical Information System in Water Resource Engineering, Taylor and Francis.
9. Thurston J., Poiker T.K. and Moore J.P. (2003) Integrated Geospatial Technologies: A Guide to GPS, GIS, and Data Logging, Hoboken, New Jersey, Wiley.
10. Vincent R.K.(1997)Fundamentals of Geological and Environmental Remote Sensing New Jersey, Prentice Hall.


Casestudies

Websites

**Journals**


11. Advances in Water Resources
12. Agricultural and Forest Meteorology
13. Asian Journal of Geoinformatics
14. Ecological Modelling
15. International Journal of Geoinformatics
16. International Journal of Remote Sensing


**Additional information(if any)**

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| **Magazines**<br>1. Coordinates<br>2. GIM International<br>3. GIS World<br>4. GIS@development<br>5. Geospatial today<br>6. GPSWorld |
| **Student responsibilities**<br>Attendance, feedback, discipline, guest faculty etc |

**Course Reviewer:**

- Prof MP Punia, Head & Sr Scientific Officers, Department of Remote Sensing, BIT, Mesra -Jaipur
- Prof PK Joshi, SES, JNU, New Delhi