GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering
Level: UG
Branch: Environmental Engineering
Subject Code: BE04013041
Subject Name: Basics of Remote Sensing and GIS

w. e. f. Academic Year:	2025-26
Semester:	4
Category of the Course:	Professional Core Course

Prerequisite:	Familiarity with fundamental scientific principles, particularly those related to physics (e.g., electromagnetic spectrum), would also aid in grasping the course material more effectively.
Rationale:	This course teaches geospatial technologies—a crucial set of modern tools. It combines Remote Sensing (collecting data from a distance), GIS (organizing and analyzing that data), and GNSS (pinpointing locations) which give students a strong foundation to acquire and interpret spatial data for real-world applications, such as environmental management and resource monitoring. The course requires a basic understanding of geography and computers, but no specific prerequisites are listed.

Course Outcomes:

Sr. No.	CO statement	Marks% weightage
CO-1	Understand the fundamental concepts of remote sensing, including the electromagnetic spectrum, the remote sensing process, and the types of sensor resolutions.	17%
CO-2	Describe the principles of aerial photography, photographic scale, and various digital imaging techniques, including thermal remote sensing.	17%
CO-3	Explain the working principles of GNSS, identify sources of error, and understand the importance and process of collecting ground truth data.	23%
CO-4	Apply remote sensing techniques to analyze and monitor environmental phenomena, land use, and natural resources like oceans, agriculture, forestry, and water.	20%
CO-5	Describe the core components and data models of GIS, and apply fundamental cartographic principles related to maps, coordinate systems, and projections.	23%

Teaching and Examination Scheme:

Teaching / Learning Scheme (in Hours per semester)					Total Credits	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	PBL*	Total no of hours per semester		ESE (E)	PA / CA (M)	PA/CA (I)	PBL (I)	ESE (V)	
30	30	00	30	90	03	70	30	20	30	0	150

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, ESE = End-Semester Examination, PA = Progressive Assessment

Content:

Sr. No.	Content	Total Hrs
1	**Introduction** Remote Sensing, Electromagnetic Radiation and Radiation Principles, Remote Sensing Process, Types of Remote Sensing, Concept of Swath and Nadir, Sensor Resolutions (Spatial, Spectral, Temporal, and Radiometric Resolution), Advantages and Limitations of Remote Sensing	05
2	**Fundamental of Photographic and Digital Imaging** Geometry of Aerial Photography, Photographic Scale, Area Measurement, Image Scanning Techniques (Across and along track scanning), Thermal Remote Sensing and Other Sensors	05
3	**Global Navigation Satellite System (GNSS)** Satellite based Navigation and Positioning System, Functional Segment of GPS, Working Principle of GPS, Errors of GPS, Differential GPS, Applications of GNSS, Introduction of Ground truth data, Requirement of Ground truth data, Instrumentation, Parameters of Ground truth data, Factors affecting Spectral Measurement.	07
4	**Application of Remote Sensing** 1. Environmental Impact Assessment, a. Landuse and landcover change and mapping 2. Ocean and Coastal Monitoring a. Ocean features, color and phytoplankton Concentration b. Measurement of SST c. Oil Spill Detection d. Sea Surface Height e. Ship Routing f. Sea Ice 3. Agricultural and Forestry a. Crop Mapping and Monitoring b. Forest burn mapping c. Deforestation d. Species Identification 4. Hydrology a. Flood Delineation and mapping b. Soil moisture c. Groundwater prospects and recharge	06
5	**Concept of GIS** Introduction to GIS, Key Components of GIS, functions of GIS, advantages of GIS, functional requirement of GIS, Applications of GIS, Introduction to Data Models: Spatial and Raster Data model, Maps – Orientation, Scale, Accuracy and Resolution of Maps, Classification of Maps, Coordinate System, Concept of Spheroid, Geoid, and Datum, Concept of Map Projection, Introduction to GIS software: QGIS	07
	TOTAL	30

Suggested Specification table with Marks (Theory): (For B.E. only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
40	**50**	**10**	**00**	**00**	**00**

R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Remote Sensing and GIS by Basudeb Bhatta, Oxford Publication, 2013
2. Geoinformatics for Environmental Management by M Anji Reddy, B S Publications
3. Introduction to Remote Sensing, (5^{th} Ed.), The Guildford Press, New York, 2012
4. Crackn ell, A.P., Introduction to Remote Sensing, (2^{nd} Ed.), Tylor & Francis, London, 1991
5. Lillesand, T.M., Remote Sensing and Image Interpretation, (5^{th} Ed.), John Wiley & Sons, 2007.

List of Tutorials:

1. Fundamentals of the Electromagnetic Spectrum and Remote Sensing Process
2. Differentiating Sensor Resolutions: Spatial, Spectral, Temporal, and Radiometric
3. Geometry of Aerial Photography and Calculation of Photographic Scale
4. Introduction to Thermal Remote Sensing and Other Sensor Types
5. Working Principle and Functional Segments of GPS
6. Understanding Errors in GNSS and the Concept of Differential GPS (DGPS)
7. Application of Remote Sensing in Environmental Monitoring and Impact Assessment
8. Application of Remote Sensing in different sectors (Agriculture, Forestry, Ocean and Coasts)
9. Key Components of GIS and Differences Between Vector and Raster Data Models
10. An Overview of Coordinate Systems, Datums, and Map Projections

Major Equipment:

Hand held GPS

List of Open-Source Software/Learning website:

1. NPTEL MOOC Course (https://nptel.ac.in/)
2. Google Map (https://maps.google.com)
3. Google Earth (https://earth.google.com)
4. QGIS (https://qgis.org)

List of suggested activities for Problem Based Learning:

Sl. No.	Name of the activity	No. of hours	Evaluation Criteria
1.	**NPTEL Video Lecture**: Rudiments of Remote Sensing and Advantages: Lecture 01 to 05* **Link:** https://nptel.ac.in/courses/105107201	Video = 05, Report and test = 03, Total = 08	Summarizing lectures in form of the report MCQ based test
2.	**NPTEL Video Lecture**: Laws of Radiation and their relevance in Remote Sensing: Lecture 06 to 10* **Link:** https://nptel.ac.in/courses/105107201	Video = 05, Report and test = 03, Total = 08	Summarizing lectures in form of the report MCQ based test
3.	**NPTEL Video Lecture**: Digital Image Processing: Module 03 to 04* **Link:** https://nptel.ac.in/courses/105108077	Video = 05, Report and test = 03, Total = 08	Summarizing lectures in form of the report MCQ based test
4.	**NPTEL Video Lecture**: Digital Image Processing: Module 05* **Link:** https://nptel.ac.in/courses/105108077	Video = 05, Report and test = 03, Total = 08	Summarizing lectures in form of the report Online MCQ based test
5.	**Case Study on Application of Remote Sensing:** Research and prepare a case study report on the applications of remote sensing in Ocean and Coastal monitoring.	Research = 05, Report = 03, Total = 08	Prepare report and present poster on case study
6.	**Case Study on Application of Remote Sensing:** Research and prepare a case study report on the applications of remote sensing in Environmental Impact Assessment.	Research = 05, Report = 03, Total = 08	Prepare report and present poster on case study
7.	**Case Study on Application of Remote Sensing:** Research and prepare a case study report on the applications of remote sensing in Agricultural and Forestry.	Research = 05, Report = 03, Total = 08	Prepare report and present poster on case study

8.	**Case Study on Application of Remote Sensing:** Research and prepare a case study report on the applications of remote sensing in Hydrology.	Research = 05, Report = 03, Total = 08	Prepare report and present poster on case study
9.	**Aerial Photo Scale Calculation** Find a freely available aerial photograph and calculate its scale and area using provided reference data points.	Calculation = 04, Report = 02, Total = 06	A report showing the step-by-step calculations for scale and area, along with the results.
10	**Thermal Imaging Analysis:** Explore principle and application of thermal remote sensing in environmental monitoring and different sectors.	Exploration and Preparation = 05, Presentation = 03, Total = 08	A technical presentation with images and charts demonstrating how thermal data is used to identify environmental monitoring
11.	**GNSS Data Collection:** Use a smartphone GPS application to collect position data at multiple points within your city and develop a network between points.	Digital Data collection = 04, Network analysis = 03, Total = 07	A report detailing the data collection process, and a discussion of network analysis.
12.	**Differential GPS Research:** Prepare a comprehensive report on the working principle of Differential GPS (DGPS) and its practical applications in surveying and navigation.	Research = 06, Report = 03, Total = 09	A detailed report explaining DGPS technology, its benefits, and specific real-world use cases with illustrations.
13.	**Land Use/Land Cover Mapping:** Use a free online tool like Google Earth Engine to create a simple land use/land cover map of a selected area and analyze changes over time.	Software work = 06, Report = 04, Total = 10	A report with a final map, showing a change detection analysis and a brief summary of the findings.
14.	**GIS Data Models:** Use a free GIS software to create and differentiate between vector and raster data layers for a small study area.	Software work = 05, Report = 03, Total = 08	A report with screenshots demonstrating the creation of vector and raster data, and an explanation of their differences and uses.

15.	**Map Projections Analysis:** Research the concepts of datum, spheroid, and map projections. Compare the characteristics of at least two common map projections	Research = 05, Report = 02, Total = 07	A report that defines key terms and compares two map projections based on their distortion properties (area, shape, distance, direction) and common applications.

*You may explore other open-source online videos available on other education platforms and perform self-learning exercises 1 – 4.

Note:

- All the suggested activities should be related to the subject.
- The number of hours is suggestive. Faculty can sub-divide the number of hours based on the activity.
- Rubrics for the evaluation can be prepared by the faculty.
- All records pertaining to the evaluation and assessment of self-learning activities must be properly
- maintained and preserved at the institute level. These records should be made available to the university upon request.
- Institutes are encouraged to utilize digital platforms, such as Microsoft Teams, for effective record-keeping and to ensure transparency in the evaluation and assessment of self-learning activities.

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