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|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|----------------------------------------------------|------------------------------|--------------|----------|-----------|
| <b>Course title:</b> Spatial Data Modeling and Applications                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                 |                                                    |                              |              |          |           |
| <b>Course code:</b><br>NRG 174                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>No. of credits:</b><br>4                                                                                     | <b>L-T-P distribution:</b><br>32-4-40              | <b>Learning hours:</b><br>56 |              |          |           |
| <b>Pre-requisite course code and title (if any):</b> NRG 175 Principles of GIS and GPS                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                 |                                                    |                              |              |          |           |
| <b>Faculty:</b> Prof P K Joshi                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                 | <b>Department:</b> Department of Natural Resources |                              |              |          |           |
| <b>Course coordinator (s):</b><br>Prof P K Joshi                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                 | <b>Course instructor (s):</b> Prof P K Joshi       |                              |              |          |           |
| <b>Contact details:</b>                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                 |                                                    |                              |              |          |           |
| <b>Course type</b>                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>Compulsory</b>                                                                                               | <b>Core</b>                                        | <b>Elective</b>              |              |          |           |
| <b>Course offered in</b>                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>Semester 1</b>                                                                                               | <b>Semester 2</b>                                  | <b>Semester 3</b>            | <b>Other</b> |          |           |
| <b>Course Description</b><br>The course covers fundamental aspects of spatial data modeling specifically on the aspect of three-dimensional (3D) modeling, structuring, raster and vector analysis etc. It also looks into 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. |                                                                                                                 |                                                    |                              |              |          |           |
| <b>Course objectives</b><br>1. To introduce fundamental aspects of spatial data modeling.<br>2. To integrate non-spatial data into various applications                                                                                                                                                                                                                                                                                        |                                                                                                                 |                                                    |                              |              |          |           |
| <b>Course content</b>                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                 |                                                    |                              |              |          |           |
| <b>SNo</b>                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>Topic</b>                                                                                                    |                                                    |                              | <b>L</b>     | <b>T</b> | <b>P</b>  |
| 1.                                                                                                                                                                                                                                                                                                                                                                                                                                             | Introduction to geospatial modeling and interpretation                                                          |                                                    |                              | 2            |          |           |
| 2.                                                                                                                                                                                                                                                                                                                                                                                                                                             | Applications of GIS models, case exercise                                                                       |                                                    |                              | 2            | 2        |           |
| 3.                                                                                                                                                                                                                                                                                                                                                                                                                                             | Topographic/terrain based analysis (DEM, STM, DSM, Slope, Aspect etc.)                                          |                                                    |                              | 4            |          | 6         |
| 4.                                                                                                                                                                                                                                                                                                                                                                                                                                             | Spatial data editing (errors in geospatial data, topological editing, concept of geodatabase)                   |                                                    |                              | 2            |          | 6         |
| 5.                                                                                                                                                                                                                                                                                                                                                                                                                                             | Geostatistics (spatial interpolations methods and data analysis)                                                |                                                    |                              | 4            | 2        | 6         |
| 6.                                                                                                                                                                                                                                                                                                                                                                                                                                             | Vector data analysis, introduction to spatial statistics and various tools (global measures, local measures)    |                                                    |                              | 4            |          |           |
| 7.                                                                                                                                                                                                                                                                                                                                                                                                                                             | Raster/GRID data analysis and visualization techniques (hill shades, contour, fly through generation/animation) |                                                    |                              | 4            |          | 6         |
| 8.                                                                                                                                                                                                                                                                                                                                                                                                                                             | Network analysis; utility mapping                                                                               |                                                    |                              | 2            |          | 4         |
| 9.                                                                                                                                                                                                                                                                                                                                                                                                                                             | Spatial modeling (regression: OLS, GWR, weighted overlay), 3D GIS                                               |                                                    |                              | 4            |          | 6         |
| 10.                                                                                                                                                                                                                                                                                                                                                                                                                                            | Spatial decision support system and thematic areas (application of MCDM/ AHP in spatial modeling)               |                                                    |                              | 4            |          | 6         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Total</b>                                                                                                    |                                                    |                              | <b>32</b>    | <b>4</b> | <b>40</b> |
| <b>Evaluation criteria</b>                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                 |                                                    |                              |              |          |           |
| ▪ 2 minor tests:                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                 | 10% each                                           |                              |              |          |           |
| ▪ Practical:                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                 | 40%                                                |                              |              |          |           |
| ▪ Major exam:                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                 | 40%                                                |                              |              |          |           |
| <b>Learning outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                 |                                                    |                              |              |          |           |

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**

#### **Materials**

##### Required text

1. Burrough P.A. and McDonnell R.A. (1998) Principles of Geographical Information Systems, Oxford University Press, Oxford, 327 pp.
2. Longley P.A., Goodchild M.F., Maguire D.J. and Rhind D.W. (2005) Geographic Information Systems and Science, Chichester, Wiley, 2nd edition.
3. 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. ( ) 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. Muralikrishna V. ( ) Geographical Information Systems and Remote Sensing Applications Allied Publishers Private Limited.
7. Ott T. and Swiaczny F. (2001) Time-integrative GIS, Management and Analysis of Spatio-temporal Data, Berlin/Heidelberg/New York, Springer.
8. Roy P.S. ( ) Geoinformatics for Tropical Ecosystems Bishen Singh Mahendra Pal Singh, Dehradun.
9. Steven M.D. and Clark J.A. ( ) Applications of Remote Sensing in Agriculture London Butterworths.
10. 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.
11. Vincent R.K. ( ) Fundamentals of Geological and Environmental Remote Sensing New Jersey, Prentice Hall.

##### Case studies

##### Websites

##### Journals

1. Advances in Water Resources
2. Agricultural and Forest Meteorology
3. Asian Journal of Geoinformatics
4. Ecological Modelling
5. Geocarto International
6. International Journal of Geoinformatics

7. International Journal of Remote Sensing
8. ISPRS Journal of Photogrammetry and Remote Sensing
9. Journal of Indian Society of Remote Sensing
10. Remote Sensing of Environment

**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