JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech. in Minors in REMOTE SENSING AND GIS

COURSE STRUCTURE & SYLLABUS

Semester	Theory (Credits) (Which is not studied in regular course)	Total Credits
II Year II Sem	Concepts of Remote Sensing and GIS	3
II Year II Sem	GIS Laboratory	1
III Year I Sem	Geospatial Analysis and Research	3
III Year II Sem	Database Concepts and Web GIS	3
III Year II Sem	Remote Sensing Laboratory	1
IV Year I Sem	Drone Survey and Mapping	3
IV Year I Sem	Project/ Experiential Learning	4
	Total Credits	18

CONCEPTS OF REMOTE SENSING AND GIS

Course Code: 22CEM101

L	T	P	C
3	0	0	3

Course Outcomes: At the end of the course, the student will be able to:

CO1: Explain the principles of Remote Sensing
CO2: Differentiate types of sensors and satellites
CO3: Describe the principles of photogrammetry
CO4: Demonstrate the concepts and fundamentals of geographic information system
CO5: Apply the knowledge of RS and GIS in data analysis

UNIT-I

INTRODUCTION OF REMOTE SENSING:

History, Development, Definition, Concept & Principles, Electromagnetic Radiation (EMR) and Its Characteristics, Wavelength Regions and their Significance, Interaction of EMR with Atmosphere and Earth's Surface: Absorption, Reflectance and Scattering, Atmospheric Windows, Spectral Response and Spectral Signature.

Learning outcomes: At the end of the unit, the student will be able to

1. explain the importance of Remote Sensing in Civil Engineering
2. discuss the elements in Remote Sensing
3. describe the concepts of energy interactions with various features

UNIT-II

SATELLITES & SENSORS:

Spectral, Spatial, Temporal and Radiometric resolutions, Satellite and sensor characteristics of LANDSAT series, SPOT, IRS, High Resolution Satellite Systems. Visual interpretation keys - converging evidence.

Learning outcomes: At the end of the unit, the student will be able to

1. explain the various sensors in a satellite system
2. discuss the sensor characteristics
3. explain the factors that influence image interpretation

UNIT-III

PHOTOGRAMMETRY:

Introduction – principle and types of aerial photographs, Stereoscopy, Scale of a vertical aerial photograph, map Vs aerial photographs, mosaic, ground control, parallax measurements for height.

Learning outcomes: At the end of the unit, the student will be able to

1. explain the concepts of Photogrammetry
2. discuss the principles in Aerial Photo data capture
3. describe the overall process in photogrammetry

UNIT-IV

GEOGRAPHICAL INFROMATION SYSTEM:

Introduction, GIS categories, components of GIS, fundamental operations of GIS, A theoretical framework for GIS. Types of data representation- Data collection data input and output. Manual digitizing and scanning. GIS data file management; Layer based GIS, Feature based GIS mapping.

Learning outcomes: At the end of the unit, the student will be able to

1. explain the components and workflow of GIS

2. explain the methods to create GIS database
3. discuss the importance of data accuracy

UNIT-V

GEOSPATIAL DATA AND ANALYSIS:

Data storage – raster, vector and attribute data storage, Overview of the data manipulation and analysis. Integration of RS, GIS & GPS, Raster and Vector data Analysis, Integrated analysis of the spatial and attribute data.

Learning outcomes: At the end of the unit, the student will be able to

1. discuss the methods to store data in GIS
2. explain the GIS data models
3. explain the methods to integrate GIS, GPS and RS

Text Books:

1. Lillesand and Kiefer, "Remote Sensing and Image Interpretation", 5th Edition, published by John Wiley and Sons, 2008.
2. M.Anji Reddy, "Remote Sensing and Geographical Information systems", 3rd Edition, B.S.Publications, 2006.
3. A.M. Chandra, S.K. Ghosh, "Remote Sensing and Geographical Information System", Narosa Publishing house, 1st Edition, 2007.
4. Basudeb Bhatta, "Remote Sensing and GIS" Oxford University Press.

References:

1. Micheal N Demers, "Fundamental of GIS", 3rd Edition, John Wiley & Sons, 2008.
2. C.P.Lo Albert, K.W. Yonng, "Concepts & Techniques of GIS", 2nd Edition, Prentice Hall (India) Publications, 2008.
3. David P Paine, "Aerial Photography and Image Interpretation", 2nd Edition, published by Wiley, Higher Education, 2006.
4. Kang – Tsung chang, "Introduction to GIS", 4th Edition, TMH Publications & Co., 2007.
5. Ian Heywood, Sarah Cornelius, Steve Carver, "An Introduction to Geographical Information Systems", 1st Edition, Pearson Education Asia, 2000.
6. Bernhardsen, "Geographic Information Systems- An Introduction", 3rd Edition, Published by John Wiley Sons, 2006.
7. LRA Narayana, "Basics of Remote Sensing and its applications", Universities press, 1st Edition, 2001
8. Peter A Burrough and Rachael A, MC Donnell, "Principles of Geographical Information Systems", 1st Edition, Oxford Publishers, 1998.

GEOSPATIAL ANALYSIS AND RESEARCH

Course Code:	L	T	P	C
	3	0	0	3

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Explain the concepts of Geospatial database
CO2: Explain data analysis tools using Raster data
CO3: Explain data analysis tools using Vector data
CO4: Demonstrate the uses of 3D GIS
CO5: Describe the importance of geo spatial data in research

UNIT-I

GEO SPATIAL DATABASE:

Spatial and Non-Spatial data, Data Base Management Systems (DBMS), Components of DBMS, Functions of DBMS, Data abstraction models, Geodatabase model, Geospatial data standards

Learning outcomes:

At the end of the unit, the student will be able to

1. discuss the database concepts
2. explain the spatial and non-spatial data
3. discuss types of analysis

UNIT-II

RASTER ANALYSIS:

Raster Data & its Representation, Raster data models, Image processing -Preprocessing, post processing, Data Compression-block code, chain code, run length code, quadtree, MrSID, Surface analysis, Supervised and Un-Supervised classification.

Learning outcomes:

At the end of the unit, the student will be able to

1. explain the raster data structure
2. discuss about the data compression techniques
3. explain image classification

UNIT-III

VECTOR ANALYSIS:

Vector data representation, Vector data models, Topology, Geo Processing-Buffer, Intersect, Clip, Union, Dissolve, Neibourhood analysis, Network Analysis.

Learning outcomes:

At the end of the unit, the student will be able to

1. explain the vector data structure
2. discuss the concept of topology
3. discuss the Geo processing tools

UNIT-IV

MODELING AND ANALYSIS:

DEM Generation Surface Representation & Analysis-GRID, TIN, Terrain Analysis-Slope, Aspect, Hill shade, Relief, Applications of DEM/DTM.

Learning outcomes:

At the end of the unit, the student will be able to

1. explain the 3D GIS
2. differentiate between TIN and GRID
3. demonstrate applications using DEM/DTM

UNIT-V

GEO SPATIAL RESEARCH AND DATA SOURCES:

Geo-spatial Research Problems. National and International Projects: Past and Recent, Different types of Geo-spatial data requirement, USGS Global Visualization Viewer (GloVis), NASA Earth Observation (NEO), USGS Earth Explorer, ESA's Sentinel data, NOAA, IPMUS Terra, LANCE, VITO Vision, Bhuvan, MOSDAC, India-WRIS, Identification of problems at regional and Local level.

Learning outcomes:

At the end of the unit, the student will be able to

1. identify the research areas in Geo Spatial Technology
2. identify the data sources for research
3. discuss past and present research

Textbooks:

1. Lillesand and Kiefer, "Remote Sensing and Image Interpretation", 5th Edition, published byJohn Wiley and Sons, 2008.
2. M.Anji Reddy, "Remote Sensing and Geographical Information systems", 3rd Edition, B.S.Publications, 2006.
3. A.M. Chandra, S.K. Ghosh, "Remote Sensing and Geographical Information System", Narosa Publishing house, 1st Edition, 2007.
4. Basudeb Bhatta, "Remote Sensing and GIS" Oxford University Press

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1. Micheal N Demers, "Fundamental of GIS", 3rd Edition, John Wiley & Sons, 2008.
2. C.P.Lo Albert, K.W. Yonng, "Concepts & Techniques of GIS", 2nd Edition, Prentice Hall (India) Publications, 2008.
3. David P Paine, "Aerial Photography and Image Interpretation", 2nd Edition, published by Wiley, Higher Education, 2006.
4. Kang – Tsung chang, "Introduction to GIS", 4th Edition, TMH Publications & Co., 2007.
5. Ian Heywood, Sarah Cornelius, Steve Carver, "An Introduction to Geographical Information Systems", 1st Edition, Pearson Education Asia, 2000.
6. Bernhardsen, "Geographic Information Systems- An Introduction", 3rd Edition, Published by John Wiley Sons, 2006.
7. LRA Narayana, "Basics of Remote Sensing and its applications", Universities press, 1st Edition, 2001
8. Peter A Burrough and Rachael A, MC Donnell, "Principles of Geographical Information Systems", 1st Edition, Oxford Publishers, 1998.

DATABASE CONCEPTS AND WEB GIS

Course Code:

L	T	P	C
3	0	0	3

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Explain the concepts of Geo Spatial database

CO2: Explain about database models

CO3: Discuss the components of Web GIS

CO4: Discuss the basics of web development

CO5: Describe the importance open source Web GIS

UNIT-I

GEO SPATIAL DATABASE:

Spatial and Non-Spatial data, Data Base Management Systems (DBMS), Components of DBMS, Functions of DBMS, Data abstraction models, Geodatabase model, Geospatial data standards

Learning outcomes:

At the end of the unit, the student will be able to

1. discuss the database concepts
2. explain the components of DBMS
3. Discuss the Geospatial data standards

UNIT-II

DATABASE MODELS:

GIS data file management - Ordered sequential and indexed files, Database models - Hierarchical model, Network systems, Relational database models, Storage of GIS data- hybrid data model, integrated data model, Object based data models, entity relationship attribute model.

Learning outcomes:

At the end of the unit, the student will be able to

1. discuss the GIS data file management
2. explain the database models
3. explain storage of GIS data

UNIT-III

WEB GIS INTRODUCTION:

Definition, concept of Web GIS, History of Web GIS, components of web GIS, internet, web GIS v/s Internet GIS, Distributed GIS, users and stake holders of web GIS, advantages and limitations of web GIS.

Learning outcomes:

At the end of the unit, the student will be able to

1. explain the concepts of Web GIS
2. discuss the advantages and limitations of Web GIS

3. **explain** the history of Web GIS

UNIT-IV

BASICS OF WEB DEVELOPMENT:
HTML- The structure of an HTML document, Basic HTML Tags, HTML Tables, HTML Forms, Basics of CSS, Web mapping: static and interactive web mapping.

Learning outcomes:

At the end of the unit, the student will be able to

1. explain HTML forms
2. discuss basics of CSS
3. discuss the methods of web mapping

UNIT-V

OPEN SOURCE AND PROPRIETARY WEB APPLICATIONS:
Open source and proprietary web-based scripting and mapping environments, KML, GeoJSON, and other formats for drawing vector data in the browser, GeoServer, NSDI, Census GIS, BHUVAN, Crowd Sourcing.

Learning outcomes:

At the end of the unit, the student will be able to

1. discuss the open source web platforms
2. explain different formats for vector in web
3. Discuss GeoServer, BHUVAN

Textbooks:

1. M.Anji Reddy, “Remote Sensing and Geographical Information systems”, 3rd Edition, B.S.Publications, 2006.
2. Kraak, M. and Brown, A. Web Cartography: Development and Prospects, Taylor and Francis,London, 2001.
3. Tereshenkov, A., Web GIS Application in Local Government, VDM Verlag, 2009.

References:

1. Micheal N Demers, “Fundamental of GIS”, 3rd Edition, John Wiley & Sons, 2008.
2. C.P.Lo Albert, K.W. Yonng, “Concepts & Techniques of GIS”, 2nd Edition, Prentice Hall(India) Publications, 2008.
3. Peter A Burrough and Rachael A, MC Donnell, “Principles of Geographical InformationSystems”, 1st Edition, Oxford Publishers, 1998.
4. Pinde Fu and Jiulin Sun, Web GIS: Principles and Applications, ESRI Press, 2011
5. Maximiliano Firtman., jQuery Mobile: Up and Running, O'Reilly, 2012

DRONE SURVEYING AND MAPPING

Course Code:	L	T	P	C
	3	0	0	3

Course Outcomes:

At the end of the course the student will be able to:

CO1: Explain the fundamentals of Drone surveying

CO2: Describe the Methods of Surveying with Drone

CO3: Explain the concepts of Image processing and Photogrammetry

CO4: Explain Modeling with Drones

CO5: Discuss about Drone applications

UNIT-I

INTRODUCTION ON DRONES:

Introduction to Drones, History of Drone/UAS/UAVs, payload, battery life, Specs for good results, Regulations of DGCA and Drone license, Pre and Post Flight planning- Flight execution and photography, data collection

Learning outcomes:

At the end of the unit, the student will be able to

1. explain the components in Drone
2. discuss about flying regulations
3. explain the flight plan

UNIT-II

SURVEYING WITH DRONE:

Consideration for hardware selections, comparison on surveying drone and its accuracy, Techniques of controlling errors, Consideration of GCP in vertical and horizontal accuracies, Planning and estimation of drone surveying jobs, Autonomous flight vs. manual and hybrid flight profiles

Learning outcomes:

At the end of the unit, the student will be able to

1. explain drone hardware
2. describe about drone applications and accuracy
3. explain the planning process in Drone Surveying

UNIT-III

IMAGE PROCESSING AND PHOTOGRAMMETRY:

Aerial Triangulation, post processing softwares, Analyzing Data, Contouring, DEM, DSM, Cut, Fill, and Volumetric Measurement Calculation and orthophoto generation.

Learning outcomes:

At the end of the unit, the student will be able to

1. discuss the software workflow
2. explain the terrain data extraction
3. describe the process of orthophoto generation

UNIT-IV

MAPPING AND MODELING:

Introduction to mapping and modeling concepts, Understanding RTK, PPK and GCP's, Overview of popular data processing software platforms and functions.

Learning outcomes:

At the end of the unit, the student will be able to

1. explain the concepts of mapping
2. describe the concepts of RTK and GCP
3. explain drone data processing

UNIT-V

APPLICATIONS:

Application of drone for Surveying & Mapping-Construction, Irrigation and Agricultural, Engineering Land Survey and Transportation.

Learning outcomes:

At the end of the unit, the student will be able to

1. discuss the applications of drones in construction
2. explain the role of drones in irrigation and agriculture
3. explain drone role in land survey

TEXT BOOKS:

1. Lillesand and Kiefer, "Remote Sensing and Image Interpretation", 5th Edition, published byJohn Wiley and Sons, 2008.
2. One Nation Under Drones: Legality, Morality, and Utility of Unmanned Combat Systems byJohn E. Jackson.
3. A.M. Chandra, S.K. Ghosh, "Remote Sensing and Geographical Information System", NarosaPublishing house, 1st Edition, 2007.

REFERENCES:

1. David P Paine, "Aerial Photography and Image Interpretation", 2nd Edition, published byWiley, Higher Education, 2006.
2. Drones and Support for the Use of Force by James Igoe Walsh.

GIS LABORATORY

Experiments

1. Software Interface and Data Loading

Launch QGIS; add vector (shapefiles: roads, boundaries) and raster layers. Explore toolbars, zoom/pan; save project. Output: Layer-stacked map view.

2. Symbology and Map Layout

Symbolize layers (graduated colors for population); add legend, scale bar, north arrow in Print Layout. Export PDF. Focus: Visual hierarchy.

3. Attribute Queries and Selection

Query roads by length/type (Select by Expression: "length" > 5000 AND "type" = 'paved'). Export selection; compute statistics. Output: Filtered layer.

4. Digitization of Features

Trace points (wells), lines (rivers), polygons (parcels) over imagery. Snap/edit vertices; add attributes. Output: New editable shapefile.

5. Map Projections and Reprojection

Check CRS (e.g., WGS84 to UTM 43N); reproject layers. Overlay for alignment check. Output: Consistent projection map.

6. Georeferencing Scanned Maps

Place 10+ GCPs on scanned toposheet; apply polynomial warp (RMSE <0.5). Output: Georeferenced raster overlaid on basemap.

7. Buffering and Proximity Analysis

Buffer schools (500m); union with zones. Calculate overlap areas. Output: Accessibility heatmap.

8. Overlay Operations

Intersect land use with flood zones; dissolve boundaries. Output: Risk polygons with area stats.

9. Spatial Joins and Table Management

Join census CSV to boundaries; calculate per-capita fields. Output: Enriched attribute table/map.

10. Choropleth and Thematic Mapping

Normalize data (density choropleth); classify 5 breaks. Output: Print-ready population density map.

11. Raster Analysis Basics

Convert vectors to raster; resample elevation DEM. Output: Slope/aspect derivatives.

12. Basic Topology and Validation

REMOTE SENSING Laboratory

Experiments

1. Image Display and Band Composites

Open Landsat/Sentinel bands in ENVI/QGIS. Create RGB (true: 4-3-2; false: 5-4-3). Output: Composite images with profiles.

2. Grayscale and Pseudo-Color Enhancement

Stretch single bands (linear/histogram equalize); apply pseudo-color ramps. Output: Enhanced grayscale views.

3. Geometric Correction (Orthorectification)

Select GCPs (20+); warp subscene (cubic convolution). Output: RMSE report; basemap overlay.

4. Radiometric Correction

Correct haze (dark object subtraction); normalize multi-date images. Output: Histogram-matched pairs.

5. Image Subsetting and Layer Stacking

Subset ROI (Hyderabad); stack bands into multi-band file. Output: Cropped, stacked imagery.

6. Vegetation Indices (NDVI, NDWI)

Raster calc: (NIR-Red)/(NIR+Red). Threshold classify. Output: Binary vegetation map.

7. Unsupervised Classification (K-Means)

Cluster 5-10 classes on stacked image. Output: Land cover map; statistics table.

8. Supervised Classification (Maximum Likelihood)

Train 5 classes (signatures); classify/validate. Output: Classified raster with confusion matrix.

9. Change Detection (Post-Classification)

Compare two dates (2024-2025); matrix of from-to changes. Output: Change map (urban growth).

10. Edge Detection and Filtering

Apply directional filters (Sobel); focal statistics (mean/median). Output: Enhanced edges/textures.

11. Accuracy Assessment

Generate 50 random points; error matrix from ground truth. Output: Kappa coefficient report.

12. Principal Component Analysis (PCA)

Transform bands to PCs; select PC1-3 for composite. Output: Noise-reduced PCA image; eigenvalue table.