Course title: Principles of GIS and GNSS			
Course code: NRG 176	**No. of credits:** 4	**L-T-P:** 38-2-32	**Learning hours:** 56
Pre-requisite course code and title (if any): None			
Department: Department of Natural Resources			
Course coordinator: Dr Vinay Sinha		**Course instructor:** Dr Vinay Sinha	
Contact details:			
Course type: Core		**Course offered in:** Semester 1	

Course Description

It introduces participant to the fundamentals of GIS, GNSS, data models, data sources, databases, cartography, Overview of Global Navigation Satellite System (GNSS) and geospatial metadata.

Course objectives

1. To provide a firm understanding of the conceptual and technical understanding of GIS and GNSS
2. To prepare students for spatial data analysis and modelling

Course content

Th#	Topic	L	T	P
1	Basic concepts about spatial information: Philosophy, brief history and definition of GIS, Computer Aided Cartography Vs GIS, Manual mapping Vs GIS mapping.	2		
2	Geometrical feature and real word Pictures, Variables- Points, Lines and Areas and applications of GIS in various sectors (a case study approach)	2		
3	Basic Objectives and Components of GIS – details of hardware, software and management; Conceptual models of Real world phenomena.	2		
4	Introduction to GIS software; Overview of open source GIS Mercator, Polyconic, Lambert, Orthographic and UTM		2	
5	Information organization and data structure; Basic file structures, Tabular databases and Advantages of databases	2		
6	Spatial and Non-spatial data base, Spatial data model: Geo relational Vector data model, Object based vector data model, Geodatabase	2		
7	Raster data model; Hybrid relational database Vs Object orientation. Comparative analysis of spatial database	2		
8	GIS data Requirement, various sources, Standards and collection of GIS data, Methods of data capture: scanning, digitization and	2		

	associated errors; Conversion from other digital Sources, Attribute data input and management			
9	Different kinds of geospatial data, Sources of errors in GIS database: Errors through processing, Errors associated with overlay issues of features, Detecting and evaluating errors, Edge matching	2		
10	Introduction of Global Navigation Satellite System, Satellite constellation & Segments (Control, Space & User) GNSS signals and data, Geopositioning – Basic concepts (GPS, NAVSTAR, GLONASS and IRNSS /NAVIK)	2		
11	Introduction to Hand held GPS receivers; Initial setting & Creating codes and attribute table in receiver			
12	GNSS Positioning Types-Absolute positioning, Differential positioning	2		
13	GNSS performance and policy (Accuracy, integrity, SPS, PPS DoD & DoT policy, anti-spoof); Positioning Errors: Multi path, Ionosphere, Troposphere, Satellite Geometry, Satellite signals and its strength,	2		
14	Introduction to DGPS, wide area augmentation system (WAAS)	2		
15	Nature of geographic data-Types of uncertainty in a GIS; Data quality parameters: Positional accuracy, Attribute accuracy, Logical consistency, Completeness lineage,	2		
16	Topological relationships; Creation of topology and error correction;	2		
17	Attribute data query, SQL, Logical, Boolean, Arithmetical operation and function,	2		
18	Feature base operation – buffer, eliminate, dissolve	2		
19	Layer based overlay analysis: point to polygon, line to polygon, clip, erase, split, identity, union and intersection, Distance measurement	3		
20	Raster data structure, Local operations, Neighbourhood operations, Zonal operations	3		
Exp #	PRACTICALS			
1	Lab 1. Analog to Digital conversion -Scanning methods			2
2	Lab 2. Introduction to software			
3	Lab 3 Map Rectification, Define projection and Reprojection.			2

4	Lab4: Vector Transformation – Affine and Polynomial, co-ordinate definition. Map Bound.			2
5	Lab 5. Digital database creation -Point features, Line features, Polygon features			2
6	Lab 6. Data editing-Removal of errors -Overshoot & Undershoot, Snapping, Topology Creation			2
7	Lab 7. Data collection and Integration, Non-spatial data attachment working with tables			2
8	Lab 15. Introduction to GPS receiver and initial setting & Creating codes and attribute table in receiver			2
9	Lab 16. Point data collection using GPS with different datum			2
10	Lab 17. Point / Line / Area data collection using GPS and measurements			2
11	Lab 18. GPS data collection in DGPS mode			
12	Lab 19. Post processing of the GPS data			2
13	Lab 20. Image rectification using GPS coordinate data			2
14	Lab 8. Dissolving and Merging			2
15	Lab 9. Clipping, Intersection and Union			
16	Lab 10. Proximity Analysis			2
17	Lab 11. Spatial and Attribute query and Analysis			2
18	Lab12. Creation of Blank Grid/Raster			2
19	Lab13. Map algebra / Math in Raster data			
20	Lab 14. Layout generation and report			2
	Total	**38**	**2**	**32**

Evaluation criteria

- Test 1: Written test [at the end of Th# 9 and Exp# 7] 10%
- Test 2: Written test [at the end of Th# 14 and Exp# No 13] 10%
- Practical: Laboratory + Written test [at the end of practical, full experiment 1-20] -- 40%

- Test 4: Written test [at the end of the semester, full syllabus] -- 40%

Learning outcomes

Upon completion of this course, student will be able to:

1. Create and understand database in spatial platform for analysis and modeling for various applications [test -1]
2. Conduct the GNSS based survey and mapping under variety of planning and management applications [test-2]
3. Capable to understand the use of spatial tools & techniques for analysis and modeling of the spatial data over various natural and human resource mapping, monitoring and management [Practical and test-3]

Pedagogical approach:

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

Materials

Required text

1. Burrough P.A. and McDonnell R.A. (1998) Principles of Geographical Information Systems, Oxford University Press, Oxford,
2. Chang K. (2007) Introduction to Geographic Information System, 4th Edition, McGraw Hill.
3. Lo C. P and Yeung A. K. W. (2009) Concepts and Techniques of Geographic Information Systems, 2nd Edition, New Jersey, Pearson Prentice Hall
4. Verbyla D. L. (2002) Practical GIS Analysis, London and New York, Taylor and Francis.
5. Berry J.K. (1993) Beyond Mapping: Concepts, Algorithms and Issues in GIS, Fort Collins, CO, GIS World Books.
6. Bolstad P. (2005) GIS Fundamentals: A First Text on Geographic Information Systems, Second Edition, White Bear Lake, MN, Eider Press
7. Kaplan E. D. and Hegarty C J (2006) Understanding GPS Principles and Applications, Second Edition, ARTECH House INC. Norwood.
8. Paul D. Groves (2013) Principles of GNSS, inertial, and multisensor integrated navigation systems, 2nd edition, Artech House, Boston/London

Suggested readings

1. Elangovan K. (2006) GIS: Fundamentals, Applications and Implementations, New India Publishing Agency, New Delhi.
2. Heywood I., Cornelius S. and Carver S. (2006) An Introduction to Geographical Information Systems, Prentice Hall, 3rd 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.
4. Maguire D.J., Goodchild M.F. and Rhind D.W. (1997) Geographic Information Systems: Principles and Applications, Longman Scientific and Technical, Harlow.
5. Ott T. and Swiaczny F. (2001) Time-integrative GIS, Management and Analysis of Spatio-temporal Data, Berlin/Heidelberg/New York, Springer.
6. 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.
7. Tomlinson R.F. (2005) Thinking about GIS: Geographic Information System Planning for Managers, ESRI Press.
8. Wise S. (2002) GIS Basics, London, Taylor & Francis.

9. Worboys M. and Duckham M. (2004) GIS: A Computing Perspective, Boca Raton, CRC Press.

Case studies

Websites

Journals

1. Asian Journal of Geoinformatics
2. Geocarto International
3. International Journal of Goeinformatics
4. International Journal of Remote Sensing
5. ISPRS Journal of Photogrammetry and Remote Sensing
6. Journal of Indian Society of Remote Sensing
7. Remote Sensing of Environment

Additional information (if any)

Magazines

1. Coordinates
2. Geospatial today
3. GIM International
4. GIS World
5. GIS@development
6. GPS World

Student responsibilities

The students are expected to submit assignments in time and come prepared with readings when provided.

Course reviewer:

- Prof. P K Joshi, JNU
- Prof. J. K. Garg, Guru Gobind Singh Indraprastha University