CE-432A

Geographical Information System

2022 – 23-II

COURSE MANUAL

Dr. B. Nagarajan and Dr. Bharat Lohani
Geoinformatics
Department of Civil Engineering
Indian Institute of Technology Kanpur
KANPUR – 208016

Email: nagaraj@iitk.ac.in **and** blohani@iitk.ac.in

Course Objective

To learn the principles, theory, and practices of the Geographical Information System (GIS).

Learning Objectives

The course aims to introduce the general concepts of GIS, so one is prepared to do research in these areas and work in related industries. Having done this course, one should understand the sources of geospatial data, their processing, coordinate systems, data models, geodatabase, various spatial processes, and GIS applications.

Course Content (3-2-0-11)

- Introduction: What is GIS? Applications of GIS, Examples of use cases, Components of GIS, Brief History of GIS, Elements of GIS:
- Geospatial data, Data acquisition, data management, data display, data exploration and data analysis; Future of GIS.
- Geospatial data; data types: Spatial and non-Spatial, Vector and Raster data types;
- Elements of raster and vector data types; vector and raster data models and encoding; advantages and disadvantages of raster data model; advantages and disadvantages of vector data model;
- Integration of raster and vector data models in GIS; Geo-referencing; Transformation models using GCPs; accuracy analysis;
- Resampling: Nearest Neighbour, Bilinear, Bicubic; Advantages and Disadvantages of each resampling approach;
- Map to Image registration, Image to Image registration. Geospatial data acquisition: raster data and vector data acquisition;
- Metadata; Importing data in GIS; Raster to vector data conversion (digitization): Manual approach, Semi-automatic approach, Automatic approach, Errors in digitization: Topological errors; rasterization of data;
- Management of attribute data.
- Coordinate reference systems, Projection Systems and Coordinate Transformations. Database models: Flat,
- Hierarchical, Network, Relational, Georelational (Shape file and coverage); Primary and Foreign Key; Database Normalization and rules; Relationships in database: One to one, one to many, many to one, many to many; Joins and Relates;
- Hybrid Data model (Geodatabase); SQL: Language structure, queries by attribute, queries by geography.
- Spatial interpolation: Multi-linear regression, density map,
- Delaunay Triangulation and Theissen polygons, Kriging.
- Vector data operations: Buffering and Overlay,
- Raster data operations: Display, Local operations, Reclassification, Overlay, Neighbourhood operations, Zonal operations, Global operations.
- Least cost path analysis, Network analysis,
- Viewshed and Watershed analysis, Geocoding.

Text/Reference Books

- Introduction to Geographical Information System by Kang-tsung Chang (Tata McGrow Hill Indian Edition)
- Lo, C. P., and Yeung, A.K W., Concepts and techniques of GIS, Prencice Hall of India Pvt. Ltd., 2002
- Burrough, P. A., and McDonnell, R. A., Principles of Geographical Information Systems, 2nd Edition, Oxford University Press, 1998
- Demers, M. N., Fundamentals of Geographic Information Systems, John Wiley & Sons, 3rd Edition, 2002
- Longley, P. A., Goodchild, M. F., Maguire, D. J., and Rhind, D. W., Geographic Information Systems and Science, 2nd Edition, John Wiley and Sons, 2005
- Longley, P. A., Goodchild, M. F., Maguire, D. J., and Rhind, D. W., Geographical Information Systems: Principles, Techniques, Management and Applications, 2nd Edition, John Wiley & Sons, 2005
- National Centre for Geograhic Information and Analysis (University of California at Santa Barbra)
- Several GIS tutorial sites on the internet

You could procure some of the above books in ebook form. Your seniors (TAs) can help you with this. More references etc. will be provided to you during the course.

Journals

- International Journal of Applied Earth Observation and Geoinformation
- The Geograhical Journal
- International Journal of GIS
- ASPRS Journal of PE&RS
- Transactions in GIS
- Cartography and Geographic Information Science

IIT Kanpur subscribes to a few of these journals. Otherwise, you can read the abstract of all publications for free.

Course Notes

The course lecture PPTs and other material will be provided as we progress.

Online Platform for Course

All materials related to the course will be uploaded on the MookIT course site. The link to the site is:

CE432A: GEOGRAPHICAL INFORMATION SYSTEM (GIS) | Home (iitk.ac.in)

Lecture Schedule

The classes will be in offline mode.

The course has two lectures of a 1:15 hours duration per week. These will be held on Monday at 12:00 noon and Tuesday at 9:00 am in the **Instruction Room of PEB building**. (Next to flight lab). The tentative lecture schedule is as follows.

Week	Lecture nos.
1.	1 to 3
2.	4 to 5
3.	6 to 7
4.	8 to 9
5.	10 to 11
6.	12 to 13
7.	14 to 15
8.	16 to 17
9.	18 to 19
10.	20 to 21
11.	22 to 23
12.	24 to 25
13.	26 to 27

Attendance is not mandatory during lectures, but students are advised not to miss any lectures.
Any change in the above will be intimated.

Laboratory

The laboratory for the course is on Tuesday 4:00 pm to 6:00 pm.

The laboratory assignment will be supplied a day before through email or other platforms by the course TAs. The students should complete the laboratory during the assigned slot as above. The lab assignment must be submitted by 7:00 pm each Tuesday at the designated site specified by the TAs.

Help about the laboratory will be provided during these hours by the course instructors and TAs. Course Instructors and TAs will be available for any query on the laboratory during this period.

The labs will be conducted in the **GI laboratory in PEB Building**.

All Software and Hardware will be available in the laboratory. Any additional requirements will be informed.

Home Assignment

The home assignment will be submitted on the designated day and time which will be informed when the home assignment is being given.

Prior to approaching the Course Instructor for any queries regarding assignment submissions and marks obtained, students are advised to talk to TAs.

TAs and Contact Details

Tutor Name	Prog.	Dept.	Email
Sri Priyanka Kommula	PhD	CE	spriyankak20@iitk.ac.in
Surbhi Barnwal	PhD	CE	surbhib20@iitk.ac.in
Hemanth Kumar Kallagunta	M.Tech.	CE	Hemanthkk@iitk.ac.in
Karan Chawla	M.Tech.	CE	karanch21@iitk.ac.in

Validation of Uploaded Marks

The marks earned by students are uploaded on a spreadsheet with the instructor. A copy of this sheet with the marks of each students individually will be sent to the students through email at two occasions:

1. After Mid-Sem
2. Before End-Sem

The students are advised to inform the TAs / Course Instructor in the case of any discrepancy in the marks uploaded immediately upon receipt of the above email. It is the responsibility of students to inform any correction in the tabulated marks at each stage.

Course Evaluation Policy

The course will follow a continuous assessment policy, i.e., formative and summative assessments will be made throughout the course. The summative assessment will be made through the following means:

1. Quizzes – multiple, surprise
2. Home assignment
3. Laboratory assignment
4. Lab exam
5. Project
6. Mid sem exam
7. End sem exam

The format of the above assessment will be informed at the time of the exam only. All assessment will be in online or offline mode. Therefore, students are advised to prepare for all possible questions, e.g., multiple

choice, subjective, numerical, hands-on exercise etc. The Mid Sem and End Sem exams will be in the slots as in the institute calendar.

Weightage

- Quizzes 15%
- Home assignment 5%
- Lab assignments 15%
- Lab exam 5%
- Project 10%
- Mid sem exam 20%
- End sem exam 30%

Use of Unethical Means

Cheating in exams or assignments would result in a lowering of grade by an appropriate number of slabs even leading to awarding of a grade 'F' depending on the nature of the cheating. The decision of the Course Instructors will be final.

Grading Policy

Letter grades A*, A, B+, B, C+, C, D+, D, E, F, and I will be awarded on the basis of natural grouping or statistical grouping method. Grade 'I' is awarded for incomplete.

Leaves

Leaves will be permitted only if DUGC/SUGC has recommended the same. Late submission of an assignment or make-up quiz or exam or proration of marks will only be permitted if the leaves are sanctioned by DUGC/SUGC. It is the responsibility of students to obtain such official leave and inform the instructor.

Plagiarism

Students should make themselves aware of what constitutes plagiarism. Plagiarism in any form if more than 10% in reports, assignments, term paper etc. will result in reduction of the marks obtained to zero in that particular case. The student's submission may be checked by plagiarism checker available in institute. You may like to visit the site https://www.plagiarism.org/article/what-is-plagiarism to know more.

Copyright

Please read the following regarding the copyright of the course material being supplied to you during this course.

"The instructor of this course owns the copyright of all the course materials. This lecture material was distributed only to the students attending the course "CE432A – Geographical Information System" of IIT Kanpur, and should not be distributed in print or through electronic media without the consent of the instructor. Students can make their own copies of the course materials for their use."