COURSE TITLE	**GEOGRAPHIC INFORMATION SYSTEMS AND APPLICATIONS**
COURSE CODE	**01CT0829**
COURSE CREDITS	**3**

Objective:

1 This course provides a foundational understanding of GIS principles, data models, and spatial analysis techniques. It equips students with practical skills in GIS software and introduces Python scripting to automate geospatial tasks. Students learn to apply GIS tools to solve real-world problems in various fields effectively.

Course Outcomes: After completion of this course, student will be able to:

1 Apply fundamental concepts, components, and data models of Geographic Information Systems (GIS), including raster, vector, and TIN, to solve spatial problems

2 Apply GIS software tools such as ArcGIS and QGIS for data visualization, map creation, spatial data processing, and layout design

3 Analyze spatial datasets using geospatial techniques such as georeferencing, spatial interpolation, DEM derivatives, and spatial joins

4 Evaluate the application of GIS in real-world domains such as environmental monitoring, land use planning, public health, emergency management, and business analytics

5 Analyze GIS-related data structures and spatial data handling techniques for different application scenarios

6 Develop geospatial processing workflows using Python and automate GIS tasks using libraries such as ArcPy and GeoPandas

Pre-requisite of course: Programming with python, Environmental science

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	0	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**GIS Fundamentals and Spatial Data Types** GIS Introduction, Essential Components of GIS, Vector Data Types and Topology, Raster vs Vector Comparisons, TIN Model and Non-Spatial (Attribute) Data, Basic Operations in GIS Software	6
2	**Data Management, Compression, and Projections** Vector & Raster Data Compression Techniques, Georeferencing Concepts and Techniques, Metadata, Coordinate Systems, Map Projections, NoData Concepts and Attribute Types, Spatial Database Systems, Preprocessing Spatial Data	6

MR. CHANDRASINH DHIRUBHA PARMAR
Digitally signed by (Name of HOD)

DR. RAJENDRASINH BAHADURSINH JADEJA
Digitally signed by (Name of Dean/ Principal)

Contents : Unit	Topics	Contact Hours
3	**Spatial Analysis and Interpolation** Interpolation Techniques (IDW, Kriging, Spline), GIS Analyses: Buffer, Overlay, Clip, Union, Classification of Attributes, Spatial Joins and Geoprocessing Tools, Pattern & Hotspot Analysis (Autocorrelation, Heatmaps), Spatial Analysis using ArcGIS/QGIS	6
4	**Digital Elevation Models (DEMs) and Terrain Modelling** DEM Concepts, Types, and Resolutions, Techniques to Generate DEMs (LIDAR, Photogrammetry), Slope, Aspect, Hillshade, TIN Models, Surface Hydrologic Modeling and Dam Simulation, Shaded Relief Models and DEM Quality Assessment, DEM Processing in GIS	6
5	**Thematic Applications of GIS** Land Use Change Detection & Buildout Analysis, Public Health GIS (Disease Surveillance, Access Analysis), Emergency Management & Evacuation Planning, Business GIS (Market, Supply Chain, Location Allocation), Environmental Applications (Wildfire Risk, Watershed Mapping), Application Use-Cases in GIS	6
6	**Cartography, Visualization, and Web GIS** Cartographic Design, Symbology, Labeling, Layouts, 3D Visualization and Map Books, Introduction to ArcGIS Online and Experience Builder, Creating and Publishing Web Maps and Layers, Digital Twins and Future Trends in GIS	6
7	**Introduction to GeoPython for GIS Automation** GeoPython, Setting Up Python Environment (Jupyter, Anaconda), Python Libraries: geopandas, shapely, fiona, rasterio, Reading/Writing Spatial Data, Basic Vector Operations: Buffer, Merge, Intersect	6
Total Hours		**42**

Textbook :

1 GIS Fundamentals: A First Text on Geographic Information Systems, Bolstad, P, Eider Press, 2019

2 Python Scripting for ArcGIS Pro, Zandbergen, P. A., , Esri Press, 2020

References:

1 Geoprocessing with Python, Geoprocessing with Python, Garrard, C., , Manning Publications, 2016

Suggested Theory Distribution:

The suggested theory distribution as per Bloom’s taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery

MR. CHANDRASINH DHIRUBHA PARMAR
Digitally signed by (Name of HOD)

DR. RAJENDRASINH BAHADURSINH JADEJA
Digitally signed by (Name of Dean/ Principal)

Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking / Creative
10.00	15.00	20.00	30.00	15.00	10.00

Instructional Method:

1. The course delivery method will depend upon the requirement of content and need of the students. The teacher in addition to conventional teaching method (Chalk and Talk) may use any of the tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc. for effective teaching.
2. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
3. Students may use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory, etc.
4. The course delivery method will depend upon the requirement of content and need of the students. The teacher in addition to conventional teaching method (Chalk and Talk) may use any of the tools such as demonstration, role play, Quiz, brainstorming, Flipped class, Project based learning, Collaborative learning, MOOCs etc. for effective teaching.

Supplementary Resources:

1. https://www.coursera.org/specializations/gis#courses
2. https://onlinecourses.nptel.ac.in/noc25_ce23/preview
3. https://onlinecourses.nptel.ac.in/noc22_ce84/preview
4. https://elearning.iirs.gov.in/courses/paper_05/default.htm
5. https://automating-gis-processes.github.io/2016/Lesson1-Intro-Python-GIS.html#

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