Syllabus Prescribed for 2024-2025 Year **PG Programme**
Programme: M.Sc. Geoinformatics

M.Sc. PART II (M.Sc. Geoinformatics) EXAMINATION (Semester –III)
Examination scheme under NEP for the subject Geoinformatics

Part B
Syllabus Prescribed for Second Year 2024-25
PG Programme : M.Sc. Geoinformatics
Semester- III

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
3 GNF1C	DSC- I.3 (GIS Development and Open Source GIS)	60
3 GNF2C	DSC- II.3 (Geoinformatics Applications in Natural Resources Management)	60
3 GNF3C	DSC- III.3 (Geoinformatics Applications in Agriculture)	60
3 GNF 4A **OR** 3 GNF 4B	DSE- I.3A (Application of GIS for Disaster Management) **OR** DSE- I.3B (Surveying and Data Processing)	60
3 GNF5C	Open sources GIS - Lab	60
3 GNF6C	GIS Applications in Natural Resources and Agriculture-Lab	60

3GNF-1C: GIS Development and Open Source GIS

COs(Course Outcomes)
After successfully completing the course, the students will be able to

1. Acquire knowledge of database fundamentals, data flow, algorithms, and problem-solving methods.
2. Through Python programming, students learn the object-oriented programming methodology.
3. To fulfill the time constraints, students learn how to integrate GIS procedures with Python scripting.
4. Students acquire the skills necessary to develop a spatial visualization of such datasets and deliver it in browsers using cloud computing and Web-based GIS languages.
5. Students will be able to develop C++ programs that comprehend the fundamentals of OOP.

Unit 1: Customization of GIS: Overview-programming for GIS applications - the expansion of GIS through customization and related capabilities - Automation of redundant processes - Data development/update automation - user tool development. 10 Periods

Unit2 : Java Review: Write, debug and repair java code for GIS- Integration of code in GIS environment. Introduction to Python- Variables - control structures - looping statements ï functions Strings- Data structures - classes ï objects - Inheritance ï polymorphism, Creating NDVI, Creating Map Book, Collecting Field data, Geo locating photos on Map 10 Periods

Unit3 :	Introduction to .NET. Application of Python, JAVA and .NET in GIS development. Basics of C# Programming. Python Geo and data sciences packages and Jupyter notebook. GIS data access and manipulation with python.	10 Periods
Unit 4 :	Introduction to Arc Objects: Introduction to Arc GIS family of products- Programming Arc GIS using Arc Objects- understanding Component Object Model (COM). Diagrams-Fundamental Object Model Diagram, different types of class relationships-working with events- Accessing and Rendering Data-Querying and selecting data-working with geometry-creating and editing data	10 Periods
Unit 5 :	Introduction to Open source GIS. Advantages of Open source GIS platforms. Open source GIS Software- Introduction to Open source tool kit - Openjump ï GRASS ï ILWIS ï Open street map - QGIS - SagaGIS - Map window-cloud GIS system. Google Earth Pro-Engine. Use of Bhuvan Portal, Open Geo-spatial Consortium.	10 Periods
Unit 6 :	QGIS operations with different tools, Working and configurations with different Projections, Datum Transformation, Vector data- Editing, Query Builder, Field Calculator, Raster data ï Properties, Raster Calculator, QGIS as OGC Data Client & Server, GPS Plugin, QGIS Plugin,	10 Periods

Text Books

1. Tyler Mitchell (2015). Web Mapping Illustrated: Using Open Source GIS Toolkits, OÕReilly; 1ed.
2. Lutz, M. (2010): Programming Python, OÕRelly Media California
3. Robert Burke, Andrew Arana, Thad Tilton (2003). Getting to Know About ArcObjects: Ingram Publisher Services.
4. Markus Neteler And Helena Mitasova (2007): Open Source GIS: A GRASS approach, Springer-Verlag Berlin, Heidelberg
5. Balagurusamy E., (2001): Object Oriented Programming with C++, Tata McGraw Hill Jo Wood, 2002. Java programming for spatial sciences, CRC Press.
6. Paul A. Zandbergen (2020) Python Scripting for ArcGIS Pro, ESRI Press.

Reference Books

1. Laura Tateosian (2018). Python For ArcGIS. Springer.
2. Stuart Dabbs Halloway (2002): Component Development for the Java platform: Addison-Wesley
3. Mark Summerfield, Programming in Python 3, Pearson Education Inc, South Asia, 2009
4. Michael Zeiler, 2001. Exploring ArcObjects: ESRI.
5. Andrew Cutts, Anita Graser (2018): Learn QGIS , https://www.packtpub.com/applicationdevelopment/learn-qgis-fourth-edition

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3GNF-2C: GIS Applications in Natural Resources Management

COs(Course Outcomes)
After successfully completing the course, the students will be able to

1. Students will able to understand the earth natural recourses.
2. Students can distinguish between distinct land use and land cover systems using a variety of GIS based platform to delineate natural resources.
3. To understand rock types, minerals, economic minerals and their occurrence.
4. Students are able to use of geological skills with GIS domain for natural resources inventory
5. Students can understand the utility management with respect to Natural recourses.

Unit 1:	Natural Resource Evaluation: Need ï objectives ï sources of data ï limitations ï need for evaluation in development planning. Land Evaluation: Objectives ï principles ï procedures ï approaches ï land use requirements and land quality parameters ï layer creation ï matching ï classification ï case studies.	10 Periods
Unit2 :	Geosciences and Geology: Mineral resources and their varieties, Geomorphology concepts, landform analysis, slope mapping, and an integrated method for zonation models and mapping of landslide hazards.	10 Periods
Unit3 :	Water Resources management : surface and Ground water investigation - artificial recharge zone identification. Groundwater potential zone mapping, water quality monitoring, water quality mapping, watershed approach for natural resource management ï runoff and hydrological modeling by using RS and GIS tools.	10 Periods
Unit 4 :	Basics of Marine Ecology, Bio-Resource Monitoring and Mapping, and Coastal Bathymetry are some marine resources. SST mapping, potential fishing zone mapping, and ocean colour mapping.	10 Periods
Unit 5 :	Natural Vegetation: Forests ï classification (NRSA) ï grasslands ï layer creation overlay ï management ï case studies. Wastelands: Types ï identification ï management ï eroded lands ï types ï layer creation ï Case studies related to Natural Vegetation Management.	10 Periods
Unit 6 :	Geospatial applications in natural resource surveys and monitoringï strategies for natural resource management- millennium eco-system assessment project-resources utilization and conservation in India-Case studies.	10 Periods

Text Books

1. Fischer, M., H.J. Scholten, and D. Unwin, (1996): Spatial Analytical Perspectives on GIS, Taylor & Francis, London, UK.
2. H.S. and Binda P.R (2007): Modeling In Resource Management and Environment through Geomatics
3. Jensen J.R. (2000) : Remote Sensing of the Environment: An Earth Resource Perspective.
4. Michael F. Goodchild, Louis T. Steyaert, Bradley O. Parks (1996): GIS and Environmental Modeling: Progress and Research Issues. Fort Collins, CO 80525: GIS World Inc.

Reference Books

1. Fotheringham, S., and P. Rogerson, Ed. (1995): Spatial Analysis and GIS , Taylor & Francis, London, UK.
2. Ripple, William J. (ed.). (1994): The GIS Applications Book: Examples in Natural Resources: A

Compendium , American Society for Photogrametry and Remote Sensing, Bethesda, Maryland.
3. Young, Haines, David Green, and Steven Cousins (eds.), (1994): Landscape Ecology and GIS.

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3 GNF-3C: Geoinformatics Applications in Agriculture

COs(Course Outcomes)
After successfully completing the course, the students will be able to

1. Students are able to understand Remote Sensing and GIS applications in Agriculture.
2. Students will able to perform agriculture water demand estimation.
3. Students will learn about the social framework of agriculture sector.
4. Students will understand about the Crop Yield Modeling.
5. Students are able to perform Agro-Ecological Zone based mapping.

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Unit 1:	Major agricultural types in India & world agricultural region. Crops: Introduction - Agriculture Ecosystems, Yield parameters, spectral properties of crops, identification of crops and acreage estimation, vegetation indices, production forecasting through digital analysis, monitoring and condition assessment - case studies .	10 Periods
Unit2 :	Soils: introduction - Soil survey methods, soil classification, Land evaluation, Saline, alkaline soils, soil mapping, soil identification and mapping of problem soils, sedimentation and erosion, soil conservation - case studies.	10 Periods
Unit 3 :	Field-scale applications of RS and GIS: soil moisture content assessment, crop phenologic stage identification, crop biomass and yield production estimation, crop disease, weed and insect infestation detection and monitoring, farms mapping, cropping system analysis, agro-ecological zoning.	10 Periods
Unit 4 :	Spectral Characteristics of Crop, Crop inventory, Crop yield modeling, Physiographic soil mapping. Crop water management, Agro ecological zoning and land evaluation Review of case studies in Geosciences, Water Agriculture and Soil. Case studies related to agricultural management by using GIS.	10 Periods
Unit 5 :	Retrieval of agrometeorological parameters from satellites, floods and droughts assessment and monitoring for agricultural management, water and wind induced soil erosion assessment and monitoring. Climate change impact on agriculture economy;	10 Periods
Unit 6 :	Geo-informatics for Precision Farming- Importance and relevance to Indian Agriculture. Agronomy, environment, and economics, Tools of Precision Farming: variable rate technology (VRT), GPS, GIS, Yield monitoring and mapping, Developing prescriptive maps for VRT management, Applications.	10 Periods

Text Books:

1. FAO (2016). Planning, implementing and evaluating Climate-Smart Agriculture in Smallholder Farming Systems. Job Number 15805. Report under Mitigation of Climate Change in Agriculture (MICCA) Programme of FAO. ISBN: 978925109305.
2. Steven, M.D. and Clark, J.A., Butterworths, (1990): Application of Remote Sensing in Agriculture, London.
3. Roland Billen, Elsa Joao, David Forrest (2006): Dynamic and Mobile GIS: Investigating Changes in Space and Time, CRC Pres.
4. Pierce J. Francis and Clay David (2007): GIS Applications in Agriculture, Taylor & Francis Group.

Reference Books:

1. Sharon A. Clay (2019): GIS Applications in Agriculture, Volume Three Invasive Species
2. IPCC (2014). IPCC Assessment Report. UNFCCC.
3. Ripple, William J. (ed.). (1994): The GIS Applications Book: Examples in Natural Resources: A Compendium , American Society for Photogrametry and Remote Sensing, Bethesda, Maryland.
4. Roy, P. S.(2002): Biodiversity Characteristics at Landscape Level in North East using satellite Remote Geographical Information System, IIRS, Dehradun.
5. J.V.S. Murty (2007): ñWatershed Managementò, New Age International, New Delhi.

3 GNF 4A : Application of GIS for Disaster Management

COs (Course Outcomes)
After successfully completing the course, the students will be able to

1. Students learn about the dynamics of the earth's systems over time and space.
2. Students distinguish between natural and man-made disasters.
3. Students prepares a model for disaster management.
4. Students will learn disaster management at various scales.
5. Using GIS tools, students learn to adopt the remote sensing and GIS tools for managing the pre-event and post-events of disasters.

Unit 1: Concepts of disaster, Types of disaster-Natural and manmade: Disaster preparedness with regard to various disasters, definition, categories of disasters, importance of RS and GIS for disaster management, prediction, forewarning system. Disaster management using spatial data infrastructure and a GIS-based decision support system management and satellite observation to prevent disasters. 10 Periods

Unit 2 : Drought: types and causes of metrological, agricultural, hydrological and socio economic drought, GIS based drought analysis, Forest Fire – causes, management using GIS, risk zonation mapping, forecasting system. Causes, types, effects and mitigation measures. 10 Periods

Unit 3 : Flood, Tsunami and Cyclone hazard zone mapping. Landslides: RS and GIS for zonation, monitoring and management; Soil erosion: RS and GIS for soil erosion and sediment estimation. Remote Sensing and GIS applications in earthquake hazard mitigation and management. 10 Periods

Unit 4 :	Assessment of Disaster Vulnerability of a location and vulnerable groups. Preparedness and Mitigation measures for various Disasters. Preparation of Disaster Management Plans. Issues in Environmental Health, Water & Sanitation, Volcanic Eruption, Earthquake Mitigation, Fire, Landslides and other natural calamities. Post Disaster Relief & Logistics Management	10 Periods
Unit 5 :	Emergency Support Functions and their coordination mechanism. Resource & Material Management. Management of Relief Camp. information systems & decision making tools. Role of Remote Sensing, Science and GIS Technology in rehabilitation programmes	10 Periods
Unit 6 :	The concept of disaster management cycle. (Post Disaster review, Prevention, Mitigation, Preparedness, Disaster Impact, Response, Recovery & Development) Voluntary Agencies & Community Participation at various stages of disaster management. Geospatial applications for Population & Economic Development, Poverty and Environment, sustainable Development.	10 Periods

Text Books:

1. Brian Tomaszewski (2020) Geographic Information Systems (GIS) for Disaster Management, Routledge, U.K.
2. Nirupama, (2002): Role of Remote Sensing in Disaster Management, ICIR Research Paper Series.
   N0. 21, Institute for catastrophic loss reduction, University of Western Ontario, Ontario.
3. Roy, P. S. (2000):Natural Disaster their Mitigation, IIRS, Dehradun
4. ISRS (2000): National Symposium on Spatial Technologies for Natural Hazards Management, IIT, Kanpur.

Reference Books:

1. Jenson, J.R. 2000, Remote Sensing of the environment ï An Earth Resource Perspective, Prentice Hall Inc.
2. Schultz, G. A. and Engman, E. T., 2000, Remote Sensing in Hydrology and Water Management, Springer-Verlag, Berlin, Germany.
3. Spatial Technologies for Natural Hazard Management. Proceedings of ISRS National Symposium, Nov. 21-22, 2000, IIT, Kharagpur.

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3 GNF 4B : Surveying and Data Processing

COs (Course Outcomes)
After successfully completing the course, the students will be able to

1. To introduce students to various surveying instruments and technologies used in Geoinformatics.
2. To provide hands-on experience with surveying equipment and software for data acquisition and processing.
3. To develop skills in data analysis, interpretation, and visualization for geospatial applications.
4. To enable students to apply surveying techniques in real-world scenarios and solve complex spatial problems.

Unit 1:	Fundamentals of Surveying: Definition and scope of surveying, Role of surveying in geoinformatics, Introduction to surveying principles and techniques, Basic measurements: chain/tape survey, plane table survey, Introduction and application to surveying instruments: Theodolite, Dumpy Level.	10 Periods
Unit 2:	Advance Global Positioning System (GPS) and Differential GPS (DGPS): Introduction, Principles and Advance Application of GPS and DGPS, GPS and DGPS data acquisition techniques and real-time kinematic (RTK) positioning, static positioning, and post-processing methods, Differential correction methods: beacon-based corrections, satellite-based corrections, and network-based corrections, Data processing and Integration of GPS/DGPS with GIS Software.	10 Periods
Unit 3:	LiDAR Technology: Basic principles and operation of LiDAR (Light Detection and Ranging), Types of LiDAR systems: airborne, terrestrial, mobile, LiDAR data acquisition and processing: sensor specifications, flight planning, scanning patterns; data collection parameters: point density, coverage area, and terrain characteristics; LiDAR Data Processing and Interpretation: steps involved in pre-processing raw LiDAR data.	10 Periods
Unit 4:	Total Station Surveying: Introduction to Total Station instruments, Total Station data acquisition techniques, Total Station data processing and analysis, Applications of Total Station in surveying and mapping.	10 Periods
Unit 5:	Drones Surveying: Introduction to drone technology in surveying, Drone data acquisition techniques, Drone data processing and analysis, Applications of drones in aerial surveying and mapping, Mapping and 3D model generation using drone data.	10 Periods
Unit 6:	Data Processing and Analysis: Introduction to AutoCAD for drafting and analysis, Integration of total station with CAD software, AutoCAD drawings georeferenced and import into GIS: Data processing techniques for surveying data, Spatial analysis and visualization methods, Practical applications of Integration of AutoCAD and GIS.	10 Periods

Text Books:

1. Moffitt, F. H., &Bossler, J. D. (2014). Elementary Surveying: An Introduction to Geomatics (14th ed.). Prentice Hall.
2. El-Rabbany, A. (2015). Introduction to GPS: The Global Positioning System (2nd ed.). Artech House.
3. Wolf, P. R., &Ghilani, C. D. (2017). Elementary Surveying: An Introduction to Geomatics (15th ed.). Pearson.

Reference Books:

1. Li, Z., Zhu, Q., & Gold, C. (Eds.). (2012). Advances in Photogrammetry, Remote Sensing and Spatial Information Sciences: 2008 ISPRS Congress Book. CRC Press.
2. Djokic, D., &Ġiljeg, A. (2019). Drones in Geoscience: New Approaches for the 21st Century. Springer.
3. Longley, P. A., Goodchild, M. F., Maguire, D. J., &Rhind, D. W. (2015). Geographic Information Science and Systems (4th ed.). Wiley.

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DSE 3C - MOOC/Swayam Courses

1. A Basic Course in Machine Learning for All By Sumitra Padmanabhan , uGDX School of Technology, ATLAS SkillTech University, Mumbai. (https://onlinecourses.swayam2.ac.in/imb24_mg126/preview)
2. Artificial Intelligence : Search Methods For Problem solving By Prof. Deepak Khemani, IIT Madras. (https://onlinecourses.nptel.ac.in/noc24_cs88/preview)
3. Environment Natural resources and Sustainable Development By Prabhakar Rao Jandhyala | University of Hyderabad. (https://onlinecourses.swayam2.ac.in/aic19_ge05/preview).

Programme: M.Sc. Geoinformatics (Semester-III)

Code of the Course/Subject	Title of the Course/Subject (Laboratory/Practical/practicum/ hands-on/Activity)	(No. of Periods/Week)
3 GNF 5C	Open sources GIS-Lab	**04**
3 GNF 6C	GIS Applications in Natural Resources and Agriculture-Lab	**04**
3 GNF 7C	Research Project Phase-I	**04**

3 GNF 5C: Open sources GIS-Lab

COs(Course Outcomes)

Upon completion of the course successfully, Students would be able to:

1. Learn about the Concepts and protocols used in Open Source GIS handling of advanced GIS tools.
2. students will be able to Introduction to Open source tool kit
3. Students will be able to work Open source database management.
4. Understand the multiple aspects of GIS software in Desktop and Web based environment.

***List of Practical/Laboratory Experiments/Activities etc.**

Itôs necessary to perform at least seven experiments from the list given below.

1. Perform with Open source tool kit ï Bhuvan
2. Perform with Open source tool kit ï USGS
3. Perform with Open source tool kit ï Openstreet map
4. Image -processing in Q-GIS Software
5. To preparation of thematic layers-onscreen from Satellite imagery-Road
6. To preparation of thematic layers-onscreen from Google imagery- Settlement, LULC.
7. To make network analysis for road features.
8. Layer creation on Google Earth Pro.
9. Spatiotemporal analysis.
10. Generating Map layer to KML
11. Generating KML to Shapefile
12. Problems of practicals based on Python/ HTML/ XML/JavaScript/ VBScript

Reference Books

1. Markus Neteler, Helena Mitasova (2007): Open Source GIS: A GRASS GIS Approach, Edition, Springer.
2. Neteler, M and H.Mitasova (2008) Open Source GIS. A GRASS GIS Approach, Kluwer Academic Publishers, Bostan, USA/London, UK.
3. Tyler Mitchell (2015). Web Mapping Illustrated: Using Open Source GIS Toolkits, O'Reilly; 1ed.
4. Qgis: https://www.packtpub.com/application-development/mastering-qgis.

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3 GNF 6C: GIS Applications in Natural Resources and Agriculture-Lab

Cos (Course Outcomes)

Upon completion of the course successfully, Students would be able to:

1. Students will be able to map earth natural resources.
2. Students can perform GIS based analysis for Agricultural management
3. Students can understand the utility management with respect to Natural recourses.
4. Students are able to use of geological skills with GIS domain for natural resources inventory

***List of Practical/Laboratory Experiments/Activities etc.**

Itôs necessary to perform at least seven experiments from the list given below.

1. Preparation of theme based map layers (of Soil, water and land) and integration, classification using standard color and symbol codes.
2. Spectro-radiometric survey of agriculture crops.
3. Determination of agricultural land acreage from the image data.
4. Delineation of watershed in different types.
5. To generation of natural resource maps for sustainable management.
6. Morphometric analysis
7. To prepare of water table map.
8. To prepare of Geomorphological map.
9. To prepare geological map.
10. To prepare Mineral recourses maps.
11. To prepare forest resources maps
12. Crop Pattern/ Crop yield/Crop Health estimation.

Reference Books

1. Fotheringham, S., and P. Rogerson, Ed. (1995): Spatial Analysis and GIS , Taylor & Francis, London, UK.
2. Sharon A. Clay (2019): GIS Applications in Agriculture, Volume Three Invasive Species
3. Ripple, William J. (ed.). (1994): The GIS Applications Book: Examples in Natural Resources: A Compendium , American Society for Photogrametry and Remote Sensing, Bethesda, Maryland.

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3 GNF 7C: Research Project Phase-I

COs(Course Outcomes)

Upon completion of the course successfully, Students would be able to:

1. Recognize research objectives and spatial challenges that lend themselves to GIS analysis.
2. Use tools for spatial analysis to obtain relevant data.
3. Construct eye-catching maps to convey study findings.
4. Become proficient with GIS programs with different software tools and techniques.

- The Individuals or Groups of students will be assigned to work on the project as per depth and area of project topic.
- It is mandatory for students to deliver the results of their projects in an organized manner at the last of respective semester ends with presentations.

Syllabus Prescribed for 2024-2025 Year
PG Programme : M.Sc. Geoinformatics Semester- IV

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
4 GNF 1C	DSC ï I .4 (DBMS and Advances in Geospatial Technologies)	60
4 GNF 2C	DSC ï II .4 (Web Mapping and Web GIS)	60
4 GNF 3C	DSC ï III .4 (GIS for Urban Planning and Infrastructure Development)	60
4 GNF 4A **OR** 4 GNF 4B	DSE ï IV .4A (Geoinformatics Applications in Water Resources Management) OR DSE ï IV 4B (GIS for Coastal Management)	60 60
4 GNF5C	(Advanced Geospatial data Processing GIS ï Lab)	60
4 GNF6C	Urban Development and Water Resources Management-Lab	60
4 GNF7C	Research Project Phase-II	--

4 GNF-1C: DBMS and Advances in Geospatial Technologies

COs (Course Outcomes)
After successfully completing the course, the students will be able to

1. Students are able to perform the applications of Database in GIS.
2. Students understand the concepts of problem solving, data flow, algorithms, schemas of various problems and database.
3. Students know the Normalization and Denormalization concepts of Data Base.
4. Students will understand about the SQL queries and its application for GIS.
5. Students are able to perform the Multi-criteria Decision Analysis with advanced GIS tools and techniques.

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Unit 1: Introduction to Database Management Systems: Data, Information, Database, Transaction and its desired properties, File Server Model, Client Server Model, Advantages of using DBMS over conventional methods, DBMS Features, Components of DBMS, Data Abstraction, Data Independence. — 10 Periods

Unit2 : Data Modeling: Logical and Physical Data Models, E-R Modeling, Record Based Models, Relational Model An overview, Relational Concepts, Tables, Keys, Constraints, Data Integrity and Constraints, Integrity Rules.
RDBMS: components, concept, database Spatial data input - Digitization, error identification. Errors: Types. — 10 Periods

Unit 3 :	Introduction to SQL: Introduction to SQL, SQL Features, SQL Operators, SQL Datatypes, SQL Parsing, Types of SQL Commands, Querying Data from the database, Correlated Sub-queries, Joins, Hierarchical Queries. Emerging trends Object Oriented databases, Object oriented queries.	10 Periods
Unit 4 :	Active databases Deductive databases concepts of next generation databases, XML, Data Warehouses Data Mining. Control Database access. Data Types, DDL, DML, DCL Constraints: Types of Constraints, Primary Key, Foreign Key, Check Constraint, Not Null, Altering Constraint, Concept of Backup recovery. Overview of Index.	10 Periods
Unit 5 :	Landuse/ Land cover change modeling; geographically weighted analysis; general suitability and multicriteria modeling; Artificial intelligence, FR, and AHP for GIS; time series analysis. introduction; benefits and challenges of satellite time series data; temporal composite methods.	10 Periods
Unit 6 :	Recent Trends: Location Based Services, Virtual Globe, Enterprise Resource Planning, SAP ERP. GeoAI; GeoGTP Tools; Introduction of Cloud Computing; Cloud Computing in GIS; Introduction to ETL and GIS ETL Tools.	10 Periods

Text Books

1. Abraham Silberschatz; Henry F Korth, (2002): Database System Concepts.
2. B.C. Desai (2005): An Introduction to Database Systems, Galgotia Publications, New Delhi.
3. Won Kim (1990): Introduction to Object-Oriented Databases.
4. James B. Campbell, Randolph H. Wynne, Valerie A. Thomas (2022). Introduction to Remote Sensing, Guilford Press, New York.

Reference Books

1. Elmasri,Ramez; Navathe, Shamkant B (2000): Fundamentals of Database Systems, Pearson,
2. Jan L Harrington (2000): Object Oriented Database Design Clearly Explained, Harcour.
3. Stefano Ceri; Giuseppe Pelagatti, Distributed Databases (2000): Principles and Systems, Universities Press.

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4 GNF-2C: Web Mapping and Web GIS

COs(Course Outcomes)
After successfully completing the course, the students will be able to

1. Learning cloud computing and Web-based GIS languages allows students to spatially visualize such datasets and present them in browsers.
2. Students can recognize current mechanisms for data dissemination and use online services to download the relevant geographic and non-spatial data.
3. Students will learn about the customize GIS software in ArcObjects, WebGIS and Image Processing.
4. Students will understand about the binding and creating Web Pages with GIS.
5. Students are able to perform the applications of Web based mapping.

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Unit 1:	Fundamentals of computer networking ï network environment ï network communication models ï protocols ï TCP/IP. Web GIS: Distributed GIS services and Internet GIS, Internet GIS networking foundations, web mapping's technical development, and commercial web mapping software The Google Earth Engine is introduced.	10Periods
Unit2 :	Web mapping ï static and interactive web mapping, collaborative web mapping. System and generic architecture of mobile geographic information systems Mobile GIS operating systems, wireless web, examples of mobile GIS applications, real-time applications, and mobile GIS customization.	10Periods
Unit 3 :	Distributed geographic information services ï principle ï components ï logic and data components. Server for ArcGIS ArcSDE: GIS Web Service, Web Application Functionality, and ArcGIS Server. Introduced, SDE Connection, Configuration Options for ArcSDE.	10Periods
Unit 4 :	Data storage for developers using SDE, SDE Geodatabase, Architecture for ArcSDE. Open Geospatial Consortium- Web Map Servers- WMS-, interoperable systems and non-interoperable systems- Web Feature Servers- Metadata standard.	10Periods
Unit 5 :	XML, Geographic Markup Language. Client/server computingï client/server system partition ï layered architecture ï advantages and disadvantages of client and server side architecture. Web GIS Service, OGC specifications for GIS web services (WMS, WFS, WCS, WPS, SLD etc.)	10Periods
Unit 6 :	Distributed component framework ï Web GIS Implementation: Web Map servers and Data servers, Configuration, layering, design of interfaces, Quality of Service and Security Issues in the Development of Web GIS - Performance, Security, Scalability. Applications of Web GIS in various sectors.	10Periods

Text Books:

1. Korte,G. B., (2001): The GIS book: 5th Edition, Onward press, Australia. Cartwright, W., M.P. Peterson, G. Gartner (Eds) Multimedia Cartography, Berlm: Springer.
2. Kraak,M., and A.Brown (2001): Web Cartography: Development and Prospects, London: Taylor and Francies.
3. Roland Billen, Elsa Joao, David Forrest (2006): Dynamic and Mobile GIS: Investigating Changes in Space and Time, CRC Pres

Reference Books:

1. Zhong-Ren Peng, Ming-Hsiang Tsou, Peng (2003): Internet GIS: Distributed Geographic Information Services for the Internet and Wireless Networks, John Wiley & Sons.
2. Jonathan Raper (2008): Mobile GIS: The Arcpad Way, Esri Pr; Illustrated edition
3. Kraak, M. and F. Ormeling (2003) Cartography: Visualization of Geospatial Data, Delhi: Pearson Education.

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4 GNF-3C: GIS for Urban Planning and Infrastructure Development

COs(Course Outcomes)
After successfully completing the course, the students will be able to

1. Students learn about urban land use models and their organization for planning
2. Students learns the flow of information through the networks in Geography
3. Students prepares a model for network and its interconnectedness to solve the problems in micro-level planning of amenities as well as infrastructure .
4. Students will learn through practical application of the water, sewage, social network, electrical, and telecommunication networks models.
5. Using GIS tools, students learn about the human, socio-economic, environmental, and mapping status.

Unit 1:	Urban and regional planning, Traffic and Parking Surveys, Urban Land Use Classification and Monitoring, GIS data modeling for urban design, Utility Planning, Integrated Development Planning, Urban Conservation, Transportation Planning and Land Information System	10 Periods
Unit2 :	GIS applications in Networks and Utility Management: Data representation, analysis and modeling (multi-dimensional GIS-T models), Applications and issues include spatial interaction models, Demography and urban governance: Population distribution mapping with categories, Crime zone mapping. .	10 Periods
Unit 3 :	GIS applications for managing urban environments include: air quality indexing and mapping, monitoring atmospheric haze, smoke, and toxic gas movement and identifying vulnerable zones, noise pollution zonation, natural resource inventory and management, vegetation and soil conservation, site suitability for groundwater recharge and rainwater harvesting, and urban area heat budgeting.	10 Periods
Unit 4 :	Utility Networks: Water and Electricity communications, sewage lines, and distribution. Environmental Impact Assessment (EIA) and management. GIS applications in Automated Mapping (AM) and Facility Management. Integrated development planning. Urban land conservation, transportation Planning.	10 Periods
Unit 5 :	The vehicle routing challenge, and the positioning of facilities. implication of Urban Form and Size on Services, Norms and Standards, National and Local guidelines ï Demand Strategy, Issues and tasks.	10 Periods
Unit 6 :	The Sewerage / Drainage Management, Solid Waste Management, roads and Street Lightings management. Effective System Analysis by using GIS ï Private and Public partnership and innovative concepts and practices in infrastructure Development.	10 Periods

Text Books:

1. Charles Redman, Maik Netzband, William L. Stefanov (2007): Applied Remote Sensing for Urban Planning, Governance and Sustainability.
2. Qihao Weng, Dale Quattrochi, Paolo Gamba (2018): Urban Remote Sensing.
3. Soergel Uwe (2010): Radar Remote Sensing of Urban Areas.

Reference Books:

1. Basudeb Bhatta (2010): Analysis of Urban Growth and Sprawl from Remote Sensing Data.
2. M. S. Nathawat, Arvind Chandra Pandey (2008): Geoinformatics for Decentralized Planning and Governance.
3. Nabeel Hamdi , Reinhard Goethert (1997): Action Planning for Cities: A Guide to Community Practice.

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4 GNF-4A: Geoinformatics Applications in Water Resources Management

COs(Course Outcomes)
After successfully completing the course, the students will be able to

1. Students are able to Understand local, State and regional policies as they apply to integrated water resource management by using GIS.
2. Students will able to perform water resources utilization by GIS techniques.
3. Students will learn about the impact of anthropogenic activities on water bodies.
4. Students will perform the groundwater quality and quantity based mapping.
5. Students are able to perform micro level planning for enhancement of water resources. .

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Unit 1:	Introduction: Hydrologic cycle, components of hydrologic cycle - processing and parameterization in hydrology; Water resource scenario in India, Water budget equation; World water balance; Global Fresh water resources.	10 Periods
Unit2 :	Groundwater, hydro geomorphology, Ground water potential assessment, groundwater prospect zones mapping, ground water modeling, ground water information system, planning and management of ground water. Geomorphic controls on the groundwater resources of Coastal, Island and hinterland terrains.	10 Periods
Unit 3 :	Spectral properties of water. Floods types; causes and mitigation measures, flooding potential zonation mapping, flood hazard assessment, flood risk analysis using RS and GIS, RS and GIS in Cyclone mapping and mitigation, Groundwater quality mapping. Ground and surface water interactions.	10 Periods
Unit 4 :	Irrigation management: Mapping and monitoring of catchments and command areas, land irrigability, soil irrigability mapping, irrigation canal alignment, crop norm violation, agriculture water demand estimation for different crops and tank information system.	10 Periods

Unit 5 :	Watershed management: Watershed- Drainage and water body mapping, morphometric analysis, classification, delineation and coding of watersheds, reservoirs sedimentations- watershed development planning, watershed prioritization, Watershed Information System; mapping drought-prone areas.	10 Periods
Unit 6 :	Digital surface modeling and flood hazard simulation. Wet land mapping, siltation mapping, optimum usage planning and management of irrigation water. Hydrological modeling. GIS applications in water resources development and management.	10 Periods

Text Books:

1. John G Lyon (2003): GIS for Water Resources and Watershed Management,CRC Press LLC.
2. K.Kovar & H.P. Nachtnebel, (1996): Application of Geographic Information Systems in Hydrology and Water Resources Management, International Association of Hydrological Sciences.
3. N.D. Mani (2005): Watershed Management: Principles, Parameters and Programmes, Dominant Publishers and Distributors, New Delhi.

Reference Books:

1. Lynn E.Johnson [2002] Geographic Information Systems in Water Resources Engineering, CRC Press LLC
2. Jain S.K and Singh V.P., 2003, Developments In Water Science ï Water Resources Systems Planning and Management, Antony Rowe Ltd
3. U.M.Shamsi, 2002, Water, Waste water and Storm Water Systems, American Society of Civil Engineers.

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4 GNF-4B: GIS for Coastal Management

COs(Course Outcomes)

After successfully completing the course, the students will be able to

- To enhance proficiency in advanced GIS techniques tailored to coastal environments, including spatial analysis, remote sensing, and geospatial modelling
- To learn to integrate diverse datasets, such as remote sensing imagery, bathymetric surveys, and socio-economic data, to support comprehensive coastal management strategies.
- To develop the ability to conduct independent research and apply GIS methodologies to address complex coastal management challenges, fostering innovation and critical thinking.
- To explore the role of GIS in informing coastal policies and decision-making processes, including land-use planning, ecosystem management, and disaster risk reduction.

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Unit 1:	Introduction to Coastal Management and GIS: Concepts, Challenges and Objectives; Applications Geographic Information Systems (GIS) in Coastal Management, Role of GIS in Coastal Zone Mapping, Analysis, and Decision Making.	10 Periods
Unit2 :	Coastal Environment and Geospatial Data: Coastal Environment: Physical, Biological, and Human Interactions, Geospatial Data Types for Coastal Management: Remote Sensing, GIS Datasets, Bathymetry, etc., Data Acquisition Techniques for Coastal Mapping: Remote Sensing	10 Periods

	Platforms, GPS Surveys, etc., Pre-processing and Integration of Geospatial Data for Coastal Analysis.	
Unit 3 :	Spatial Analysis Techniques for Coastal Management: Basics of Spatial Analysis: Overlay, Buffering, Interpolation, and Density Analysis, Advanced Spatial Analysis Techniques for Coastal Management: Network Analysis, Viewshed Analysis, etc., Application of Spatial Analysis in Coastal Hazard Mapping, Ecosystem Assessment, and Land Use Planning.	10 Periods
Unit 4 :	Coastal Monitoring and Modelling: Techniques for Coastal Monitoring: Satellite Remote Sensing, UAVs, Ground-based Sensors, etc., Introduction to Coastal Modelling: Hydrodynamic, Sediment Transport, and Coastal Erosion Models, Integration of GIS and Coastal Models for Predictive Analysis and Scenario Planning.	10 Periods
Unit 5 :	Participatory GIS for Coastal Stakeholder Engagement: Importance of Stakeholder Engagement in Coastal Management, Participatory GIS (PGIS) Methods and Tools for Community Mapping and Engagement, Techniques for Public Participation and Citizen Science in Coastal Projects, Practical Exercises on Conducting PGIS Workshops and Integrating Community Data into GIS.	10 Periods
Unit 6 :	Coastal Policy and Planning with GIS: Overview of Coastal Policy Frameworks: International Conventions, National Laws, and Regulations, GIS Applications in Coastal Policy Development, Implementation, and Monitoring, Coastal Planning Processes: Zoning, Resource Allocation, and Integrated Coastal Zone Management (ICZM), Group Projects on GIS-based Coastal Planning and Policy Analysis	10 Periods

Textbooks:

1. Longley, P. A., et al. (Year). Geographic Information Systems and Science.
2. Kamphuis, J. W. (Year). Introduction to Coastal Engineering and Management.
3. Parker, R. N., et al. (Year). GIS and Spatial Analysis for the Social Sciences: Coding, Mapping, and Modelling.
4. Fischer, M. M., &Getis, A. (Year). Spatial Analysis: Statistics, Visualization, and Computational Methods.
5. Davidson-Arnott, R. (Year). Introduction to Coastal Processes and Geomorphology.
6. Cicin-Sain, B., &Knecht, R. W. (Year). Integrated Coastal Zone Management: Concepts and Practices.

Reference Books:

1. Clark, J. R. Coastal Zone Management Handbook.
2. Wright, D. J., &Barlett, D. J. Marine and Coastal Geographical Information Systems.
3. Wolanski, E., Day, J. W., Elliott, M., & Ramesh, R. (Year). Coasts and Estuaries: The Future.
4. Olsen, R. C., et al. Remote Sensing and GIS for Coastal Ecosystem Assessment and Management.

5. Bartlett, D., & Smith, J. . Geographic Information Systems in Coastal and Marine Management.
6. Ciavola, P., & Coco, G. Coastal Dynamics.
7. Green, D. R., & Epperson, J. L. Coastal and Marine Geographic Information Systems.
8. Olamijuwon, E., &Zur, M. Participatory Geographic Information Systems: A Literature Review.
9. Thapa, B. Public Participation GIS: A Method for Identifying Local Knowledge.
10. Van Berkel, L. R., & Cartwright, W. Participatory Mapping: New Data, New Cartography.
11. Shaw, T. M., & Sewell, L. Coastal Governance.

DSE 4C - MOOC/Swayam Courses

1.Water Resources and Watershed Management by- Dr. Harish Gupta ,University College of Engineering,Osmania University, Hyderabad (https://onlinecourses.swayam2.ac.in/cec21_ge14/preview)

2. Availability and Management of Groundwater Resources by Prof. Prasoon Kumar Singh, IIT(ISM) Dhanbad. (https://onlinecourses.nptel.ac.in/noc24_ce106/preview)

3. Urban Utilities Planning : Water Supply, Sanitation and Drainage by Prof. Debapratim Pandit, IIT Kharagpur,(https://onlinecourses.nptel.ac.in/noc24_ar18/preview)

Programme: M.Sc. Geoinformatics (Semester-IV)

Code of the Course/Subject	Title of the Course/Subject (Laboratory/Practical/practicum/hands-on/Activity)	(No. of Periods/Week)
4 GNF 5C	Advanced Geospatial data Processing GIS -Lab	**04**
4 GNF 6C	Urban Development and Water Resources Management-Lab	**04**
4 GNF76C	Research Project Phase-II	**08**

4 GNF 5C: Advanced Geospatial data Processing GIS -Lab

COs(Course Outcomes)

Upon completion of the course successfully, Students would be able to:

1. Learn about the handling of advanced GIS tools.
2. Interpret various satellite imageries with advanced tools.
3. Students will be able to work with Web GIS tools.
4. Understand the multiple aspects of Geospatial analysis..

***List of Practical/Laboratory Experiments/Activities etc.**

Itôs necessary to perform at least seven experiments from the list given below.

1. Perform on Google Earth Engine
2. Perform on Internet GIS
3. Perform for web mapping
4. Perform on Mobile GIS
5. Handling of ArcGIS Server
6. Web Application Functionality
7. Handling of ArcGIS online
8. Principal Component Analysis
9. Fourier Transformation
10. Texture and Image Fusion
11. Advance Spatial Analysis-Multi-Criteria Analysis
12. Ground Radiometry-Data Collection, Data Integration and Analysis

Reference Books

1. ESRI (2003):Introduction to ArcGIS ï II, Course Lectures, GIS Education Solutions, RedlandsPress
2. Jonathan Raper (2008): Mobile GIS: The Arcpad Way, Esri Pr; Illustrated edition
3. Roland Billen, Elsa Joao, David Forrest (2006): Dynamic and Mobile GIS: Investigating Changes in Space and Time, CRC.
3. Zhong-Ren Peng, Ming-Hsiang Tsou, Peng (2003): Internet GIS: Distributed Geographic Information Services for the Internet and Wireless Networks, John Wiley & Sons.

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4 GNF 6C: Urban Development and Water Resources Management-Lab

COs(Course Outcomes)

Upon completion of the course successfully, Students would be able to:

1. Learn about the regional planning and its application.
2. Students are able to work with urban morphology and hierarchy processes for urban managemngt.
3. Students will be able to work with GIS tools for Urban Development, watershed management with surface and subsurface water bodies.
4. Understand the utilization of tools and techniques of RS and GIS for mankind..

***List of Practical/Laboratory Experiments/Activities etc.**

Itôs necessary to perform at least seven experiments from the list given below.

1. Perform With AHP (Analytical hierarchy process) methods to demarcate Groundwater Potential zones.
2. Perform on Machine Learning based models for Urban Utility Management
3. Uses of Artificial Intelligence tools with GIS platform to perform Urban management
4. Identification of Spectral Characteristics of water for groundwater quality parameters.
5. Identification of Spectral Characteristics of land surfaces for groundwater management.
6. Performance with GIS tools for Coastal management.
7. Drought assessment and Management with GIS and RS tools.
8. Perform for trend analysis (Urban Air Quality/ Rainfall pattern/Temperature)
9. Perform with Trends in urbanization and Urban morphology

Reference Books

1. Michael Law (2021) Getting to Know ArcGIS Pro 2.8 Fourth Edition, ESRI Press, U.S.A.
2. John G Lyon (2003): GIS for Water Resources and Watershed Management,CRC Press.
3. LLC.K.Kovar & H.P. Nachtnebel, (1996): Application of Geographic Information Systems.
4. Bedient, Philip B. and Huber, Wayne Charles 2002. Hydrology and Floodplain Analysis. Prentice Hall, Englewood Cliffs NJ.
5. Juliana Maantay, John Ziegler, John Pickles, GIS for the Urban Environment, Esri Press 2006.
6. Roland Fletcher, The Limits of Settlement Growth: A Theoretical Outline (New Studies in Archaeology) (First edition), Cambridge University Press; 2007.
7. Allan Brimicombe, GIS Environmental Modeling and Engineering, CRC; 1 edition 2003.

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4 GNF 7C: Research Project Phase-II

Cos (Course Outcomes)

On completion of the course successfully, students would be able to perform his skills in the multiple domain of Remote Sensing and GIS.

1. Students may carry out their internship project in an industry or any reputed academic/research institutes.
2. The internship project aims at giving the student an opportunity to participate and work in a substantive project activity.
3. Typically, the project helps the student to learn about work culture, business processes, technologies, marketing strategies, etc.
4. Under the institute project, the student takes up a research topic or participates in an Institute project under the guidance of a faculty member or project coordinator in respective departments. .
   The Research Project Report should be submitted both in print form and digital form.

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