R25 - Course Structure
&
Syllabus
M.TECH. REMOTE SENSING
(APPLICABLE FOR BATCHES ADMITTED FROM 2025-2026)

Jawaharlal Nehru Technological University Kakinada
Kakinada, Andhra Pradesh, INDIA-533003.
www.jntuk.edu.in

I Semester

S. No	Course Title	L	T	P	C
1	Principles of Remote Sensing	3	1	0	4
2	Principles of Geographical Information System	3	1	0	4
3	Python & Java Script	3	1	0	4
4	**Program Elective – I**	3	0	0	3
	Earth Systems				
	Global Navigational Satellite System				
	Space Science & Technology				
	Water Resources Management				
5	**Program Elective – II**	3	0	0	3
	Geo-Statistical Methods				
	Geospatial Systems & Security				
	Disaster Management - Framework				
	Agriculture & Soil Resource Management				
6	Visual Interpretation Laboratory	0	1	2	2
7	Geographical Information System Laboratory	0	1	2	2
8	Seminar-I	0	0	2	1
	TOTAL	15	5	6	23

II Semester

S. No	Course Title	L	T	P	C
1	Digital Image Processing	3	1	0	4
2	Advanced Remote Sensing	3	1	0	4
3	Remote Sensing & GIS Applications	3	1	0	4
4	**Program Elective – III**	3	0	0	3
	Principles of Geodatabase				
	Geospatial Data Processing and Modelling				
	Soft Computing Techniques				
	Environmental Planning & Impact Assessment				
5	**Program Elective – IV**	3	0	0	3
	Web & Mobile GIS				
	Coastal Zone Management				
	Drone Technology and Applications				
	Urban & Regional Planning				
6	Digital Image Processing Laboratory	0	1	2	2
7	Geospatial Simulation Laboratory	0	1	2	2
8	Seminar-II	0	0	2	1
	TOTAL	**15**	**5**	**6**	**23**

III Semester

S. No	Course Title	L	T	P	C
1	Research Methodology and IPR / *Swayam 12 week MOOC course – RM&IPR*	3	0	0	3
2	Summer Internship/ Industrial Training (8-10 weeks)*	-	-	-	3
3	Comprehensive Viva[#]	-	-	-	2
4	Dissertation Part – A[$]	-	-	20	10
	TOTAL	**3**	**-**	**20**	**18**

* *Student attended during summer / year break and assessment will be done in 3rd Semester.*

[#] *Comprehensive viva can be conducted courses completed upto 2nd Semester.*

[$] *Dissertation – Part A, internal assessment*

IV Semester

S. No	Course Title	L	T	P	C
1	Dissertation Part – B[%]	-	-	32	16
	TOTAL	**-**	**-**	**32**	**16**

[%] *External Assessment*

I Semester	**PRINCIPLES OF REMOTE SENSING**	L	T	P	C
		3	1	0	4

COURSE LEARNING OBJECTIVES

This course aims to make the students:

CLO-1 Introduce the physical principles of Remote Sensing and Photogrammetry as a tool for mapping

CLO-2 To familiarize data products, their properties and methods of preparing thematic information.

CLO-3 Enhance their knowledge about optical, thermal and microwaves based Remote Sensing concepts.

COURSE OUTCOMES

After completion of course, students would be able to:

CO1 Analyse the energy interactions in the atmosphere and earth surface features

CO2 Identify the earth surface features from satellite images

CO3 Select the type of remote sensing technique / data for required purpose

CO4 Acquire knowledge about concepts of remote sensing, sensors and their characteristics

CO5 Acquire knowledge in basic concepts of photogrammetry and mapping method

COURSE SYLLABUS

Unit 1 : PHYSICS OF REMOTE SENSING

Sources of Energy, Active and Passive Radiation, Electromagnetic Radiation - Reflectance, Transmission, Absorption, Thermal Emissions, Interaction with Atmosphere, Atmospheric windows, Interaction with Earth's surface features, Spectral reflectance of Earth's surface features, Multi concept of Remote Sensing.

Unit 2 : SATELLITES PLATFORMS

Types of Platforms, Active and Passive Systems, Imaging and Non-Imaging Systems, Resolutions in Remote Sensing - Spatial, Spectral, Radiometric and Temporal, Satellite orbits, Scanning mechanism, Ground truth data collection Instruments.

Unit 3 : EARTH OBSERVATION SATELLITES

LANDSAT, SPOT, IRS, MODIS, IKONOS, Cartosat, Oceansat, SeaSat, RISAT, RADARSAT, ASTER, SRTM, NOAA, Geoeye, Kompsat, Worldview II & III and Other recent satellites and their application potential;

Image Interpretation Techniques: Visual image interpretation techniques and applications of LU/LC, Geology and water resources.

Unit 4 : TYPES OF REMOTE SENSING

Thermal Remote Sensing: Introduction, Thermal sensors and characteristics, emissivity, thermal inertia, Interpretation of thermal images; Microwave remote sensing: Introduction, Definitions, Wavelengths, Types of Sensors and platforms, SLAR, Geometry of radar Images; Hyperspectral Remote Sensing: Introduction, Spectral cube, Hyperspectral image analysis.

Unit 5 : PHOTOGRAMMETRY

Introduction- Types of photographs, Geometry of vertical photographs, Scale of a vertical photograph over flat terrain, over variable terrain – average photo scale, methods of determining scale of vertical photographs, Flying height of a vertical photograph, Stereoscopic viewing of Vertical photographs – depth perception; overlap, side lap; flight planning; vertical exaggeration - factors involved.

Textbooks:

1. George Joseph. "Fundamentals of remote sensing". Universities Press, 2005.
2. James B. Campbell , Randolph H. Wynne, "Introduction to Remote Sensing" - The Guilford press, 5th edition, 2011.
3. Floyd F Sabins Jr,. "Remote Sensing: Principles and Interpretation", W.H.Freeman & Co., New York, 3rd edition, 1997
4. Thomas Lillesand, Ralph W. Kiefer, Jonathan Chipman "Remote sensing and image interpretation" John Wiley & Sons, New York, 2015..
5. Paul R. Wolf, Elements of Photogrammetry, McGraw-Hill Science, 2001, ISBN 0070713464, 9780070713468

References:

1. John A. Richards and Xiuping Jia. "Remote Sensing Digital Image Analysis: An Introduction" (2006).
2. John R. Jensen "Remote Sensing of the Environment: An Earth Resource Perspective" Pearson Education India; 2ed (2013)
3. Fawwaz T. Ulaby, Richard K. Moore, and Adrian K. Fung. "Microwave remote sensing active and passive." Vol. 1,2 and 3, Addison – Wesley Publication Company, (2015)
4. Manual of Remote Sensing: American Society of Remote Sensing and Photogrammetry, Virginia, USA

I Semester	PRINCIPLES OF GEOGRAPHIC INFORMATION SYSTEM	L	T	P	C
		3	1	0	4

COURSE LEARNING OBJECTIVES

This course aims to make the students:
 CLO-1   Introducing the students to the basic concepts of GIS and making the students familiar with the spatial data and spatial analysis techniques
 CLO-2   To familiarize data models and data structures in GIS and to introduce various Raster and Vector Analysis capabilities.
 CLO-3   To expose the concept of quality and design of cartographic outputs in open GIS environment.

COURSE OUTCOMES

After completion of course, students would be able to:
 CO1   Analyse the basic components of GIS
 CO2   Classify the maps, coordinate systems and projections
 CO3   Process spatial and attribute data and prepare thematic maps
 CO4   Perform Spatial Querying & Analysis
 CO5   Conceptualization of GIS project

COURSE SYLLABUS

Unit 1 :   FUNDAMENTALS:
Geographical Information System - Definition, – History and Developments, Map –analysis with paper based maps - limitations, Advantages of digital maps, Mapping concepts - Grid Systems for Mapping, Map Abstraction, Thematic maps, Projections and Coordinate systems, Spatial Elements, Spatial Measurement Level, Spatial Location and Reference, Spatial Patterns, Geographic Data Collection.

Unit 2 :   GIS MODELS
Data Models – Representation of geographical space, concept of Tessellation, Spatial and Non-spatial data, Data Collection and Input, Vector data models, Raster Data Models, Data compression techniques, Data Conversion between Raster and Vector, Metadata, file formats for Raster and Vector

Unit 3 :   GIS DATABASE
Database Management – Data storage, Files, Database Structures models - Hierarchical Data Structures, Network Systems, Relational Database Management Systems, OODBMS, Standard Data Formats, Compression Techniques.

Unit 4 :   GIS ANALYSIS
Spatial Analysis - Proximity Analysis - buffering, Thiessen polygon, Overlay Analysis - overlay operations, Network Analysis- optimal routing, Digital Elevation Models, Attribute data Analysis-concept of SQL queries. Map composition, Preparation of qualitative and

quantitative maps, levels of maps, map elements and map scales.

Unit 5 :   GIS PROJECT PLANNING

GIS Project Planning and Implementation – Understanding the Requirements, Phases of Planning, Specifications, Procedure for analysis projects and design projects.

Textbooks :

1. Michael N Demers, "Fundamental of GIS", John Wiley & Sons Inc, 4ed, 2008
2. Kang Tsung Chang., "Introduction to Geographic Information Systems", Tata McGraw Hill Publishing Company Ltd, New Delhi, 2008.
3. Burrough, P.A., "Principles of GIS for Land Resource Assessment", Oxford Publications, 2005.
4. C.P.Lo & Albert K. W.Yeung, "Concepts and Techniques of Geographic Information Systems", Prentice Hall India Pvt.Ltd, 2002

References :

1. Jeffrey Star and John Estates, "Geographic Information System- An Introductory", Pretence Hall Inc.
2. Marble, D.F and Calkins, "Basic Readings in Geographic Information System", H.W – Spad Systems Ltd.
3. A.M.Chandra & S.K. Ghosh "Remote Sensing and GIS". Narosa Publishing House, New Delhi. 2000.

I Semester	PYTHON & JAVA SCRIPT	L	T	P	C
		3	1	0	4

COURSE LEARNING OBJECTIVES

This course aims to make the students:

CLO-1 Understand core programming concepts using Python and JavaScript.

CLO-2 Develop skills in data manipulation, file handling, and web development.

CLO-3 Build interactive web applications using modern tools and frameworks.

COURSE OUTCOMES

After completion of course, students would be able to:

CO1 Write Python programs using control structures, functions, and file operations.

CO2 Apply advanced Python features like OOP, exceptions, and Flask.

CO3 Create interactive web pages using JavaScript and DOM manipulation.

CO4 Use asynchronous JavaScript and APIs for dynamic content.

CO5 Build full-stack applications integrating Python and JavaScript.

COURSE SYLLABUS

Unit 1 :   FOUNDATIONS OF PYTHON PROGRAMMING

Introduction to programming concepts and Python's role. Setting up the Python development environment. Python syntax and basic data types (variables, strings, numbers).Control structures: if statements and loops (while, for).Input and output handling in Python.

Unit 2 :   CORE PROGRAMMING CONCEPTS AND DATA MANIPULATION

Functions: definition, parameters, return values, and scope. Lists and Tuples: creation, indexing, slicing, and methods. String manipulation and formatting. File handling: reading, writing, and working with files. Comprehensive exercises combining functions and data manipulation.

Unit 3 :   ADVANCED PYTHON CONCEPTS

Dictionaries and Sets, key-value pairs, unique elements, and methods.

Exception handling: try-except blocks, raising exceptions. Introduction to modules and libraries. Introduction to object-oriented programming (OOP) concepts. File handling in Python: reading and writing files. Error handling and exceptions in Python. Introduction to web development concepts. Creating simple web pages using HTML and CSS.

Introduction to Flask: Building a basic web application with Python

Unit 4 :   JAVASCRIPT FUNDAMENTALS

DOM Manipulation and Event Handling: Introduction to JavaScript and its role in web development. Setting up the development environment for JavaScript. JavaScript syntax and basic data types (variables, strings, numbers). Control structures: if statements and loops (while, for). Basic input and output in JavaScript. Introduction to the Document Object Model (DOM). Selecting and manipulating DOM elements using JavaScript. Event listeners and handling user interactions. Creating interactive web pages with JavaScript. Practical

exercises combining DOM manipulation and event handling

Unit 5 :   ADVANCED JAVASCRIPT CONCEPTS

Functions: definition, parameters, return values, and scope. Asynchronous JavaScript: callbacks, promises, and async/await. Fetching data from APIs using JavaScript. Introduction to frontend frameworks, Building a dynamic web application using JavaScript.

Textbooks :

1. McClain, B. P. (2022). Python for geospatial data analysis: theory, tools, and practice for location intelligence. " O'Reilly Media, Inc.".
2. Evan Quest (2025) GIS PROGRAMMING USER GUIDE: A Practical Guide to Python, JavaScript, Web Mapping, Spatial Databases, and Automation for Real-World Geospatial Solutions.
3. Matthes, E. (2015). Python   Crash   Course: A   Hands-On, Project-Based Introduction   to Programming. United States: No Starch Press.
4. Haverbeke, M. (2018). Eloquent javascript: A modern introduction to programming. No Starch Press.
5. Quigley, E. (2010). JavaScript by Example. United States: Pearson Education.

References :

1. https://www.w3schools.com/python/
2. https://www.freecodecamp.org/news/learn-javascript-full-course/

I Semester	EARTH SYSTEMS	L	T	P	C
		3	0	0	3

COURSE LEARNING OBJECTIVES

This course aims to make the students:

CLO-1 Provide a comprehensive understanding of Earth's physical, chemical, and biological processes, including earth materials, geologic time, and plate tectonics

CLO-2 Exposed to various Erosional and Depositional Agents of Nature

CLO-3 Understand in detail about the Atmosphere and Oceanography

COURSE OUTCOMES

After completion of course, students would be able to:

CO1 Understand mapping lithological and structural features

CO2 Understand mapping concepts involved in Fluvial structures

CO3 Understand thematic concepts of Glacial/Aeolian landforms

CO4 Analyse the structure and behaviour of Atmosphere

CO5 Get exposed to various Climate Models

COURSE SYLLABUS

Unit 1 : FUNDAMENTALS

Geological Time Scale, Earth Surface Forms and Processes – Basic Geology and Geomorphology; Endogenetic processes: Diastrophism, Volcanism and Tectonism; Exogenic processes: Weathering, Mass Wasting and Erosion; Geomorphic Agents

Unit 2 : FLUVIAL & COASTAL LANDFORMS

Fluvial processes and landforms: valleys and valley-forming processes - associated features; Alluvial fans, Alluvium – Active and Relict alluvium; Floodplain morphology; Types of streams – Genetic classification of streams; and Deltas

Shore Zone processes and landforms: Shoreline, Shore zone and Coast; Waves – Wind Waves, Tsunamis, Storm Surges; Tides – Diurnal, Semi-Diurnal; Currents – Longshore Currents and Littoral Current; Erosional and Depositional landforms

Unit 3 : GLACIAL & AEOLIAN LANDFORMS

Glacial processes and landforms: Ice and Glaciers; Types of Glaciers; Glacial Motion; Regimen of Glaciers – Nourishment and Wastage of Glaciers; Active, Passive and Dead Glaciers; Erosional and Depositional Landforms.

Aeolian processes and landforms: dominance of wind processes in arid and semi-arid regions; erosional and depositional landforms

Unit 4 : ATMOSPHERE & METEOROLOGY

Composition and Vertical Structure; Insolation and Heat Budget; Atmosphere Pressure and Winds: Factors affecting wind direction and speed; General circulation of the atmosphere; Atmospheric humidity, clouds and precipitation and monsoons; Air masses, fronts, weather disturbances – storms, tornadoes and their impact on life and property.

Climate models, methods, types, GCM, RCMs, climate databases. Concepts and definition of climate change and climate variability, causes, IPCC climate change scenarios. Modeling of climate change scenarios and scaling issues using RS & GIS. Dynamic and Statistical downscaling of climate model data.

Unit 5 :   THE WORLD OCEANS

Physical properties of Sea Water – Salinity, Density, Temperature, Pressure, Colour; Ocean currents – Cold and Warm Currents and Ocean Circulation Patterns; Sea level changes – Episodic, Seasonal and Long-term changes and their impacts; Predicted sea-level rise: causes and consequence.

Textbooks :
1. A L. Bloom, "Geomorphology",Wavel and Pr.Inc. 2004
2. W.D. Thornbury, "Principles of Geomorphology" Wiley Eastern, 1984
3. Richard Huggett, "Fundamentals of Geomorphology" Routledge, 2ed, 2007
4. Critchfield, Howard J., "General Climatology", 3ed, Prentice-Hall, Inc., 1974.
5. Howard J. Critchfield, "General climatology", Prentice-Hall of India private Limited, New Delhi, 1987
6. Reddy, M.P.M., "Descriptive Physical Oceanography", Oxford & IBH Publishing Co. 2001
7. Bengtsson et al., "Earth's Cryosphere and Sea Level Change", Springer, 2011

References :
1. Tikka, R.N., "Physical Geography", Kedar Nath Ram Nath &Co, Meerut, 2006
2. Beaches and Coasts, C.A.M. King, Edward Arnold, 1961
3. Oceanography – A Brief Introduction, Siddhartha, K., Kisalaya Publications, 2004

I Semester	GLOBAL NAVIGATIONAL SATELLITE SYSTEM	L	T	P	C
		3	0	0	3

COURSE LEARNING OBJECTIVES

This course aims to make the students:

CLO-1 Introduce the concept of geodesy and augmentation systems

CLO-2 Introduce satellite-based positioning system using Pseudo-range Positioning methods

CLO-3 Study various Reference surfaces (Datum), Coordinate transformation models.

COURSE OUTCOMES

After completion of course, students would be able to:

CO1 Identify GNSS components and their functions

CO2 Interpret the navigational message and signals received by the GNSS

CO3 Identify error sources in GNSS observations, and apply the corrections for accurate positioning

CO4 Select GNSS survey method

CO5 Map the geospatial features

COURSE SYLLABUS

Unit 1 : GEODESY

Definition – Fundamental goals of Geodesy – Basic concepts – Historical perspective – Development applications in Satellite Geodesy – Geoid and Ellipsoid - satellite orbital motion – Keplerian motion – Kepler's Law - Coordinate systems in Geodesy - Indian Geodetic System and Everest Spheroid, WGS 84, Geodetic coordinate systems, Time systems.

Unit 2 : GNSS

Space Segment – Satellite Configuration, Orbit determination and Orbit representation, Anti spoofing and Selective availability. Control Segment – Master, Monitor & Ground Control Stations, Task of control segment User Segment – GNSS receiver, Components of Receiver, Types of Receiver; History of GNSS: GPS system - Services and Segments, GLONASS system- Services and Segments, Galileo System- Services and Segments, Regional Navigation Satellite Systems (RNSS), Augmentation Systems, GAGAN, IRNSS systems

Unit 3 : SATELLITE SIGNAL & OBSERVABLES

Structure of Signal, Navigation message, Pseudo range measurements, Atmospheric effects, Antenna phase center offset and variation, Multipath, system accuracy characteristics, Data formats, Error budget

Unit 4 : DATA PROCESSING

Point Positioning, Different Positioning & Relative Positioning, Ambiguity Resolution, Adjustment Filtering & Smoothing, Network Adjustment, Dilution of Precision & Accuracy Measures

Unit 5 :   SURVEYING WITH GNSS

Planning a GPS survey, Prerequisites, Modes of Survey, Surveying procedure - Transformation of GPS results - Coordinate transformations, Datum transformations

Textbooks :

1. Hofmann-Wellenhof, Lichtennegger and Wasle., "GNSS: Global Navigation Satellite Systems", Springer-VerlagWein, New York, 2008
2. Seeber G. "Satellite Geodesy", Walter De Gruyter, Berlin, 1998.
3. Shuanggen Jin, Estel Cardellachadn Feiqin Xie., "GNSS Remote Sensing: Theory, Methods and Applications", Springer, London, 2014
4. Guocheng Xu "GPS Theory, Algorithms and Applications", Springer, Berlin, 2003.

References :

1. B. Bhatta., "GNSS Insights into GPS, GLONASS, Galileo, Compass and Others",CRC Press, 2011
2. Satheesh Gopi "Global Positioning System: Principles and Applications". McGraw Hill Publishers, 2005.

I Semester	SPACE SCIENCE & TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE LEARNING OBJECTIVES

This course aims to make the students:

CLO-1 Apply scientific methods to investigate space phenomena using data analysis.

CLO-2 Understand core principles of space science including astrophysics and orbital mechanics.

CLO-3 Explore the role of space technology in solving global challenges like climate and disaster management.

COURSE OUTCOMES

After completion of course, students would be able to:

CO1   Explain key concepts in space science and space environment dynamics.

CO2   Design space missions considering orbits, payloads, and constraints.

CO3   Analyse space data and evaluate scientific literature.

CO4   Apply space technologies to real-world issues with ethical awareness.

COURSE SYLLABUS

Unit 1 :   OVERVIEW OF SPACE EXPLORATION

Space: What and How to Explore, Rockets to access the space, Space Exploration platforms, Scientific Payloads & Telescopes, Solar and Heliophysics from space, Exploration of planets and satellites

Unit 2 :   SPACE EXPLORATION TECHNOLOGY

Space Science Overview : A basic introduction, Space Technology: Space Transportation Systems,   Space Technology: Spacecraft Systems, Techniques for Space Exploration, Ground Stations for Space Exploration

Unit 3 :   EXPLORATION OF THE SOLAR SYSTEM

Introduction to the Solar System, The Formation of the Solar System, The Sun: Our Star, Earth and Evolution of Earth and the Moon, Planets and their Moons of the Solar System, Minor Bodies: Comets, Asteroids and Meteorites, Life in Solar System; Platforms & Mission for Solar System Exploration, Solar System and Aditya L-1 Mission, Understanding and predicting solar activity

Unit 4 :   SPACE TECHNOLOGY & APPLICATIONS

Indian Space Programme, Communication & Navigation Satellites and its applications, Satellites and Spacecraft Systems, Indian Space Programme future challenges and opportunities, Human Space Flight Mission Challenges and opportunities

Unit 5 :   FUTURE OF INDIA'S SPACE EXPLORATION

India's Human Spaceflight Programme: Beginning of a new Era, India's Own Space Station: The Bharatiya Antarish Station (BAS), India's contributions to exploratory Lunar Science,

Scientific Opportunities for Indian Astronauts. Ground Observatories in India, Launch Vehicles for Future Space Exploration, Advanced Propulsion System for Future Space Exploration, Docking in Space: Technologies, Challenges and Possibilities, Space Robotics in Future Science Exploration.

Text books :

1. "Understanding Space: An Introduction to Astronautics" by Jerry Jon Sellers, William J. Astore, Robert B. Giffen, and Wiley J. Larson, Publisher: McGraw-Hill, 4th Edition, 2014, ISBN: 978-0073407753

2. "Advances in Space Science and Technology, Volume 9" edited by Frederick I. Ordway, Publisher: Academic Press (Elsevier), 1967 (historical reference, relevant chapters available), ISBN: 978-0120373093

3. "The Science of Interstellar" by Kip Thorne, Publisher: W. W. Norton & Company, 2014, ISBN: 978-0393351378

I Semester	WATER RESOURCES MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE LEARNING OBJECTIVES

This course aims to make the students:
- CLO-1 To learn how to assess surface and groundwater resources.
- CLO-2 To learn how to develop suitable plans for water resource development and management
- CLO-3 To learn the optimization techniques in water resources planning and management.

COURSE OUTCOMES

After completion of course, students would be able to:
- CO1 Explain Hydrological cycle and its different parameters
- CO2 Analyse the Rainfall-runoff relationship with flood forecasting
- CO3 Describe various terms related to "Groundwater"
- CO4 Explain the rainwater harvesting techniques and water models
- CO5 Describe important characteristics of "Watershed".

COURSE SYLLABUS

Unit 1 :   FUNDAMENTALS OF HYDROLOGY

Hydrological cycle – estimation of various components of hydrological cycle – clouds – rainfall – runoff – evaporation – transpiration – evapotranspiration – interception – depression storage – spectral properties of water – case studies.

Unit 2 :   DRAINAGE BASIN ASSESSMENT

Watershed divide – Stream networks – Delineation and codification of watersheds – basin morphometric analysis – linear, aerial, relief aspects – Rainfall-runoff modeling – urban hydrology –flood forecasting, risk mapping, damage assessment - soil moisture area – drought forecasting and damage assessment – mitigation - Mapping of snow covered area – snow melt runoff - CASE STUDIES.

Unit 3 :   GROUNDWATER

Groundwater prospects – Surface Water Indicators – Vegetation, Geology, Soil – Aquifer Parameters – Well Hydraulics – Estimation of Groundwater Potential – Hydrologic Budgeting – Mathematical Models – Groundwater Modeling – Sea Water Intrusion – Modeling. CASE STUDIES.

Unit 4 :   WATER MANAGEMENT

Surface water - Study of Rainfall, Estimation of Run-off at Micro Catchments, Stream Gauging; Rainwater Harvesting; Catchment, Harvesting, Harvesting Structures, Groundwater - Exploration of Canal Command Areas, Potential Areas; Integrated Water Resources Management, Conjunctive Use. - Water Resource Models: SWAT, HEC-RAS, HEC HMS and others models

Unit 5 :   WATERSHED MANAGEMENT

Watershed characteristics - size, shape physiography, slope, climate, drainage, land-use, vegetation, geology, soils, hydrology, hydrogeology, socio-economics. Linear aspects of channel systems - Aerial aspects of drainage basins. Issues in watershed management - land degradation, agricultural productivity, reservoirs sedimentation, depletion of bioresources, floods and droughts. Principles and approaches - principles of watershed management, different approaches in watershed management; Artificial recharge of groundwater – water harvesting structures – erosivity and erodibility - Universal Soil Loss Equation – sediment yield – modelling of reservoir siltation – prioritization of watershed – CASE STUDIES.

Textbooks :
1. Ven Te Chow, "Hand book of Applied Hydrology ", 2010
2. H.M. Raghunath, "Groundwater", 2015
3. R.K. Linsely & J.B. Franzini "Water Resources Engineering"
4. Soil Erosion and Conservation by R. P. C. Morgan (2005), Longman Publishing Group.
5. Warren Viessman, Jr, and Lewis, G.L, Introduction to Hydrology, Prentice Hall India Pvt., Ltd., New Delhi, 2008

References :
1. McCuen, R.H., "Hydrologic Analysis and Design", Prentice Hall Inc. N York, 2005.
2. Patra, K.C, "Hydrology and Water Resources Engineering", Narosa Publications, 2008
3. Lynn E. Johnson, "Geographic Information Systems in Water Resources Engineering", CRC Press, 2008.
4. Lawrence K. Wang, Chih Ted Yang, "Modern Water Resources Engineering", Handbook of Environmental Engineering 15, Humana Press, 2014.
5. Peter P. Mollinga,"Integrated Water Resources Management (Water in South Asia)", Sage Publications Pvt. Ltd, 2006.

I Semester	GEO-STATISTICAL METHODS	L	T	P	C
		3	0	0	3

COURSE LEARNING OBJECTIVES

This course aims to make the students:

CLO-1 understand the Statistical measures of the sample datasets

CLO-2 understand the concepts of Geo-Statistical methods and its applications in Engineering

CLO-3 study the effect of estimation theory, testing of hypothesis, correlation and regression, randomized design, and multivariate analysis.

COURSE OUTCOMES

After completion of course, students would be able to:

CO1   Study basics of statistical methods

CO2   Understand concept of probability distribution, correlation methods

CO3   Conduct hypothesis testing

CO4   Study GIS data with complex geospatial methods

CO5   Solve the geospatial problems using R

COURSE SYLLABUS

Unit 1 :   STATISTICAL METHODS

Introduction to Statistical Methods - Terminology, Measures of Central Tendency- Mean, Mode, Median, Quartiles, Measures of Dispersion- Range, Variance, Standard Deviation, Skewness & Kurtosis

Unit 2 :   CORRELATION AND REGRESSION

Binomial, Poisson and Normal distributions - Definitions, Principle of Least Squares, Fitting of straight line and parabola - Correlation - Karl Pearson's Coefficient of Correlation and Spearmann's rank correlation - Linear regression

Unit 3 :   TESTING OF HYPOTHESIS

Tests based on Normal, t, χ^2 and F distributions for testing of Means, Variance and Proportions – Analysis of r × c tables – Goodness of fit.

Unit 4 :   INTERPOLATION

Interpolation & Extrapolation methods, IDW, Geostatistical Interpolation methods – Kriging and other methods of kriging, Semi-variance, Variogram

Unit 5 :   R APPLICATIONS FOR GEOSTATISTICAL METHODS

Introduction to R, Descriptive/Inferential statistics with R, Simple linear regression with R, spatial statistics analysis using R methods.

Text books :

1. Gupta, S.C., and Kapoor, V.K., "Fundamentals of Mathematical Statistics", Sultan Chand and sons, Reprint 2003
2. Gupta, S.C., and Kapoor, V.K., "Fundamentals of Applied statistics", Sultan Chand and sons, 2003.
3. Veerarajan.T., "Probability Statistics and Random processes", TMH, 2004

References :

1. R Project for Statistical Computing [weblink] www.r-project.com
2. Jeffrey M. Yarus, and Richard L. Chambers, "Stochastic modeling and geostatistics_ principles, methods, and case studies" -American Association of Petroleum Geologists, 1994.
3. Wackernagel. Hans. "Multivariate geostatistics : An Introduction with Applications", Springer-Verlag Berlin Heidelberg, 3ed, 2003.
4. D.D. Sarma "Geostatistics with Applications in Earth Sciences" Springer, 2ed, 2009.

I Semester	GEOSPATIAL SYSTEMS & SECURITY	L	T	P	C
		3	0	0	3

COURSE LEARNING OBJECTIVES

This course aims to make the students:

CLO-1 Develop skills in applying scientific methods to formulate hypotheses, collect data, and interpret geological phenomena

CLO-2 Enable students to apply cloud-based geo-informatics to fields like disaster management, resource planning, and sustainability

CLO-3 Develop skills in assessing and mitigating cyber risks in organizational and individual contexts.

COURSE OUTCOMES

After completion of course, students would be able to:

CO1 Use quantitative methods to analyse geological data

CO2 Design workflows for geospatial problem-solving in areas like mapping and disaster response

CO3 Detect and analyse cyber threats, vulnerabilities, and attack vectors

CO4 Use cloud platforms for team collaboration and project management.

CO5 Implement machine learning algorithms using Python and frameworks like TensorFlow or PyTorch.

COURSE SYLLABUS

Unit 1 : FUNDAMENTALS OF GEOINFORMATICS

Introduction to Geospatial Technology: GIS, Remote Sensing, GPS, and Spatial Data Models. Spatial Data Types: Vector, Raster, and 3D Geospatial Data. Overview of Geo-Web Services: Concepts, Standards (OGC, WMS, WFS, WCS), and applications.

Spatial database concepts: PostgreSQL/PostGIS, Oracle Spatial, MongoDB. Spatial queries, indexing, and data modelling for Web-based GIS applications

OGC standards: Web Map Service (WMS), Web Feature Service (WFS), Web Coverage Service (WCS), and Sensor Observation Service (SOS). Service-Oriented Architecture (SOA) for geospatial web services.

Unit 2 : GEO-COMPUTATION

Implementation of Geo-Web Services using tools like GeoServer, MapServer, or ArcGIS Server. Integration of IoT with geospatial data: real-time sensor data for web applications. Geo-Computation vs Traditional GIS. Clustering (K-means, DBSCAN), Classification (SVM, Decision Trees), Regression models, Variograms and Kriging, Spatial Interpolation (IDW, Spline), Space-Time Modeling, Point Pattern Analysis, Applications in urban planning, environment, disaster, etc.

Unit 3 : GEO-DATA SHARING & CLOUD COMPUTING

Governance and policies for Geo-Web Services: Data Privacy, Licensing, and Ethics.

Industry standards and compliance for Geospatial Data Sharing. Concepts of National Spatial Data Infrastructure (NSDI) and Global SDI frameworks. Metadata standards (e.g., ISO 19115) and catalogue services (e.g., CSW). Designing SDI for Geo-Web Services deployment. Big Data in Geospatial Domain, Internet of Things (IoT) for Geo-Sensing

Unit 4 :   CYBER SECURITY

Information Warfare : Information Resources, The Value of Resources, Accounts, Getting Access, Tools and Techniques, Packet Sniffers, Password Crackers, Social Exploiting, Information Theft, Tampering, Web Hacks, Domain Name Service Hacks, Takedown, Remote Shutdown Extent. Internet of Things (IOT): IoT architectures, IoT enabling technologies, IoT Big Data Analytics, IoT security and privacy concerns, Cyber Terrorism. Introduction to the Legal Perspectives of Cybercrimes and Cyber security, Cybercrime and the Legal Landscape around the World, Why Do We Need Cyber laws, The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario in India, Cybercrime and Punishment, Cyber law.

Unit 5 :   AI/ML USING PYTHON
Integration of IoT with geospatial data: real-time sensor data for web applications. Scalability and performance optimization for cloud-based GIS. Applying AI/ML for geospatial data analysis: image classification, object detection. Developing intelligent Geo-Web Services: predictive analytics for urban or environmental applications. Tools: TensorFlow, PyTorch, or Google Earth Engine for ML workflows

Textbooks :
1. "Geoinformatics for Geosciences: Advanced Geospatial Analysis using RS, GIS and Soft Computing" edited by Nikolaos Stathopoulos et al. Publisher: Elsevier, 2023 ISBN: 978-0323989831 (Print), 978-0323957823 (E-Book)
2. "Handbook of Geospatial Artificial Intelligence" edited by Song Gao, Yingjie Hu, and Wenwen Li, Publisher: CRC Press (Taylor & Francis), 2023, ISBN: 978-1032311661 (Print), 978-1003308423 (E-Book)
3. "Cybersecurity Fundamentals: A Real-World Perspective" by Kutub Thakur and Al-Sakib Khan Pathan, Publisher: CRC Press, 2020, ISBN: 978-0367476489
4. "Cloud Computing for Geospatial Big Data Analytics: Intelligent Edge, Fog and Mist Computing" by Himansu Das, Rabindra K. Barik, Harishchandra Dubey, and Diptendu Sinha Roy, Publisher: Springer, 2019, ISBN: 978-3030033583
5. "Machine Learning and Artificial Intelligence in Geosciences (Advances in Geophysics, Volume 61)" edited by Benjamin Moseley and Lion Krischer. Publisher: Academic Press (Elsevier), 2020, ISBN: 978-0128216699 (Print), 978-0128216842 (E-Book)

References :
1. Daniel Ventre, Cyberwar and Information Warfare, John Wiley & Sons.2012
2. Dorothy Denning, Information Warfare and Security, Addison-Wesley (1998.)

I Semester	DISASTER MANAGEMENT - FRAMEWORK	L	T	P	C
		3	0	0	3

COURSE LEARNING OBJECTIVES

This course aims to make the students:

CLO-1 Understand disaster types, management principles, and resilience frameworks.

CLO-2 Apply global frameworks like the Sendai Framework for disaster risk reduction.

CLO-3 Use geospatial and data analytics tools (e.g., GIS, remote sensing, Google Earth Engine) for disaster preparedness and response

COURSE OUTCOMES

After completion of course, students would be able to:

CO1 Classify and analyse different types of disasters and their impacts.

CO2 Conduct risk assessments and apply resilience frameworks to reduce disaster vulnerability.

CO3 Utilize the Sendai Framework to design and evaluate disaster risk reduction strategies.

CO4 Apply geospatial tools (GIS, remote sensing) for mapping, monitoring, and managing disaster events.

CO5 Use platforms like Google Earth Engine for real-time data analysis and decision-making in disaster scenarios.

COURSE SYLLABUS

Unit 1 :   INTRODUCTION

Introduction to Disasters, Disaster Management Cycle - use of GIS in risk assessment, mitigation, preparedness, response and recovery phases in disaster management, types of disasters – Disaster Management overview on Natural and Technological disasters.

Unit 2 :   NATURAL & ANTHROPOGENIC DISASTERS

Earthquakes, Landslides, Droughts, Floods, Forest fires, and Glacial Lake Outbursts, Nuclear, Chemical, Biological, Case studies.

Unit 3 :   GLOBAL FRAMEWORK OF DISASTERS

International Legal Framework Related to Disasters: Major International legal instruments dealing specifically with Disasters; Sendai Framework for DRR 2015-2030; Hyogo Framework for Action 2005-2015; Yokohama Strategy; Sustainable Development Goals (SDGs) and Disaster Risk Reduction (DRR)

Unit 4 :   DISASTER FRAMEWORK OF INDIA

Legal Framework Related to Disasters in India: Disaster Management Act, 2005; Other related acts, Policies, Plans, Programmes, and Legislations - Policies Related to Disasters: National Policy on Disaster Management 2009; National Disaster Management Plan 2019; State Disaster Management Plans (SDMPs); District Disaster Management Plans (DDMPs) Institutional Arrangements in DM: National Disaster Management Authority (NDMA), State

Disaster Management Authority (SDMA), District Disaster Management Authority (DDMA), National Disaster Response Force (NDRF)

Unit 5 :   APPLICATIONS OF RS & GIS AND CASE STUDIES

Hazard and Zonation Mapping, Mapping Vulnerable Areas, Weather Monitoring: Real-time satellite data for cloud cover, rainfall, and cyclone tracking etc.., Evacuation Route Planning: GIS-based network analysis, Simulation Models: Geo-computation techniques for flood simulation etc, Damage Assessment, Search & Rescue Planning, use of Drones and RS data. Real-Time Monitoring.

Textbooks :

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, Pardeep et.al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies", Deep & Deep 4.   Publication Pvt. Ltd., New Delhi.
4. "Introduction to International Disaster Management" by Damon P. Coppola, Publisher: Butterworth-Heinemann (Elsevier), 4th Edition, 2020, ISBN: 978-0128173688
5. "Geospatial Applications for Natural Resources and Disaster Management" edited by Elias T. Ayuk and Samuel Mafoua, Publisher: Springer, 2023 (based on recent geospatial disaster management trends), ISBN: 978-3031419522

References :

1. "Handbook of Disaster Research" edited by Havidán Rodríguez, William Donner, and Joseph E. Trainor, Publisher: Springer, 2nd Edition, 2017, ISBN: 978-3319632537
2. "Natural Disaster Risk Management: Geosciences and Social Responsibility" by Ulrich Ranke, Publisher: Springer, 2015, ISBN: 978-3319206745
3. "Geographic Information Systems (GIS) for Disaster Management" by Brian Tomaszewski, Publisher: CRC Press (Taylor & Francis), 2nd Edition, 2020, ISBN: 978-1138491571

I Semester	AGRICULTURE & SOIL RESOURCE MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE LEARNING OBJECTIVES

This course aims to make the students:

CLO-1 Understand physical processes in soil and techniques to prevent erosion

CLO-2 Understand biological processes that enhance soil health

CLO-3 Promote environmentally sustainable farming methods

COURSE OUTCOMES

After completion of course, students would be able to:

CO1   Promote eco-friendly farming practices

CO2   Develop strategies for sustainable soil and water use

CO3   Optimize water management for agricultural productivity

CO4   Learn to analyse and enhance soil fertility for sustainable crop production

CO5   Develop expertise in managing complex agricultural systems

COURSE SYLLABUS

Unit 1 :   CONCEPT OF SOIL

Soil forming factors and pedogenic processes, physico-chemical properties; Soil Erosion, Transportation, and Sedimentation, Soil Pollution and Waste Management, Pollution through Fertilizers, Pesticides, soil erosion and runoff, irrigation water, mining. The processes, factors responsible for and consequences of erosion. Kinetic energy of rainfall. (USLE) Universal Soil Loss Equation – its applicability and its refinements.

Unit 2 :   AGRICULTURE

Agriculture: overview and importance; Need for Agri-informatics and Agro-Forestry; Agricultural Policy and Rural Development in India, Precision Farming Techniques, Agricultural Waste Management, Climate Change Adaptation in Agriculture, Renewable Energy in Agriculture, Data Analytics and Machine Learning for Agriculture

Unit 3 :   SPECTRAL CHARACTERISTICS

Spectral characteristics of soils and crops and Spectral Vegetation Indices; Plant signatures and vitality indicators, Chlorophyll Fluorescence, Red Edge. Optical Spectral characteristics of crops. Land Use / Land Cover classification system.

Unit 4 :   AGRICULTURAL WATER MANAGEMENT

Classification of climate; system approach to water management; crop irrigation system; soil-plant atmosphere systems; water production function types and characteristics; Concept, need, purpose and principles of artificial groundwater recharge. Planning of artificial recharge schemes. Artificial recharge techniques and plan and Rain Water Harvesting. Mathematical modelling for efficient utilization of limited water supplies and planning for optimal water use; optimization by simulation.

Unit 5 :   REMOTE SENSING AND GIS APPLICATIONS

Crop discrimination and acreage estimation; Crop Inventory & mapping. Microwave sensors parameters and signatures of vegetation in reference to Polarization, incidence angle. Hyperspectral RS applications in Agriculture. RS based crop yield modelling: Principles and approaches. Soil Resource Mapping.

Textbooks :
1. Green Technology-P K Sinha & Margaret Green way Pioneer Publ. Jaipur 2004
2. Environmental Biotechnology S.K. Agarwal APH
3. Biological and Biotechnological control of insect Pests, Rechcigl and Rechcigl, Lewis
4. Hand book of Bioremediation, Norris et al Lewis
5. Soil Biotechnology: Lynch, Blackwell
6. Soil Microbiology and Biochemistry: Paul and Clark, Acd. Press.

References :
1. Soil Pollution and soil organisms –Mishra, Ashish Publ
2. Soil Microbiology and Biochemistry -Paul and Clark, Acad. Press
3. Pesticides in the Indian Environment -Gupta, Interprint
4. Soil Biotechnology-Lynch, Blackwell
5. Hand book of organic waste conversion-Bewicks, Acad. press
6. Solid waste Pollution- Trivedi and Raj, Akashdeep
7. Remote Sensing and Large-Scale Global Processes (ed. by A. Rango) (Proc. Baltimore Symp.), 67–74. IAHS Publ. 186. IAHS Press, Wallingford, UK.
8. Ustin, S. (2001). Manual of Remote Sensing, Volume 4, Remote Sensing for Natural Resource Management and Environmental Monitoring, 3rd Edition, Willey Publishing.

I Semester	**VISUAL INTERPRETATION LABORATORY**	L	T	P	C
		0	1	2	2

COURSE LEARNING OBJECTIVES

This course aims to make the students:

 CLO-1 Get accustomed to the various Maps, Scales & Satellite Images

 CLO-2 Interpret various features on the Imageries and Toposheets

 CLO-3 Understand the various Remote Sensing Data Types

COURSE OUTCOMES

After completion of course, students would be able to:

 CO1 Analyse temporal, spectral and spatial differences of satellite data using image processing software

 CO2 Perform image pre-processing and post-processing techniques on a given satellite data

 CO3 Classify given satellite data for thematic mapping process

 CO4 Identify various geographical features on Toposheets & Satellite Images

 CO5 Understand various elements of Visual Interpretations and their identities.

LIST OF EXPERIMENTS

Topographic Map Analysis

    1. Map Fundamentals and Scale Interpretation; Topographic maps – Numbering system of topographic maps of India.
    2. Contour Lines and Topographic Profiles – Simple, Superimposed and Projected profiles.
    3. Hydrological Features and River Profiles.
    4. Drainage morphometry.
    5. Identification of Surface features from topographic maps

Remote Sensing Data Analysis

    1. Understanding Remote Sensing Data - Elements of Visual Interpretation.
    2. Drainage pattern and surface water bodies
    3. Urban growth and transportation network
    4. Forests and crops mapping
    5. Land use and land cover

Textbooks :

    1.   Fundamentals of Cartography, Rameshwar Prasad Misra, A. Ramesh, Concept Publishing Company, 1989
    2.   http://www.surveyofindia.gov.in

I Semester	**GEOGRAPHICAL INFORMATION SYSTEM LABORATORY**	L	T	P	C
		0	1	2	2

COURSE LEARNING OBJECTIVES

This course aims to make the students:

CLO-1   Experience the power of GIS

CLO-2   Understand the various aspects and applications of GIS

CLO-3   Differentiate between a Raster & a Vector

COURSE OUTCOMES

After completion of course, students would be able to:

CO1   Delineate various geographical features using ArcGIS & QGIS softwares

CO2   Understand the various Projection Systems & Coordinate Systems

CO3   Generate 3D outputs and profiles

CO4   Differentiate various Analysis – 3D, Buffer, Network, Spatial etc…

CO5   Understand all the overlay analysis techniques

LIST OF EXPERIMENTS

1. Importing maps and layers from various source
2. Georeferencing and Projection
3. Digitization - Point, Line, Polygon and Surface Data
4. ArcSWAT/QSWAT
5. Attribute Data Entry and Manipulation
6. Cleaning, Building and Transformation
7. Map Composition with Elements
8. Generation of TIN and DEM
9. Vector Analysis-Proximity, Spatial and Network analysis
10. Raster Analysis-Measurement-Arithmetic overlaying, Logical overlaying

(Above experiments have to be carried out using both ArcGIS & QGIS)

Text books :

1. ArcGIS User Manual by ESRI

2. QGIS User Guide Release 2.18, April 2019

II Semester	**DIGITAL IMAGE PROCESSING**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

COURSE LEARNING OBJECTIVES

This course aims to make the students:

CLO-1 Understand procedure of satellite data acquisition and analysis

CLO-2 To process the Satellite dataset for Remote Sensing Applications

CLO-3 To extract information from a Satellite Image for Thematic maps

COURSE OUTCOMES

After completion of course, students would be able to:

CO1 Process the remotely sensed data with satellite image processing techniques

CO2 Statistically evaluate the image variables

CO3 Classify the processed remote sensing data

CO4 Evaluate the accuracy of the image classification

CO5 Apply the advanced image processing methods for deriving the useful information

COURSE SYLLABUS

Unit 1 : FUNDAMENTALS

Satellite systems and data – acquisition – storage – orbits – Data formats –Data products – Image display systems – future missions – Elements of visual perception – Image sampling and quantization – Resolutions – Pixel characteristics – Image formation, missing scan lines

Unit 2 : PREPROCESSING

Preprocessing – Geometric correction and registration, Radiometric correction
Image statistics and descriptive analysis: Histogram and its significance- Entropy and its significance - univariate and multivariate statistical measures for satellite image bands

Unit 3 : ENHANCEMENT

Point, local and regional operation – Linear and non-linear Contrast enhancement techniques, density slicing, pseudo-colour images, spatial enhancement techniques (convolution filtering), spectral enhancement techniques, PCA, Wavelet transform, Multi-image fusion.

Unit 4 : INFORMATION EXTRACTION AND CLASSIFICATION

Classification – Feature extraction, Training set – Statistical computation, understanding feature space & scatter plots, signature purity & separability – Supervised, Unsupervised and Hybrid classification techniques, Sources of Classification Error, confusion matrix & Kappa coefficient error analysis, Analysis of Multi-Temporal series and change detection

Unit 5 : ADVANCED CLASSIFICATION TECHNIQUES

Introduction to Artificial Neural Networks (ANNs); Support Vector Machines (SVM), Random Forest, Decision Trees and other Ensemble learning approaches; Classification performance evaluation using Accuracy Assessment metrics – F1 Score, ROC Curves,

Precision-Recall analysis.

Textbooks:

1. John R Jensen, "Introductory Digital Image Processing", Prentice Hall, New Jersey,2004
2. John A.Richards, Springer-Verlag, "Remote Sensing Digital Image Analysis" 1999.
3. Florence Tupin, Jordi Inglada and Jean-Marie Nicolas, Remote Sensing Imagery, ISTE and Wiley, 2014

References:

1. Robert G Reeves, Manual of Remote Sensing Vol. I & II, American Society of Photogrammetry, Falls Church, USA, 1983.
2. Rafael C.Gonzalez, "Digital Image Processing" Prentice Hall, (2nd Edition), 2002.

II Semester	ADVANCED REMOTE SENSING	L	T	P	C
		3	1	0	4

COURSE LEARNING OBJECTIVES
This course aims to make the students:
 CLO-1 To impart the knowledge of Microwave Remote sensing and its applications
 CLO-2 understand principles, processes and applications of thermal and hyper spectral remote sensing for earth resources
 CLO-3 Study the fundamentals of LiDAR and UAV systems

COURSE OUTCOMES
After completion of course, students would be able to:
 CO1 Understand the principles of thermal and microwave remote sensing
 CO2 Relate backscattering signals from different surfaces to physical processes and understand active and passive microwave systems.
 CO3 Make use of thermal and hyperspectral data for real world applications (analysing Urban Heat Island problem, estimation of surface composition, forest species identification etc.).
 CO4 Classify and analyse Hyperspectral data
 CO5 Identify the working mechanism and applications of UAV systems

COURSE SYLLABUS

Unit 1 : MICROWAVE REMOTE SENSING
Introduction, wavelengths, Radar equation, classification of Sensors, SLAR, Resolution concept- Range resolution and azimuthal resolution, SAR, Speckle noise and reduction, Radar return and Image signature- System parameters and Target parameters, Advanced Processing Techniques such as InSAR, differential InSAR or Polarimetric InSAR.

Unit 2 : THERMAL REMOTE SENSING
Thermal radiation principles, Interpretation of Thermal Images, Determination of Emissivity, Application of LST in analysing Urban Heat Island effect, Coalfire extent, Energy balance, etc.

Unit 3 : HYPERSPECTRAL REMOTE SENSING
Principles, Spectral Cube, Airborne and Spaceborne sensors. Data correction – Atmospheric, Radiometric and Geometric, Data Visualization, Animation, Multiple Colour Composites, Observing Signatures of Various Features and Comparing with Spectral Libraries, Dimensionality reduction – Linear methods and Non-Linear methods.

Unit 4 : LiDAR
Principles of LiDAR remote sensing, LIDAR working principle, Types of LIDAR, LIDAR system components, Data Processing, Applications – Interior, Exterior of Monuments and Structures, 3D Visualization and Analysis, Generation of Archives towards Planning and

Development.

Unit 5 :   UAV: Unmanned Aerial Vehicle

Definition and Terminology, Advantages and Limitations of UAV's in Remote Sensing, UAV types, UAV – Data Acquisition, Image Processing, Ortho-Rectification, Data Modelling DEM/DTM; Applications.

Textbooks :

1. Floyd M. Henderson et.al. "Imaging Radar -Manual of Remote Sensing -Vol 2" 3ed , Wiley. 1998
2. Ulaby, F.T., Moore, R.K., and Fung, A.K., Microwave Remote Sensing – Active and Passive – Wesley Publishing, 1986.
3. Dale A. Quattrochi et.al. "Thermal Remote Sensing in Land Surface Processing", CRC Press. 2004
4. Michael T, Eismann., "Hyperspectral Remote Sensing", SPIE press, USA, 2012
5. Felipe Gonzalez Toro, Antonios Tsourdos, "UAV - Based Remote Sensing - Volume 2". Sensors-MPDI, 2018.

References :

1. Peter M. Atkinson, Nicholas J. Tate, "Advances in Remote Sensing and GIS Analysis".
2. Chein-I Chang, "Hyperspectral Imaging: Techniques for Spectral Detection and Classification", Springer; 2003.
3. Chritian Matzler., "Thermal Microwave Radiation: Applications for Remote Sensing", The Institution of Engineering and Technology, 2006.

II Semester	REMOTE SENSING & GIS APPLICATIONS	L	T	P	C
		3	1	0	4

COURSE LEARNING OBJECTIVES

This course aims to make the students:

CLO-1 Know about the various Geological Structures and Geomorphic Landforms and Tectonics

CLO-2 Exposed to various Remote Sensing Applications to Earth Sciences

CLO-3 Study various Case Studies of applications related Earth Sciences

COURSE OUTCOMES

After completion of course, students would be able to:

CO1 Visualize landforms and locate / identify geographic and geologic features.

CO2 Explain the various components of Forests using various Remote Sensing Data

CO3 Explain the Soil and Agriculture relationship using RS & GIS

CO4 Understand the importance of Watershed and its application in the real world

CO5 Integrate between RS, GIS & Disasters and provide steps for mitigations

COURSE SYLLABUS

Unit 1 : GEOLOGY & GEOMORPHOLOGY

Principles of Remote Sensing Data Interpretation in Geology, Remote Sensing Image Interpretation for Lithological Mapping, Structural Feature Identification & Analysis.

Thermal Remote Sensing for Geological applications, Earthquake Studies and Volcano monitoring; Microwave Remote Sensing for Geological applications. Multi-spectral and Hyperspectral Remote Sensing for Mineral Exploration. Surface indicators for Mineral Exploration, Types of Hydrocarbon Resources, mode of occurrence, and surface indicators; CASE STUDIES

Unit 2 : FORESTRY & AGRICULTURE

Concept of soil, physio-chemical properties. Geographical distribution of Forests Global & Regional. Spectral properties of vegetation, factors affecting spectral reflectance; Spectral Vegetation Indices, Chlorophyll Fluorescence. Remote Sensing in agriculture - Need for Agri-informatics; Crop discrimination and acreage estimation;

Hyperspectral remote sensing for species/community delineation, Microwave remote sensing in forestry, Biomass Estimation, Agricultural crop growth monitoring and assessment, LiDAR remote sensing for tree height determination. Hyperspectral Remote Sensing for species delineation

Kyoto Protocol, Paris Agreement, NATCOM, REDD, REDD+, Clean Development Mechanism (CDM) – CASE STUDIES.

Unit 3 : WATERSHED MANAGEMENT

Principles of watershed management. Watershed characteristics - size, shape physiography, slope, climate, drainage, land use, vegetation, geology, soils, hydrology, hydrogeology, socio-economics. Linear aspects, Aerial aspects and Relief aspects of drainage basins. Agricultural Productivity using RS – CASE STUDIES

Unit 4 : URBAN STUDIES

Terminology in Urban planning; Town planning Practices in Developing Countries; Urban & Regional Planning Models; Urban Area delineation Rules; Process of Preparation of Development/Master/Zonal plans. Elements of Image interpretation; Techniques of Interpretation of Urban Areas; Issues in urban land use mapping; Urban land use classification system; Rules of classifications. Urban Heat Island Concept. Characteristics of Urban Base maps; base maps for regional/district planning; Photo-maps; Ortho-photo maps; cadastral mapping; Preparation of foot-print map; RS and GIS for Property tax assessment.

Unit 5 : COASTAL ZONE MANAGEMENT

Coastal wetlands – Mangrove swamps, marshes, lagoons, tidal channels/creeks and their significance in coastal stability and economic importance - Continental margins – forms and processes; territorial waters and Exclusive Economic Zone; Sea level changes – factors involved; effects of sea level oscillations on coastal zones; Sea-level rise and coastal vulnerability; Role of Geoinformatics in assessment of coastal vulnerability to sea-level rise, Coastal Zone Management – concepts, models and information systems; Coastal Regulations Zones (CRZ) and Coastal Management Zones (CMZ): Indian context. Application of remote sensing in coastal zone studies; Role of Geographic Information Systems in coastal zone studies

Textbooks :

1. W.D. Thornbury, "Principles of Geomorphology" Wiley Eastern, 1984.
2. Brady, N.C., and Weil, R.R "The Nature and Properties of Soils",12ed, Prentice Hall, Inc., 1999.
3. M.D. Steven, J.A. Clark, "Applications of remote sensing in agriculture", Publisher – Butterworth, London, 1990
4. Champion, H.G. and Seth, S.K. "A Revised Survey of the Forest Types of India". Manager of Publications, Govt. of India, New Delhi. 1968.
5. John R. Jensen, "Remote Sensing of the Environment: An Earth Resource Perspective", 2ed., Prentice Hall. 2007
6. Gupta, R.P., "Remote Sensing Geology", Springer Verlag, Berling. 2003.
7. Schwartz, F.W. and Zhang, H., "Fundamentals of Ground Water", John Wiley & Sons, Inc. USA.2003.
8. Todd, D.K. and Mays, L.W. "Ground Water Hydrology". John Wiley & Sons, Inc. USA. 2005.
9. Arthur Holmes, "Physical Geology", Elsevier Science Publishers. Ltd. 1-259.1985,
10. Ryerson, R.A., Rencz. A. N., "Manual of Remote Sensing: Remote sensing for the

earth sciences, Volume 3", American Society for Photogrammetry and Remote Sensing. 1999

References :

1. Applications in Coastal Zone Research Management, Martin, K.St. (ed), U.N. Institute for Training and Research, 1993.
2. Integrated Ocean and Coastal Management, Sain, B.C., and Knecht, R.W.,UNESCO Publication, 1998.

II Semester	**PRINCIPLES OF GEODATABASE**	L	T	P	C
		3	0	0	3

COURSE LEARNING OBJECTIVES

This course aims to make the students:

CLO-1 Understand the fundamental concepts of DBMS and Relational DBMS

CLO-2 To gain knowledge regarding Spatial Data structure and formats

CLO-3 Study Geospatial database and its applications

COURSE OUTCOMES

After completion of course, students would be able to:

CO1   Understand the components of DBMS and file management methods

CO2   Apply the concepts of SQL and its use to manage the databases

CO3   Understand the data models and data structures used for spatial data

CO4   Perform Geospatial Topology analysis

CO5   Design a geodatabase for various Remote Sensing & GIS applications

COURSE SYLLABUS

Unit 1 :   DBMS

Introduction to DBMS – Brief history – types of DBMS – data models – ER model: concepts design. GIS data model: Conceptualizing the real world in GIS

Unit 2 :   RDBMS & SQL

Relational Data Base Management Systems: Concepts – Constrains – Relational Data base Design – Relational Models Extended with ADT. SQL – simple – complex –spatial join.

Unit 3 :   SPATIAL OBJECTS

Representation of Spatial Objects: Geographic space modelling – Representation Modes – Representing the Geometry of a Collection of objects – Spatial data formats and Exchange formats – Spatial Abstract data Types. – Object oriented GIS.

Unit 4 :   GEODATABASE

Geodatabase: – Topology – Defining the Relationship class – Geometric Networks – Geocoding services – Building geodatabases with CASE tools.

Unit 5 :   SPATIAL DATABASE

Methods of Knowledge discovery in Spatial database, Methods of Clustering, Exploring Spatial association, Mining in Image & Raster database, Big Data methods for RS & GIS Applications, National Spatial Database Infrastructure, Open Geospatial Consortium

Textbooks :

1. Korth and Silberschatz "Database System Concepts" - McGraw Hill – 2002.
2. Philippe Rigaux, Michel Scholl, and Agnès Voisard. "Spatial databases: with application to GIS." Morgan Kaufmann Publishers, 2002.
3. MacDonald "Buliding Geodata Base" ESRI publication, USA, 2002.

References :

1. Arctur, David, and Michael Zeiler. "Designing Geodatabases: Case studies in GIS data modelling". ESRI, Inc., 2004.
2. Thomas Ott, Frank Swiaczny "Time-Integrative Geographic Information systems", Springer (2000)
3. Albert K.W. Yeung, G. Brent Hall "Spatial Database Systems_ Design, Implementation and Project Management", Springer, 2007.
4. Markus Schneider "Spatial Data Types for Database Systems_ Finite Resolution Geometry for Geographic Information Systems- Springer-Verlag Berlin Heidelber, 1997.

II Semester	GEOSPATIAL DATA PROCESSING AND MODELLING	L	T	P	C
		3	0	0	3

COURSE LEARNING OBJECTIVES

This course aims to make the students:

CLO-1 Study various Spatial Analysis techniques and Applications

CLO-2 Execute various spatial techniques and models to quantify and solve real-life spatial patterns and problems

CLO-3 Study and design spatial techniques and models over R Programming

COURSE OUTCOMES

After completion of course, students would be able to:

CO1   Conduct advanced spatial analyses using GIS tools

CO2   Study GIS data with complex geospatial models

CO3   Solve the geospatial problems using programming tools

CO4   Develop models in GIS using appropriate GIS software

CO5   Analyse GIS data and generate applications

COURSE SYLLABUS

Unit 1 :   SPATIAL INTERPOLATION

Local and Global methods of Interpolation; Interpolation using Trend surfaces, Regression, ANOVA method, Nearest Neighbour method, IDW methods; Geostatistical Methods – Variogram models, Variogram for spatial analysis, Kriging methods – Ordinary, Block, Probabilistic kriging, Comparison between Interpolation methods.

Unit 2 :   DTM APPLICATIONS

Slope and aspect; site selection studies, Viewshed analysis– Line of Sight, preparation, Factors influencing Viewshed preparation, Applications; Watershed analysis – Flow direction, Flow accumulation, Watershed delineation and applications; Working with Open Source DEM's

Unit 3 :   GEOSPATIAL ROUTE ANALYSIS

Geocoding – Reference Database, Address matching, Offset Plotting; Applications of Geocoding, Dynamic Segmentation – Routes, Events; Applications: Geocoding and Dynamic Segmentation;

Least-Cost Path Analysis – Source Raster, Cost Raster, Cost Distance Measures, Options for Least-Cost Path, Applications

Unit 4 :   GIS MODELS AND MODELLING

Basic Elements of GIS Modelling, Classification, Modelling Process, Binary Models – Vector & Raster based Method and Applications, Index Models – Weighted Linear Combination method & Applications, Regression Models – Multiple Linear Regression models, Process Models – Revised USLE, Critical Rainfall Model; Classification; Model

builder tools

Unit 5 :   PROGRAMMING TOOLS

Python & R Programming – Introduction, Data Types, Variables, Functions and Code style, Operators and Statements, Class and Objects, GIS Data Models, Python & R Scripting, Point, Polyline and Polygon, Python Language Control Structure; Automating Geospatial Tools with Python & R, Data accessing and editing, Data Manipulation and Complex Objects, Implementing Spatial Relationship Calculations

Textbooks :

1. Kang-Tsung Chang, "Introduction to Geographic Information Systems", McGraw-Hill Education, 9th ed, 2019.
2. Burrough, P. A and Rachel A. McDonnell, "Principles of Geographical Information Systems", Oxford University Publications, 1998.
3. C.P.Lo., Albert K and W.Yeung, "Concepts and Techniques of Geographic Information Systems", Prentice Hall India Pvt. Ltd, New Delhi, 2002.
4. Chaowei Yang, "Introduction to GIS Programming and Fundamentals with Python and Arc GIS", CRC Press, T&F Group, 2016

References :

1. Zandbergen, Paul A. Python scripting for ArcGIS. Esri press, 2015.
2. ArcGIS 10.3 User Manuals, ESRI, 2018.

II Semester	SOFT COMPUTING TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE LEARNING OBJECTIVES

This course aims to make the students:

CLO-1 To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario.

CLO-2 To implement soft computing-based solutions for real-world problems.

CLO-3 Learn techniques of Web GIS and Mobile applications.

COURSE OUTCOMES

After completion of course, students would be able to:

CO1 Identify and describe soft computing techniques and their roles in building intelligent machines

CO2 Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering

CO3 Apply genetic algorithms to combinatorial optimization problems

CO4 Evaluate and compare solutions by various soft computing approaches for a given problem

COURSE SYLLABUS

Unit 1 : INTRODUCTION TO SOFT COMPUTING

Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics

Unit 2 : FUZZY LOGIC

Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.

Unit 3 : NEURAL NETWORKS

Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks : Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks.

Unit 4 : GENETIC ALGORITHMS

Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning: Machine Learning Approach to Knowledge Acquisition.

Unit 5 : RECENT TRENDS

Recent Trends in Deep learning, various classifiers, Neural Networks and Genetic algorithm.

Textbooks :

1. Chakraborty, Udit; Roy, Samir, "Introduction to soft computing: neuro-fuzzy and genetic algorithms", Pearson, 2013.
2. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, "Neuro:Fuzzy and Soft Computing", Prentice Hall of India, 2003
3. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic: Theory and Applications", Prentice Hall, 1995.

References :

1. Sang-Yong Rhee, Jooyoung Park, Atsushi Inoue (eds.), "Soft Computing in Machine Learning", Springer, (2014).
2. Zoran Gacovski, "Soft computing and machine learning with Python", Arcler Press, (2019).

II Semester	ENVIRONMENTAL PLANNING & IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

COURSE LEARNING OBJECTIVES

This course aims to make the students:

 CLO-1 To understand the various remote sensing and GIS technological applications in Environmental Impact Assessment and Risk Assessment

COURSE OUTCOMES

After completion of course, students would be able to:

   CO1   Understand the concepts of Environmental Impact Assessment
   CO2   Understand the principles involved in EIA management
   CO3   Get exposed to various methods of risk assessment and management

COURSE SYLLABUS

Unit 1 :   INTRODUCTION

Environmental Impact Assessment (EIA) – Principles and Concepts - Historical development - EIA in Project Cycle - Legal and Regulatory aspects in India - perspectives and requirements - Sources of Environmental hazards – Environmental and ecological risks – Environmental risk assessment framework – Environmental Auditing – Satellites for Environmental Applications

Unit 2 :   COMPONENTS AND METHODS FOR EIA

Methods: Matrices, Networks, Checklists, Overlay – Connections and combinations of processes - Cost benefit analysis – Analysis of alternatives – Software packages for EIA – Expert systems in EIA - Prediction tools for EIA – Mathematical modelling for impact prediction.

Unit 3 :   EIA MANAGEMENT

Assessment of impacts: Air, Water, Soil, Noise, Biological — Impact mapping using RS and GIS - Cumulative Impact Assessment preparation using GIS – Documentation of EIA findings – organization of information and visual display materials – Types of Reports and Reporting – Planning - Decision making – case studies.

Unit 4 :   TOOLS AND METHODS FOR RISK ASSESSMENT

HAZOP and FEMA methods – Cause failure analysis – Event tree and fault tree modelling and analysis – Multimedia and multi pathway exposure modelling of contaminant migration for estimation of contaminant concentrations in air, water, soils, vegetation and animal products – Estimation of carcinogenic and non carcinogenic risks to human health – Methods in Ecological risk assessment: Probabilistic risk assessments – radiation risk assessment – Data sources and evaluation.

Unit 5 :   RISK MANAGEMENT

Risk communication and Risk Perception – comparative risks – Risk based decision making – Risk based environmental standard setting – Risk Cost Benefit optimization and tradeoffs – Emergency Preparedness Plans using GIS – Design of risk management programs – risk based remediation; Risk communication, adaptive management, precaution and stake holder involvement – Case studies.

Text books :
1. Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Interscience, New Jersey, 2003.
2. Petts, J., Handbook of Environmental Impact Assessment, Vol., I and II, Blackwell Science, London, 1999.
3. Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
4. Kasperson, J.X. and Kasperson, R.E. and Kasperson,R.E., Global Environmental Risks, V.N.University Press, New York, 2003.

References :
1. Mark Burman, Risks and Decisions for Conservation and environmental management, Cambridge University Press. 314 p. ISBN 0521835348.2005.
2. Susan L |Cutter, "Environmental Risks and Hazards" Prentice Hall of India, New Delhi, 1999.
3. Joseph F Louvar and B Diane Louver, Health and Environmental Risk Analysis fundamentals with applications, Prentice Hall, New Jersey, 1997.
4. Lintz, J. and Simonet, Remote sensing of Environment, Addison Wesley Publishing Company, New Jersey, 1998.

II Semester	WEB & MOBILE GIS	L	T	P	C
		3	0	0	3

COURSE LEARNING OBJECTIVES

This course aims to make the students:

CLO-1   Learn advanced GIS concepts

CLO-2   Understand Network models, protocols and architectures.

CLO-3   Learn techniques of Web GIS and Mobile applications.

COURSE OUTCOMES

After completion of course, students would be able to:

CO1   Publish geospatial data in web environment

CO2   Analyse the geospatial layers in web environment

CO3   Establish Server-Client configuration for GIS environment

CO4   Develop applications in web and mobile platforms

CO5   Prepare and publish geospatial data in mobile applications

COURSE SYLLABUS

UNIT-1 :   DISTRIBUTED GIS

Introduction, Distributed GIS – Basic components, Applications of distributed GIS.

UNIT-2 :   NETWORKING

Network Models- OSI reference model, TCP/IP Model, Network environments protocols, Network Architectures - LAN-Ethernet, Token Ring, Wireless LAN, WAN- Circuit Switched and Packet switched

UNIT-3 :   CLIENT/SERVER COMPUTING

Client, Server, Glue, Client-Server Systems, 2-tier, 3-tier & n-tier architectures, DCOM Architecture and Interface, CORBA Architecture.

UNIT-4 :   WEB GIS

History of Web GIS, components of Web GIS, Web GIS v/s Internet GIS - Web Mapping - Static map publishing, clickable maps, Static Web mapping architecture, Interactive web mapping.

UNIT-5 :   CLOUD COMPUTING

Introduction to Cloud Computing, Evolution of Cloud, Cloud Reference Architecture, Virtual Machines & Hypervisors (Type I & II), Xen, VMware, KVM, Virtualization in Cloud, HTML, CSS, JavaScript, XML, JSON, Web Services (REST & SOAP), Service-Oriented Architecture (SOA), Cloud Deployment Models: Public, Private, Hybrid, Cloud Service Models: IaaS, PaaS, SaaS, Cloud service providers: AWS, Microsoft Azure, Google Cloud Platform, Security risks in cloud computing: data breaches, vulnerabilities.

Text books :

1. Harwani, "Developing Web Applications in PHP and AJAX", McGrawHill
2. Tereshenkov, A., "Web GIS Application in Local Government", VDM Verlag, 2009.
3. Zhong-ren peng , Ming- Hsiang Tsou "Internet GIS – Distributed Geographic Information Services For Internet And Wireless Networks" ,
4. Pinde Fu and Jiulin Sun, "Web GIS: Principles and Applications, ESRI Press, 2011
5. Beginning Map Server: Open Source GIS Development (Expert's Voice in Open Source)", Apress; 1st edition (2005)

References :

1. Beginning Map Server: Open Source GIS Development (Expert's Voice in Open Source)", Apress; 1st edition (2005),

II Semester	**COASTAL ZONE MANAGEMENT**	L	T	P	C
		3	0	0	3

COURSE LEARNING OBJECTIVES

This course aims to make the students:

CLO-1   To maximize the benefits provided by the coastal zone

CLO-2   To minimize conflicts and harmful effects of activities upon each other, resources and the environment

CLO-3   To evaluation of measures against pollution, erosion and degradation of coastal areas

COURSE OUTCOMES

After completion of course, students would be able to:

CO1   Manage the demands of the coastal zone as the interface between land and sea

CO2   Explain the Coastal Ecosystem and the role of RS & GIS to study

CO3   Understand the coastal disasters and their mitigations

CO4   Understand the Anthropogenic Disasters effecting the coasts

CO5   Explain various CZM techniques to solve various Coastal problems

COURSE SYLLABUS

Unit 1 :   COASTAL AND LITTORAL ZONES

Definitions and scope of study, Shore zone processes – waves, tides and currents Coastal landforms; River deltas: types of deltas and their morphological variations; Human activities and their impact on the delta-fringe coasts

Unit 2 :   COASTAL WETLANDS

Mangrove swamps, marshes, lagoons, tidal channels/creeks and their significance in coastal stability and economic importance - Continental margins – forms and processes; territorial waters and Exclusive Economic Zone; Sea level changes – factors involved; effects of sea level oscillations on coastal zones; Sea-level rise and coastal vulnerability; Role of Geoinformatics in assessment of coastal vulnerability to sea-level rise

Unit 3 :   COASTAL HAZARDS

Storm surges and Tsunamis, Origin, propagation and run-up of tsunamis; Tsunami impact – role of coastal topography and vegetation; Global warming and Sea-level rise - impact on coastal zones; coastal vulnerability Assessment; Coastal hazard preparedness – coastal protection, education and awareness of coastal communities; Role of Geoinformatics in assessment of coastal vulnerability to tsunami

Unit 4 :   HUMAN ACTIVITY AND COASTAL ENVIRONMENT

Deforestation, agriculture/aquaculture, pollution and coastal structures, and their effect on coastal zones; Coastal vegetation; shelter belts; coastal aquifers; freshwater-seawater interface Morphology of Indian coasts

Unit 5 : COASTAL ZONE MANAGEMENT

Concepts, models and information systems; Coastal Regulations Zones (CRZ) and Coastal Management Zones (CMZ): Indian context Application of remote sensing in coastal zone studies; Role of Geographic Information Systems in coastal zone studies

Textbooks :

1. Coleman, J.M., "Deltas", Continuing education Publication Co.Inc. 1976
2. Davis, A.R. (Jr.), "Coastal Sedimentary Environments", Springer-Verlag, 1985.
3. Beaches and Coasts, King, C.A.M., Edward Arnold, 1972
4. Introduction to Marine Geology and Geomorphology, King, C.A.M., Edward Arnold, 1974
5. Applications in Coastal Zone Research Management, Martin, K.St. (ed), U.N. Institute for Training and Research, 1993.
6. Integrated Ocean and Coastal Management, Sain, B.C., and Knecht, R.W.,UNESCO Publication, 1998.
7. Subtle Issues in Coastal Management, Sudarshan et al., (ed), IIRS, Dehra Dun, 2000.
8. Tsunamis – case studies and recent developments, Satake, K. (ed), Springer, 2005

References :

1. Geomorphology, Bloom, A.L., Prentice-Hall, 1978
2. www.vedas.sac.gov.in.

II Semester	**DRONE TECHNOLOGY AND APPLICATIONS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE LEARNING OBJECTIVES

This course aims to make the students:

CLO-1 Understand the fundamental concepts, history, and classification of drones along with basic aerodynamic principles.

CLO-2 Comprehend regulatory frameworks, safety protocols, and ethical considerations in drone operations.

CLO-3 Explore advanced technologies such as AI, IoT, and cybersecurity impacting modern UAV systems.

COURSE OUTCOMES

After completion of course, students would be able to:

CO1 Describe drone classifications, flight principles, and components with clarity.

CO2 Learn the Remotely Sensed Data using UAVs

CO3 Identify various Sensors used for various applications

CO4 Interpret and apply drone regulations and safety standards effectively.

CO5 Analyse emerging technologies and cybersecurity challenges relevant to UAV applications.

COURSE SYLLABUS

Unit 1 : FUNDAMENTALS OF DRONE TECHNOLOGY

Introduction to Unmanned Aerial Vehicles (UAVs), history and evolution of drones, classification of drones – fixed-wing, rotary-wing, lighter-than-air systems, aerodynamic forces – lift, thrust, drag, gravity, principal flight axes – yaw, pitch, roll, anatomy of a drone – airframe, motors, ESCs, propellers, GPS, IMU, flight controllers, applications in military, agriculture, logistics, and surveillance, emerging drone trends and societal impact.

Unit 2 : DRONE HARDWARE SYSTEMS AND DESIGN PRINCIPLES

Airframe materials and structural types, propulsion systems – brushless motors, ESCs, propeller design, battery technologies – LiPo, smart batteries, electronic subsystems – gyroscope, barometer, GPS, magnetometer, telemetry systems, RC transmitters and receivers, types of UAV configurations – VTOL, hybrid drones, tilt-rotor systems, hardware–software integration, firmware platforms – ArduPilot, PX4, payload management and sensor integration.

Unit 3 : REGULATORY   FRAMEWORK,   SAFETY   &   INDUSTRIAL APPLICATIONS

Indian Drone Rules 2021, DGCA guidelines for UAV operation, classification by weight and functionality, licensing and compliance, geo-fencing and no-fly zones, airworthiness and drone registration, safety regulations and emergency protocols, ethical concerns and privacy issues, industrial applications – agriculture, mapping, mining, construction, disaster response,

law enforcement, delivery systems, entertainment and media, drone-as-a-service (DaaS) models.

Unit 4 :   AI, IoT, CYBERSECURITY AND FUTURE RESEARCH TRENDS

Artificial Intelligence in UAVs – object detection, path planning, target tracking, machine learning for drone decision-making, swarm coordination algorithms, reinforcement learning for navigation, IoT-enabled drones in smart cities, agriculture, public health, and energy systems, cybersecurity threats and mitigation, intrusion detection systems, blockchain in drone security, future UAV trends – edge computing, digital twin, autonomous air mobility, research challenges and future scope.

Unit 5 :   APPLICATIONS USING DRONE TECHNOLOGIES

Agricultural Monitoring, Environmental Monitoring, Disaster Management, Land Use & Urban Planning, Mining and Quarrying, Coastal, Marine, Climate & Weather Studies

Text books :

1. S. N. Mohanty, J. V. R. Ravindra, G. S. Narayana, C. R. Pattnaik, and Y. M. Sirajudeen, "Drone Technology: Future Trends and Practical Applications". Hoboken, NJ, USA: Wiley-Scrivener, 2023.
2. A. Juniper, "The Complete Guide to Drones", Extended 2nd ed. Beverly, MA, USA: Wellfleet Press, 2017.
3. R. Austin, "Unmanned Aircraft Systems: UAV Design, Development and Deployment". Chichester, UK: John Wiley & Sons, 2010.
4. Directorate General of Civil Aviation (DGCA), Drone Rules 2021 and Civil Aviation Requirements (CAR) - Section 3, Series X, Part I. Ministry of Civil Aviation, Govt. of India, Aug. 2021. [Online]. Available: https://dgca.gov.in

References :

1. R. D'Andrea, "Swarm robotics and autonomous drone control," IEEE Robotics & Automation Magazine, vol. 23, no. 4, pp. 100–109, Dec. 2016. [Online]. Available: https://ieeexplore.ieee.org/document/7744818

II Semester	**URBAN & REGIONAL PLANNING**	L	T	P	C
		3	0	0	3

COURSE LEARNING OBJECTIVES
This course aims to make the students:
  CLO-1 To introduce the concepts of urban and regional planning
  CLO-2 To explore the use of geospatial technology in advanced analysis in planning.
  CLO-3 To understand the concept of Urban Sprawl, Urban Flooding, and Urban Heat Island

COURSE OUTCOMES
After completion of course, students would be able to:
  CO1 Gain knowledge of urban and regional planning concepts, the use of geomatics technology in planning and management in urban areas and regions.
  CO2 Familiarize with case studies, inputs from Remote Sensing and GIS.
  CO3 Get exposure in modelling in urban land use and its forecasting.
  CO4 To apply the concept of Urban Sprawl, Urban Flooding, and Urban Heat Island

COURSE SYLLABUS
Unit 1 :   INTRODUCTION
Terminology in Urban planning; Town planning Practices in Developing Countries; Urban & Regional Planning Models; Urban Area delineation Rules; New Towns
Unit 2 :   PLANNING AND DEVELOPMENT
Process of Preparation of Development/Master/Zonal plans; Norms in Urban planning and Building bye-laws; urban Housing, Demand & supply; Types of Housing.
Unit 3 :   IMAGE INTERPRETATION OF URBAN AREAS
Basic Principles; basic reason for applications; factors governing interpretability; Elements of Image interpretation; Techniques of Interpretation; Sequence of activities; Convergence of evidence for urban areas analysis.
Preparation of Urban Sprawl, Urban Flooding, and Urban Heat Island Maps
Unit 4 :   URBAN LAND USE PLANNING
Issues in urban land use mapping; Urban land use classification system; Rules of classifications; Various Scales; Accuracy assessment.
Unit 5 :   BASE MAPS AND CADASTRAL MAPS FOR URBAN AREAS
Characteristics of Base maps; Scale of base maps; base maps for regional/district planning; Photomaps; Ortho-photo maps; cadastral mapping; Preparation of foot-print map; RS and GIS for Property tax assessment.

Textbooks :

1. Bracken, Ian (1981). Urban Planning Methods, Research and Policy Analysis. Mathew and Co., USA.
2. Manual of Remote Sensing, Vol.5:"Remote Sensing of Human Settlements", 2006.
3. Subudhi, A.P., Sokhi, B. S. and Roy, P. S. (2001). Remote Sensing and GIS Applications in Urban and Regional Studies, Human Settlement Analysis Division, Indian Institute of Remote Sensing, Dehradun.
4. Thakur, B. et. al. (Ed.) (2007) "City, Society and Planning", Concept Publishing Co., New Delhi.

References :

1. "Manual-National Land Use Land Cover Mapping using Multi-Temporal Satellite Data". National Remote Sensing Agency, Department of Space, Government of India, (2006)
2. "Urban Development Plans Formulation & Implementation (UDPFI) Guidelines, Vol. 1", Ministry of Urban Affairs & Employment, Government of India, (1996).
3. Rhind, David and Hudson, Ray (1980) "Land Use", Methuen Publishers New Delhi.
4. Landen, David(1966). "Photomaps for Urban Planning", Photogrammetric Engineering, Vol. 31, No.1, pp36-146
5. United Nations Economic and Social Commission for Asia and Pacific. "Manual on GIS for Planners and Decision Makers".

II Semester	DIGITAL IMAGE PROCESSING LABORATORY	L	T	P	C
		0	1	2	2

COURSE LEARNING OBJECTIVES

This course aims to make the students:

CLO-1 To provide hands-on training in acquiring, visualizing, and preprocessing satellite imagery using ERDAS Imagine.

CLO-2 To enable students to perform image enhancement, classification, and spectral index-based analysis.

CLO-3 To develop the ability to validate classification results and interpret multi-temporal changes in land use/land cover.

COURSE OUTCOMES

After completion of course, students would be able to:

CO1 Analyse temporal, spectral and spatial differences of satellite data using image processing software

CO2 Perform image pre-processing and post-processing techniques on a given satellite data

CO3 Classify given satellite data for thematic mapping process

LIST OF EXPERIMENTS

1. Satellite Data downloading from different sources (Bhuvan, USGS Earth Explorer, Alaska Satellite Facility, etc.); Reading and Displaying satellite data.
2. Generation of False Color Composite (FCC)
3. Georeferencing the Satellite image
4. Extracting Area of Interest
5. Generating Histogram of various bands
6. Enhancement using Band ratio
7. Enhancement using different Filtering techniques
8. Spectral Indices – NDVI, NDWI, NDBI,
9. Principal Component Analysis (PCA)
10. Fourier Transform Analysis
11. Unsupervised Classification
12. Supervised Classification
13. Accuracy Assessment
14. Change detection study

   (Above experiments has to be carried out using ERDAS/ENVI / ILWIS/GRASS)

References :
1. ERDAS IMAGINE 2022 user manuals

II Semester	**GEOSPATIAL SIMULATION LABORATORY**	L	T	P	C
		0	1	2	2

COURSE LEARNING OBJECTIVES

This course aims to make the students:

CLO-1   Experience the 3-D modelling and analysis

CLO-2   Understand various models

CLO-3   Program on R-software

COURSE OUTCOMES

After completion of course, students would be able to:

CO1   Differentiate between various Interpolation methods

CO2   Delineate watersheds based on DEM and SWAT models

CO3   Build models using Model Builder in ArcGIS & QGIS

CO4   Perform various analysis on Hydrology using Hydrological models

CO5   Program on R software and Python scripting

LIST OF EXPERIMENTS

1. Spatial Interpolation - IDW using Groundwater Kit
2. DEM Applications
   a. Slope & Aspect
   b. Viewshed Analysis
3. Watershed Analysis
   a. Flow Direction
   b. Flow Accumulation
   c. Stream Network
   d. Stream Ordering
   e. Watershed Delineation
4. Geospatial Models
   a. Model Builder tools (ArcGIS/QGIS)
   b. Applications: Groundwater Potential Zones, Soil Erosion Zone, etc.,
5. Hydrological Modeling / Analysis
   a. HEC-RAS, HEC-HMS.
   b. Google Earth Engine (JavaScript)
6. Programming
   a. Python Script (ArcGIS/QGIS)
   b. R programming Applications: Visualization & Analysis, Model building.

Textbooks :

1. ArcPy Introductory Tutorial Nick Eubank May 28, 2014
2. An Introduction to R, W. N. Venables, D. M. Smith and the R Core Team, 2018
3. https://www.hec.usace.army.mil/software/

III Semester	**RESEARCH METHODOLOGY AND IPR**	L	T	P	C
		3	0	0	3

COURSE LEARNING OBJECTIVES

This course aims to make the students:

CLO-1 Understand research methodology fundamentals including problem identification, data collection, and analysis.

CLO-2 Develop skills in technical writing, literature review, and ethical research practices.

CLO-3 Gain knowledge of IPR concepts and recent developments at national and international levels.

COURSE OUTCOMES

After completion of course, students would be able to:

CO1 Identify and formulate a research problem with clear objectives and scope.

CO2 Conduct effective literature reviews and apply ethical standards in research and technical writing.

CO3 Prepare and present a structured research proposal for academic or industrial review.

CO4 Explain the process of patenting, types of intellectual property, and international IPR frameworks.

CO5 Analyse recent trends and case studies in IPR, including applications in biotechnology, software, and traditional knowledge.

COURSE SYLLABUS

Unit 1 : RESEARCH PROBLEM AND SCOPE FOR SOLUTION

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit 2 : FORMAT

Effective literature studies approaches, analysis, Plagiarism, Research ethics. Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit 3 : PROCESS AND DEVELOPMENT

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, patenting under PCT.

Unit 4 : PATENT RIGHTS

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit 5 :   NEW DEVELOPMENTS IN IPR

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Textbooks :

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2ⁿᵈ Edn, "Research Methodology: A Step by Step Guide for beginners"

References :

1. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
2. Mayall, "Industrial Design", McGraw Hill, 1992.
3. Niebel, "Product Design", McGraw Hill, 1974.
4. Asimov, "Introduction to Design", Prentice Hall, 1962.
5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
6. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008