Course title: Spatial Data Modeling and Applications

Course code: NRG 163	**No. of credits:** 4	**L-T-P:** 32-08-32	**Learning hours:** 56

Pre-requisite course code and title (if any): NRG 176 Principles of GIS and GPS

Department: Natural Resources

Course coordinator: Dr Vinay Sinha	**Course instructor:** Dr Vinay Sinha

Contact details: sinhav@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 database 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 non-spatial data and application developed based on the concepts by software developers, photogrammetrists, 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 modelling in any field of application.

Course content

Module	Topic	L	T	P
1	Introduction to geospatial 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	2	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		

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	2	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	Lab 1. Performing various actions over table			2
2	Lab 2. Merging of tables by using primary key			
3	Lab 3. Maintaining database			2
4	Lab 4. Point pattern analysis			2
5	Lab 5. Terrain Analysis			2
6	Lab 6. Hydrological modelling			4
7	Lab 7. Geostatistics (Surface generation)			6
8	Lab 8. Cluster Analysis			4
9	Lab 9. Site suitability analysis			4
10	Lab 10. Network analysis			2
11	Lab 11. Dynamic segmentation			4
	Total	**32**	**08**	**32**

Evaluation criteria

- Test1: 10% [module no.s 1to 5] [5-6 week]
- Test2: 10% [module no.s 7to 11] [10-12 week]
- Practical: 40% [Module no. 1-15] [End Semester]
- Test3: 40%[Experiment no. 1-15] [End Semester]

Learning outcomes

1. Equip with analysis, description and modeling of geospatial data.

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

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. Longley P.A., Goodchild M.F., Maguire D.J. and Rhind D.W. (2005) Geographic Information Systems and Science, Chichester, Wiley, 2nd edition.
5. Longley P.A., Goodchild M.F., Maguire D.J. and Rhind D.W. (2005) Geographic Information Systems and Science, Chichester, Wiley, 2nd edition.

Suggested readings

1. Andrew S. (2002) Environmental Modeling with GIS and Remote Sensing, Taylor and Francis.
2. David W. and Mark G. (2002) Spatial Technology and Archaeology, The Archaeological Application of GIS. London, New York, Taylor & Francis.
3. Goodrich M. (2000) Data Structures and Algorithms in Java, 2nd Edition Wiley.
4. Malczewski J. (1999) GIS and Multicriteria Decision Analysis, New York, John Wiley and Sons.
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 Clark J.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.

Case studies

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)

Magazines 1. Coordinates 2. GIM International 3. GIS World 4. GIS@development 5. Geospatial today 6. GPS World
Student responsibilities Attendance, feedback, discipline, guest faculty etc

Course Reviewer:

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