NATIONAL INSTITUTE OF TECHNOLOGY WARANGAL

M. Tech in

REMOTE SENSING AND GIS

(Effective from 2021-22)

DEPARTMENT OF CIVIL ENGINEERING

Vision and Mission of the Institute

National Institute of Technology Warangal

VISION

Towards a Global Knowledge Hub, striving continuously in pursuit of excellence in Education, Research, Entrepreneurship and Technological services to the society

MISSION

- Imparting total quality education to develop innovative, entrepreneurial and ethical future professionals fit for globally competitive environment.
- Allowing stake holders to share our reservoir of experience in education and knowledge for mutual enrichment in the field of technical education.
- Fostering product-oriented research for establishing a self-sustaining and wealth creating centre to serve the societal needs.

Vision and Mission of the Department

Department of Civil Engineering

VISION

To be a knowledge nerve centre in Civil Engineering education, research, entrepreneurship and industry outreach services for creating sustainable infrastructure and enhancing quality of life.

MISSION

- Generate a specialized cadre of Civil engineers by imparting quality education and training.
- Attain international standards in teaching, research and consultancy with global linkages.

Department of Civil Engineering:

Brief about the Department:

The Department of Civil Engineering was established in 1959, along with the setting up of the institute, that is, REC Warangal. The Department offers undergraduate and eight postgraduate programs in addition to Ph.D. The Department has highly committed faculty who are well qualified and are members of several national and international policy making and advisory bodies, including the BIS. The Department is a recognized QIP center since 1978 to offer Ph.D. programs to faculty of other institutes. The Department is known for its cutting-edge research and believes in disseminating the knowledge through publishing in highly reputed journals and patenting the research work.

The Department maintains excellent industry-institute linkages. Most of the students are placed in reputed companies, Government organizations, and Higher Educational Institutes in India and abroad. The alumni who are important stakeholders of the Department actively guide and provide valuable inputs. They constantly peer review the syllabus and curriculum to make students industry-ready.

The Civil Engineering Department, apart from Teaching and R&D, also does an enormous amount of consultancy, which adds up to the institutional internal revenue generation and involves faculty and students in challenging field problems. There are six centers of excellence in the Department, and most laboratories have state-of-the-art equipment.

The faculty of the Department are actively involved in sponsored projects and have prestigious projects like SPARC, BRICS, IMPRINT, DST, SERB, DBT, ARDB, to name a few. The Department takes pride in having conducted the highest number of GIAN and SPARC programs.

The Civil Engineering Department has MoUs with highly reputed organizations like NAAC, NCCBM, WALAMTARI, SCCL, INVENTA, PSI, among others, and has collaborations with several foreign universities and companies such as – Texas A&M, NCAR-Colorado, PTV Group Germany, etc.

List of Programs offered by the Department:

Program	Title of the Program
B.Tech.	Civil Engineering
M.Tech.	Engineering Structures
	Water Resource Engineering
	Geotechnical Engineering
	Transportation Engineering
	Remote Sensing and Geographical Information Systems
	Environmental Engineering
	Construction Technology and Management
	Waste Management
Ph.D.	Civil Engineering

Note: Refer to the following weblink for Rules and Regulations of M.Tech. program:
https://www.nitw.ac.in/main/MTechProgram/rulesandregulations/

M.Tech. – Remote Sensing and GIS

Program Educational Objectives

PEO-1	Apply principles of Remote sensing and GIS to collect, map and retrieve spatial information.
PEO-2	Plan, assess and evaluate natural and manmade systems using geospatial models and methods
PEO-3	Use geospatial tools and techniques for hazard mitigation and resource planning.
PEO-4	Pursue research and develop capabilities to handle multi-disciplinary field projects
PEO-5	Work in teams and demonstrate leadership skills with professional ethics.

Program Articulation Matrix

PEO / Mission Statements	PEO1	PEO2	PEO3	PEO4	PEO-5
MS1	3	2	2	3	2
MS2	1	2	2	3	2

1-Slightly; 2-Moderately; 3-Substantially

M.Tech. – Remote Sensing and GIS

Program Outcomes

PO-1	Engage in critical thinking and pursue research/ investigations and development to solve practical problems.
PO-2	Communicate effectively on complex engineering activities with the engineering community and with society at large, write and present substantial technical reports.
PO-3	Demonstrate higher level of professional skills to tackle multidisciplinary and complex problems related to “Remote Sensing and GIS”.
PO-4	Apply principles of Remote sensing and GIS to collect, map and retrieve spatial information
PO-5	Plan, assess and evaluate natural and manmade systems using geospatial models and methods
PO-6	Develop geospatial models and tools to address the social and engineering problems

SCHEME OF INSTRUCTION

M.Tech. Remote Sensing and GIS – Course Structure

I - Year, I – Semester

S. No.	Course Code	Course Title	L	T	P	Credits	Cat. Code
1	CE5501	Principles of Remote Sensing	3	0	0	3	PCC
2	CE5502	Geographical Information Systems	3	0	0	3	PCC
3	CE5503	Photogrammetry	3	0	0	3	PCC
4		Elective – I	3	0	0	3	PEC
5		Elective – II	3	0	0	3	PEC
6		Elective – III	3	0	0	3	PEC
7	CE5504	Remote Sensing and Photogrammetry Laboratory	0	1	2	2	PCC
8	CE5505	Geographical Information Systems Laboratory	0	1	2	2	PCC
9	CE5548	Seminar – I	0	0	2	1	SEM
		Total	**18**	**2**	**6**	**23**	

I - Year, II – Semester

S. No.	Course Code	Course Title	L	T	P	Credits	Cat. Code
1	CE5551	Geospatial data Processing and Modeling	3	0	0	3	PCC
2	CE5552	Satellite Image Processing	3	0	0	3	PCC
3	CE5553	Global Navigation Satellite System	3	0	0	3	PCC
4		Elective – IV	3	0	0	3	PEC
5		Elective – V	3	0	0	3	PEC
6		Elective – VI	3	0	0	3	PEC
7	CE5554	Satellite Image Processing Laboratory	0	1	2	2	PCC
8	CE5555	Advanced GIS Laboratory	0	1	2	2	PCC
9	CE5598	Seminar – II	0	0	2	1	SEM
		Total	**18**	**2**	**6**	**23**	

SCHEME OF INSTRUCTION

M.Tech Remote Sensing and GIS – Course Structure

II - Year, I – Semester

S. No.	Course Code	Course Title	Credits	Cat. Code
1	CE6547	Comprehensive Viva	2	CVV
2	CE6549	Dissertation Part - A	12	DW
		Total	**14**	

II - Year, II – Semester

S. No.	Course Code	Course Title	Credits	Cat. Code
1	CE6599	Dissertation Part - B	20	DW
		Total	**20**	

Program Elective Courses

Elective-1, 2, 3 (I Year, I Semester)		
S. No.	**Course Code**	**Course**
1	CE5511	Programming Methods for Geospatial Systems
2	CE5512	Database Management Systems
3	CE5513	Remote Sensing Geology
4	CE5514	Advanced Statistical Methods
Elective-4, 5, 6 (I Year, II Semester)		
S. No.	**Course Code**	**Course**
1	CE5561	Close Range Photogrammetry and Laser Scanning
2	CE5562	Thermal, Microwave and Hyperspectral Remote Sensing
3	CE5563	Web and Mobile GIS
4	CE5564	Atmospheric Remote Sensing
5	CE5565	Argo Remote Sensing

Note: In addition to the above electives, students can choose electives from other MTech programs of the department based on the suggestions of faculty advisor/supervisors

Credits in Each Semester					
Cat. Code	**Sem-I**	**Sem-II**	**Sem-III**	**Sem-IV**	**Total**
PCC	13	13	0	0	26
PEC	9	9	0	0	18
SEM	1	1	0	0	2
CVV	0	0	2	0	2
DW	0	0	12	20	32
Total	**23**	**23**	**14**	**20**	**80**

PCC: Professional Core Course
PEC: Professional Elective Course
SEM: Seminar
CVV: Comprehensive Viva Voce
DW: Dissertation Work

DETAILED SYLLABUS

M.Tech. – Remote Sensing and GIS

Course Code: CE 5501	PRINCIPLES OF REMOTE SENSING	Credits 3-0-0: 3

Course Outcomes:

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

CO1	Select the type of remote sensing data for mapping earth surface features
CO2	Analyze the energy interactions with the atmosphere and earth surface features
CO3	Identify the earth surface features from satellite images
CO4	Apply remote sensing techniques for natural resources evaluation

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	3	1	1
CO2	3	2	2	1		1
CO3	3	1	1	2	1	1
CO4	1	3	2		2	1

Syllabus:

Chapter-1 Physics of Remote Sensing: Sources of Energy, Active and Passive Radiation, Electromagnetic Radiation - Reflectance, Transmission, Absorption, Thermal Emissions, Interaction with Atmosphere, Atmospheric windows, Spectral reflectance of Earth's surface features, and Multi concept of Remote Sensing.

Chapter-2 Platforms and Sensors: Various types of platforms, different types of aircraft, manned and unmanned spacecrafts used for data acquisition - characteristics of different types of platforms - airborne and spaceborne, IRS Satellite Sensors, LANDSAT, SPOT, IKONOS, Quickbird, Geoeye, Kompsat, Worldview II & III, Microwave, ALOS, Planet Data, Sentinel, SMAP, MODIS etc

Chapter-3 Data Acquisition Systems: Optical, Thermal and Microwave; Resolutions - spatial, spectral, radiometric and temporal, signal to noise ratio, LiDAR data acquisition and processing.

Chapter-4Applications: Applications of Remote sensing in various Engineering and Science domains such as Agriculture, Forest, Soil, Geology, LU/LC, Water Resources, Urban, Disaster Management, etc.

Learning Resources:

Text Books:

1. Introduction to Remote Sensing, James B. Campbell & Randolph H. Wynne., The Guilford Press, 2011.
2. Introduction to the physics and techniques of Remote Sensing, Charles Elach & Jakob van Zyl., John Wiley & Sons publications, 2006.
3. Remote Sensing and Image Interpretation, Lillesand T.M & Kiefer R.W., John Wiely and Sons, 2015

Reference Books:

1. Thermal microwave radiation: Applications for remote sensing, Chritian Matzler., The institution of Engineering and Technology, London, 2006
2. Remote Sensing: Models and Methods for Image Processing, Schowengerdt, R. A., Academic Press, 2007.
3. Introduction to Remote Sensing, Cracknell, A.P., Second Edition, Tylor & Francis, London, 1991.

Online Resources:

1. https://nptel.ac.in/courses/105/108/105108077/
2. https://nptel.ac.in/courses/105/101/105101206/
3. https://nptel.ac.in/courses/105/107/105107201/

Course Code: CE 5502	GEOGRAPHICAL INFORMATION SYSTEMS	Credits 3-0-0: 3

Course Outcomes:

At the end of the course, the student will 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	Identify and rectify mapping inaccuracies
CO5	Conceptualize a GIS project

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1			3		2	
CO2	3	3	2		1	
CO3	3	2	2		1	2
CO4	2	2	1			1
CO5	3	2	2	2		

Syllabus:

Chapter- 1 Map: Mapping concepts, analysis with paper based maps, limitations, Computer Automated Cartography – History and Developments, GIS- Definition, advantages of digital maps, projections and coordinate systems.

Chapter- 2 Fundamentals of GIS: Information Systems, Modelling Real World Features Data, Data Models – Spatial and Non-spatial, Components, Data Collection and Input, Data Conversion, Metadata.

Chapter- 3 Database Management: Database Structures, Files; Standard Data Formats, Compression Techniques, Hardware and Software.

Chapter- 4 Topology: Types of Errors, Editing and Error Rectification, Types of Topology, Modelling topological Relationships, Tolerances.

Chapter- 5 Spatial Analysis: Proximity Analysis, Overlay Analysis, Buffer Analysis, Network Analysis – Route alignment, Canal alignment; Digital Elevation Models. Map composition, Preparation of qualitative and quantitative maps, levels of maps, map elements and map scales, 3D Analyst

Chapter- 6 GIS Project Planning and Implementation: Understanding the Requirements, Phases of Planning, Specifications, and Procedure for analysis projects and design projects.

Learning Resources:

Text Books:

1. Geographic Information systems and Science, Paul Longley., John Wiley & Sons, 4th Edition,2015.
2. Introduction to Geographic Information Systems, 9th Edition, Kang Tsung Chang., Tata Mc Graw Hill Publishing Company Ltd, New Delhi, 2018.
3. Concepts and Techniques of Geographic Information Systems, C.P.Lo & Albert K. W.Yeung, second Edition, Prentice Hall India Pvt. Ltd, 2016.

Reference Books:

1. Principles of GIS for Land Resource Assessment, Burrough, P.A., Oxford Publications, 2005.
2. The design and implementation of Geographic Information Systems, John E. Harmon & Steven J. Anderson., John Wiley & Sons, 2003.

Online Resources:

1. https://nptel.ac.in/courses/105/102/105102015/
2. https://nptel.ac.in/courses/105/107/105107155/
3. https://nptel.ac.in/courses/107/105/107105088/

Course Code: CE 5503	PHOTOGRAMMETRY	Credits 3-0-0: 3

Course Outcomes:

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

CO1	Acquire, measure and analyze aerial photographs
CO2	Interpret aerial photographs
CO3	Perform orientation of photos to generate orthophotos and mosaics using aerial photographs and UAV data
CO4	Analyze the point cloud data for documentation and archiving of features

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	2	2	2
CO2	1	2	2	3	2	1
CO3	1	1	1	2	3	2
CO4	2	2	3	2	2	3

Syllabus:

Chapter-1 Fundamentals of Aerial Photography Systems: Historical development – classification, application – analogue and digital cameras – geometry of vertical photographs – scale – coordinate transformations, relief displacement – tilted and oblique photographs, Flight Planning, Interpretation keys.

Chapter-2 Stereoscopy: Stereoscopes, stereoscopic view and its exaggeration – parallax equation – parallax measurement–parallax bar-measurement of heights and determination of slopes- stereoscopic plotting instruments.

Chapter-3 Analytical Photogrammetry: Concepts of orientation-interior, relative and absolute orientation of aerial photographs, Aerial triangulation, Block adjustment, Orthophotos, Kinds of mosaics- controlled, semi-controlled, uncontrolled.

Chapter-4 Digital Photogrammetry: Automatic DTM acquisition from stereo pairs or image blocks, Colour balancing, Digital image enhancement, Feature extraction. DEM Applications in Civil Engineering

Chapter-5 UAV: History of unmanned air vehicle (UAV) development. Classifications and components of UAVs – Design standards and Regulatory aspects – Environment, Budget & Time, Airframe Design & Payload, Flight planning, Mosaicing, Ground control, Feature detection and mapping, Point cloud, 3D Models, DEM generation, Orthophoto generation, UAV Applications.

Learning Resources:

Text Books:

1. Elements of Photogrammetry with Application in GIS, Wolf P. R., McGraw Hill International Book Company, Fourth Edition, 2014.

2. Photogrammetry, Moffitt, Francis H. & Mikhail, Edward M., Harper and Row Publishers, 1980.
3. Fundamentals of Computational Photogrammetry, Sanjib K Ghosh., Concept Publishing Company, 2005
4. Introduction to UAV Systems, Paul Gerin F & Thomas James Gleason., Wiley Publications, 2012

Reference Books:

1. Digital Photogrammetry Theory and Applications, Wilfried Linder., Springer 2013
2. Unmanned Aircraft Systems, Reg Austin, Wiley Publications, 2010
3. Aerial Photography and Image Interpretation, Paine D. P., Kiser J. D., John Wiley & Sons, Inc., 2012.
4. Introductory Course in Photogrammetry, Zorn H.C., Sixth Edition, ITC, Netherlands, 1980.

Online Resources:

1. https://nptel.ac.in/courses/105/104/105104100/

Course Code: CE 5511	PROGRAMMING METHODS FOR GEOSPATIAL SYSTEMS	Credits 3-0-0: 3

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

CO1	Prepare the algorithms and programming syntax
CO2	Develop programs in C++ and Java
CO3	Apply the concepts of object-oriented programming
CO4	Design and develop programs for geospatial systems

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	2	3	1	2
CO2	1	3	1	2	1	
CO3	1	1	1	3	2	1
CO4	1	1	1	3	2	

Syllabus:

Chapter- 1 Oops Concepts: Classes, Objects, Polymorphism, Inheritance, Encapsulation, Overloading.

Chapter- 2 Basics of C++: Elements of C++, input and output statements, decision making, functions, iterations and loops. Objects and Classes.

Chapter- 3 Arrays and Strings: Operator Overloading. Inheritance. Pointers. Virtual Functions and Other Subtleties; Streams and Files; Multi-file Programs, Templates and Exceptions, Object-Oriented Software Development.

Chapter- 4 Java Programming: data types, variables and arrays, operators, control statements, classes, objects, methods – Inheritance; Packages and Interfaces, Exception handling, Multithreaded programming, Strings, Input /Output.

Learning Resources:

Text Books:

1. Object Oriented Programming with C++ - TMH, E. Balagurusamy., 7th Edition, 2017.
2. C++ The complete Reference, Herbert Schildt, 4th Edition, 2017.
3. Beginning C# Object-Oriented Programming, Clark, Second Edition, Apress, 2013

Reference Books:

1. The Java 2: Complete Reference, Herbert Schildt , 5th Edition, TMH, 2017.
2. Java: How to program, H.M. Deitel, P.J. Deitel, 5th Edition, Prentice Hall of India private limited, 2003.
3. Object Oriented Programming in C++, Robert Lafore, 4th Edition, Pearson Pub., 2008
4. Object-Oriented Programming and Java,2., Poo, D., Kiong, D., & Ashok, S., Second Edition, Springer-Verlag London Limited, 2008

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105151/
2. https://onlinecourses.nptel.ac.in/noc21_cs03/preview
3. https://onlinecourses.nptel.ac.in/noc19_cs84/preview

Course Code: CE 5512	DATABASE MANAGEMENT SYSTEMS	Credits 3-0-0: 3

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

CO1	Analyze the components of Database management system and file
CO2	Apply the concepts of SQL and its use to manage the databases
CO3	Carry out the Query, update database using SQL
CO4	Design and build a simple database system using DBMS software for GIS

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1		3		
CO2	1	2		3		1
CO3	2	3	1	2	2	
CO4	1	2	1	3	2	1

Syllabus:

Chapter-1: Need for Data Base Management Systems (DBMS) Components of DBMS, Records and files, Data Models, Data Associations, Entities, Attributes and Associations, Relationships among entities, Data models classification

Chapter-2: Normalization File Organization, Constituents of file, Operations on files, Sequential files, Index- Sequential files, Direct files Relational Database

Chapter-3: Attributes and domains, Tuples, Relations and their schemes, Relation Representation, Relational operations, Relational algebra, Relational calculus, Implementation Relational Database Manipulation

Chapter-4: Structured Query Language (SQL), Query Language (QUEL) Query-by-Example (QBE), Data Manipulation and retrieval using SQL, QUEL and QBE

Chapter-5: Concepts of Relational database design. Geospatial databases, database management in GIS Introduction to Big Data Management, Data warehouse

Learning Resources:

Text Books:

1. Database Management Systems, Raghu Ramakrishnan &Jihannes Gehrke., McGraw-Hill Higher Education, 2000
2. Fundamentals of Database Management Systems., Mukesh Negi., BPB Publications, 2019
3. Introduction to Database Management Systems., Atul Kahate., Pearson, 2006

Reference Books:

1. Database Management Systems- Understanding and applying database technology., Michael M. Gorman., Butterworth-Heinemann Ltd., 2014
2. Spatial Databases- With Application to GIS., Philippe Rigaux, Michel Scholl & Agnes Voisard., Morgan Kaufmann Publishers, 2002

Online References:

1. https://gistbok.ucgis.org/bok-topics/spatial-database-management-systems
2. https://www.youtube.com/watch?v=qH2-xwUz3tU

Course Code: CE 5513	REMOTE SENSING GEOLOGY	Credits 3-0-0: 3

Course Outcomes:

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

CO1	Interpret the satellite imageries for geological features
CO2	Identify and analyse geological structures from satellite images
CO3	Apply geophysical principles for subsurface exploration
CO4	Identify ground water potential zones, landslide hazard zones and mineral resources

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	1	2
CO2	2	2	2	2	2	2
CO3	-	3	1	-	2	2
CO4	3	2	2	2	2	2

Syllabus:

Chapter-1 General: General geology, geomorphology, significance of remote sensing in geology, satellite data interpretation for geological mapping.

Chapter-2 Lithology: Identification and interpretation of igneous, metamorphic and sedimentary rock types, Spectral analysis of rocks Detection

Chapter-3 Geomorphology: Landforms formed due to weathering/ denudation, mass wasting, fluvial action, Aeolian, coastal, karst, volcanic, and glacier landforms.

Chapter-4 Structural Analysis: Iidentification and analysis of structural elements - bedding, folds, faults, joints, faults, unconformities. Field geology, structural problems and interpretation of structural maps (exercise).

Chapter-5 Engineering geology: Engineering properties of rocks, Strength and failure behavior of rocks, Rock mass strength classification, Construction materials. Mass movement types and classifications of landslides, Landslide causes; mapping and monitoring of landslides; Landslide hazard zonation; Landslide hazard mitigation and management, Assessment Dam and Reservoir site selection: Criteria for suitable dam/ reservoir site selection in different geological setting; study for dam/reservoir site selection

Chapter-6 Exploration Techniques: Subsurface exploration techniques, geophysical investigations – electrical resistivity and seismic methods. Hydrogeology - principles of ground water and ground water geology Ground water flow, surface and ground water interaction; controls of ground water occurrence and movement Ground water geology: Hydrogeological properties of different rocks, structures and landforms and their detection from remotely sensed data, Ground water targeting and resource assessment Ground water targeting in

different geologic terrains, rain water harvesting, artificial ground water recharge.

Learning Resources:

Text Books:

1. Remote Sensing Geology, Ravi P. Gupta, Springer Verlag Publications, 2017.
2. Remote sensing: Principles and Interpretation, Floyd F. Sabins., W.H. Freeman and Company, 2020.
3. Text Book of Engineering Geology, N. Chenna Kesavulu., Mac Millan Ltd., New Delhi. 2018

Reference Books:

1. Principles of Geomorphology, Thornbury, W.D., New Age International Publishers, 2018.
2. Image Interpretation in Geology, Druary, S.A., Allen and Unwin Ltd, 2004.
3. Remote Sensing and Image Interpretation, Thomas Lillesand, Ralph W. Kiefer, Jonathan Chipman, Wiley Publishers, 2015
4. Fundamentals of Remote Sensing, George Joseph, C Jeganathan, University Press, 2015

Online Resources:

1. https://www.nrcan.gc.ca/maps-tools-publications/satellite-imagery-air-photos/tutorial-fundamentals-remote-sensing/9309

Course Code: CE 5514	ADVANCED STATISTICAL METHODS	Credits 3-0-0: 3

Course Outcomes:

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

CO1	Perform exploratory data analysis
CO2	Analyze and apply tools of regression analysis to model relationship between variables and make predictions given a set of input variables
CO3	Apply appropriate methods in order to formulate and examine statistical associations between variables within a data set
CO4	Apply advanced statistical modeling techniques to model wide range of real-world relationships

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	2	1	1
CO2	2	3	2	2	2	2
CO3	-	2	1	-	2	1
CO4	3	2	2	3	-	2

Syllabus:

Fundamentals of Statistics and Probability: Organization of Data: Frequency Distribution, Measures of Central Tendency and Dispersion Moments of Distribution, Skewness and Kurtosis. Events, Randomness, Sample, Conditional Probability and Independence, Bayes Theorem, Discrete and Continuous Probability random variables.

Probability distribution and Statistical Test: Joint Probability, Conditional Probability. Binomial, Poisson, Hypergeometric, Multinomial, Gamma, Exponential and Normal distributions. Hypothesis Testing Involving one and univariate population for large samples, Chi- Square, t, F tests,

Statistical Modeling: Point and Interval Estimation, parametric Estimation, Method of Estimation (Maximum likelihood estimation, method of moments), Regression Analysis, Multivariate Techniques, Factor Analysis, Linear Discriminant Analysis. Principal component analysis (PCA) and Trend Surface Analysis (TSA)

Geostatistical Applications: Expectations, Moment Generating and Characteristic Functions, Semi-variogram, Auto correlation, Linear Estimation, Kriging & cokriging Equations, Nonlinear estimation, Semi- variogram and Normalized Data, Non-parametric Estimation, Conditional Simulation, Multivariate Simulation. Introduction to SPSS/ PAST/R

Introduction to Machine Learning Techniques: Types of learning, hypothesis space and inductive bias, evaluation, cross-validation. Linear regression, Decision trees, overfitting. Support Vector Machine, Kernel function and Kernel SVM. Neural network: Perceptron, multilayer network, backpropagation, introduction to deep neural network.

Learning Resources:

Text Books:

1. Matrix and Linear Algebra, Kanti Bhushan Dutta PHI Learning Private Limited, Second Edition (Revised), India, 2014
2. Murray R. Spiegel Theory and Problems of Probability and Statistics, McGraw-Hill Book Company, 1980.
3. Probability and Statistics for Engineers and Scientists, Ronald E. Walpole, Raymond H. Meyers & Sharon L. Meyers, Pearson Education, 2012

Reference Books:

1. How to Think Like a Computer Scientist: Learning with Python, Downey, A., Wentworth, P., Elkner, J. & Meyers, C., O'Reilly Media, Inc. 2016.
2. Introductory statistics with R, Dalgaard P., Springer, ISBN 978-0-387-79054-1(2008)
3. The Geospatial Desktop: Open Source GIS and Mapping, Sherman, G. Locate Press. 2012
4. Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies, Kelleher J.D., Namee B.M., and D'Arcy A., 2015

Online Resources:

1. http://ecoursesonline.iasri.res.in/course/view.php?id=265
2. https://www.youtube.com/channel/UCLqEr-xV-ceHdXXXrTId5ig
3. https://www.youtube.com/playlist?list=PLh35GyCXlQaQ1LNGWr4vCD9AGOGni8yxq

Course Code: CE 5504	REMOTE SENSING AND PHOTOGRAMMETRY LABORATORY	Credits 0-1-2: 2

Course Outcomes:

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

CO1	Interpret remote sensing data
CO2	Map earth surface features
CO3	Perform orientation of photographs
CO4	Generate ortho images and elevation models

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	2	2	1	1
CO2	1	2	1	3		1
CO3	1	2	2	2	1	1
CO4	2	3	2	2	1	1

Syllabus:

1. Remote Sensing Laboratory: Creation of spectral signature curves of various features Mapping of
    a. Land use and land cover
    b. Geological and structural features
    c. Drainage pattern and surface water bodies
    d. Hydro-geomorphology for ground water potential zones
    e. Urban growth and transportation network
    f. Watershed delineation
2. Photogrammetry Laboratory:
    a. Importing Satellite/Aerial data, performing interior and exterior orientation
    b. Automatic, Semi-Automatic feature extraction
    c. DEM generation from stereo satellite images, Editing, Accuracy aspects
    d. Ortho image generation

Learning Resources:

Text Books:

1. Remote Sensing and Image Interpretation, Lillesand T.M and Kiefer R.W., John Wiley and Sons,2015.
2. ERDAS Software manual
3. Photogrammetric Software manual

Course Code: CE 5505	GEOGRAPHICAL INFORMATION SYSTEMS LABORATORY	Credits 0-1-2: 2

Course Outcomes:

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

CO1	Prepare the different geospatial layers
CO2	Compute geometric measurements and perform spatial analysis
CO3	Create high-quality maps and associated graphics
CO4	Integrate different geospatial layers

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	2	2	1	1
CO2	1	2	1	3		1
CO3	1	2	2	2	1	1
CO4	2	3	2	2	1	1

Syllabus:

Importing maps and layers from various sources
Georeferencing and projection
Digitization of Points and Lines
Editing Map Elements
Attribute Data Entry and Manipulation
Cleaning, Building and Transformation
Data Analysis – Overlay, Buffer
Map Generation with Patterns and Legends
Buffer Analysis
Network Analysis

Learning Resources:

1. ArcGIS user manuals,
2. QGIS User Manuals

Course Code: CE 5548	Seminar – I	Credits 0-0-2: 1

Course Outcomes:

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

CO1	Select a topic relevant to geospatial technologies
CO2	Undertake a critical review of the literature on the chosen topic
CO3	Prepare and present a technical report
CO4	Present a technical talk on the chosen topic

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	-	-	2	-
CO2	2	-	-	-	2	-
CO3	1	1	1	1	2	2
CO4	2	2	2	1	-	1

Syllabus:

The student can choose any topic, of his choice, pertaining to Remote Sensing and GIS technologies. Topic should be a relevant and currently researched one. Students are advised to refer articles published in current journals in the area of geospatial applications for choosing their seminar topics. Student should review minimum of 5 to 6 research papers relevant to the topic chosen, in addition to standard textbooks, handbooks, etc. Students are required to prepare a seminar report, in the standard format and give presentation to the Seminar Assessment Committee (SAC) in the presence of their classmates.

Learning Resources:

1. Remote sensing, GIS and Photogrammetry Journals, Conference Proceedings
2. Research Articles / Reports available on Internet
3. Remote sensing and GIS Textbooks and Handbooks

Course Code: CE 5551	GEOSPATIAL DATA PROCESSING AND MODELING	Credits 3-0-0: 3

Course Outcomes:

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

CO1	Apply advanced GIS tools
CO2	Prepare GIS data for various elevation models
CO3	Solve geospatial problems using programming tools
CO4	Analyze GIS data using complex geospatial models

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2	3	2	1
CO2	2	3	3	2	2	1
CO3	3	3	3	3	2	2
CO4	2	2	2	2	1	1

Syllabus:

Interpolation Methods: Local and Global methods of Interpolation, Kriging methods, Geo-statistical Methods.

DTM Applications: Slope and aspect; site selection studies, viewshed and watershed analysis; Working with Open Source DEM's

GIS Models: Modelling Process; Classification; Model builder tools.

Programming Tools: Python, R programming and MATLAB concepts for geo-processing tools

Free and Open Source GIS: Components, Data Sources, Free and open source GIS software and applications

Learning Resources:

Text Books:

1. Principles of GIS for Land Resource Assessment, Burrough, P.A., Oxford Pub., 2005.
2. Concepts and Techniques of Geographic Information Systems, C.P.Lo& Albert K. W.Yeung, second Edition, Prentice Hall India Pvt.Ltd, 2016.
3. Remote Sensing and Image Interpretation, Lilles T.M and Kiefer R.W., John Wiley, 2015

Reference Books:

1. Remote Sensing Imagery, Florence Tupin, Jordi Inglada and Jean-Marie Nicolas, ISTE and Wiley, 2014
2. Principles of GIS for Land Resource Assessment, Burrough, P.A., Oxford Publications, 2005.

Online References:

1. https://nptel.ac.in/courses/105/102/105102015/
2. https://nptel.ac.in/courses/105/107/105107155/
3. https://nptel.ac.in/courses/107/105/107105088/

Course Code: CE 5552	SATELLITE IMAGE PROCESSING	Credits 3-0-0: 3

Course Outcomes:

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

CO1	Analyze remote sensing data using image processing techniques
CO2	Classify the remote sensing data
CO3	Evaluate the accuracy of image classification
CO4	Apply advanced processing methods to map geographical features

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	-	-	-	1
CO2	1	3	2	3	2	2
CO3	3	-	3	1	2	1
CO4	-	2	1	1	2	-

Syllabus:

Chapter- 1 Data Products and Image Preprocessing: Data Products and Their Characteristics, Digital image formation, digital image display mechanism, image histograms, look up table data, Pre-processing – Atmospheric, Radiometric, Geometric Corrections - Basic Principles of Visual Interpretation, Ground Truth, Orthorectification, Applications

Chapter- 2 Image enhancements: Linear and non-linear Contrast enhancement techniques, density slicing, pseudo colour images, spatial enhancement techniques (convolution filtering), spectral enhancement techniques, Image algebra, PCA, data fusion techniques;

Chapter- 3 Image Classification Techniques: Supervised Classification, Training set - Statistical computation, understanding feature space & scatter plots, signature purity & separability, Signature Baye's decision rule, non-parametric & parametric classification techniques, minimum distance rule, Parallelepiped algorithm, maximum like-hood method, unsupervised and hybrid classification techniques, classification analysis - confusion matrix, error analysis & kappa coefficient, Analysis of Multi-Temporal series and change detection.

Chapter- 4 Advanced classification techniques: Learning methods, Object, Texture, Object based Fuzzy, ANN and SVM classification techniques, sub-pixel mixture analysis; Object Oriented Image Classification

Chapter- 5 Image Processing: Segmentation - Methods, MDL, Watershed, Mean-shift, Edge detection; Spectral indices - Vegetation indices, water related indices, indices related to cloud properties, Google Earth Engine platform for satellite data processing,

Learning Resources:

Text Books:

1. Digital Image Processing, John R J, Introductory Prentice Hall, New Jersey,2016.
2. Remote Sensing Imagery, Florence Tupin, Jordi Inglada and Jean-Marie Nicolas, ISTE and Wiley, 2014.

3. Remote Sensing and Digital Image Processing, Jarocińska, Anna, van der Meer, Freek D., Springer, 2016

Reference Books:

1. An Introduction to Support Vector Machines, Nello Cristiani and John Shawe Taylor., Cambridge University Press, 2013
2. Remote Sensing and Image Interpretation, Lillesand, T.M., Kiefer, R.W. and Chapman, J.W., Fifth Edition, John Wiley & Sons, 2007.
3. Digital Image Processing, Gonzalez, Rafael C. and Richard E. Woods, Third Edition, Pearson Education, London.

Online References:

2. https://www.nrcan.gc.ca/maps-tools-publications/satellite-imagery-air-photos/tutorial-fundamentals-remote-sensing/9309

3. https://nptel.ac.in/courses/105/107/105107160/

Course Code: CE 5553	GLOBAL NAVIGATION SATELLITE SYSTEM	Credits 3-0-0: 3

Course Outcomes:

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

CO1	Identify GNSS components and their functions
CO2	Select GNSS survey method
CO3	Interpret navigation message and GNSS satellite signals
CO4	Identify error sources and apply corrections in GNSS observations
CO5	Process GNSS data for accurate positioning

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	-	-	-	-
CO2	2	-	2	2	2	1
CO3	3	2	2	-	1	-
CO4	2	2	1	1	2	1
CO5	3	2	-	1	2	2

Syllabus:

Chapter-1 Introduction: 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.

Chapter-2 Reference Systems and Coordinate systems: Definition and scope of Geodesy, Earth, Geoid and Ellipsoid of rotation, Reference surfaces and coordinate systems in Geodesy, Indian Geodetic System and Everest Spheroid, WGS 84, Geodetic coordinate systems, Datum transformations, Height systems, Time systems.

Chapter-3 Satellite Orbits: Orbit - Description, Determination and Dissemination.

Chapter-4 Satellite Signal: Structure of Signal, Navigation messages.

Chapter-5 Satellite Observables: Pseudo range measurements, Atmospheric effects, Antenna phase center offset and variation, Multipath, system accuracy characteristics, Data formats, Error budget.

Chapter-6Surveying with GNSS: Planning a GNSS Survey, Positioning methods – point positioning, relative positioning, Static, Differential, RTK, and Field data collection.

Chapter-7Data Processing: Ambiguity resolution, Post processing, real time processing, Accuracy measures, software modules, GIS and GNSS data integration, Applications of GNSS

Learning Resources:

Text Books:

1. GNSS: Global Navigation Satellite Systems, Hofmann-Wellenhof, Lichtennegger and Wasle., Springer-Verlag Wein, New York, 2008.

2. Satellite Geodesy Foundations-Methods and Applications, Gunter Seeber., 2003.
3. GNSS Remote Sensing: Theory, Methods and Applications, Shuanggen Jin, Estel Cardellachadn Feiqin Xie., Springer, London, 2017.

Reference Books:

1. Springer Handbook of Global Navigation Satellite Systems, Peter J.G. Teunissen, Oliver Montenbsruck., Springer International Publishing, 2017
2. GNSS Insights into GPS, GLONASS, Galileo, Compass and Others, B. Bhatta., CRC Press, 2011
3. GNSS Systems and Engineering: The Chinese Beidou Navigation and Position Location Satellite, Tan, S.,John Wiley& Sons, Singapore, 2018.
4. Environmental Monitoring using GNSS: Global Navigation Satellite Systems, Awange, J. L, Springer, London, 2012

Online Resources:

1. https://nptel.ac.in/courses/105/107/105107194/

Course Code: CE 5561	CLOSE RANGE PHOTOGRAMMETRY AND LASER SCANNING	Credits 3-0-0: 3

Course Outcomes:

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

CO1	Acquire, measure and analyze the photographic data taken
CO2	Perform orientation of photographic data
CO3	Generate orthophotos, DEM and 3D models for topographical mapping
CO4	Analyze point cloud data for documentation and archiving of features

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	2	2	2
CO2	1	2	2	3	2	1
CO3	1	1	1	2	3	2
CO4	2	2	3	2	2	3

Syllabus:

Chapter-1 Close Range Photogrammetry: Photogrammetric process, Coordinate systems, Coordinate transformations, Applications – Interior, exterior of monuments and structures,

Chapter-2Image Acquisition systems: Image acquisition, Imaging systems – stereometric cameras, Metric and non-metric cameras, digital cameras, Thermal imaging cameras, 3D cameras, UAVs, Terrestrial laser scanners, Specifications and Capabilities, Resolutions

Chapter-3Image measurement systems and Outputs: Control for terrestrial photogrammetry, Interior and Exterior orientation, Direct Linear Transformation, Single image photogrammetry, Vanishing points, Data outputs- DEMs, contours, ortho-photos, Volumes/ Cut and Fill etc.,

Chapter-4Laser Scanning: Concept, Instruments, Data acquisition and processing. 3D visualization and analysis, generation of archives towards planning and development, LiDAR characteristics and types of systems, Applications -

Chapter-5 Applications of Close-Range Photogrammetry and Laser Scanning: Architectural monument documentation, Building Information modeling, 3D models of buildings, Industrial, Forensic, Underwater, Accident studies, Medical imaging, Mining and geological, etc.3D visualization and analysis, generation of archives towards planning and development, Interior, exterior of monuments and structures,

Learning Resources:

Text Books:

1. Close Range Photogrammetry-Principles, Techniques and Applications., Luhmann, T., Robson, S., Kyle, S & Harley, I., Whittles Publishing, 2011
2. LiDAR: Remote Sensing of Terrestrial Environments, Popescu, S. C,. 1st edition, CRC Press. ISBN 978-1420047639, 2012.
3. Airborne and Terrestrial Laser Scanning., George Vosselman & Hans-Gerd Maas., CRC Press, 2010.

Reference Books:

1. Close Range Photogrammetry and 3D Imaging., Thomas Luhmann, Stuart Robson, Stephen Kyle & Jan Boehm., Walter de Gruyter GmhH, 2nd Edition, 2014.
2. Photogrammetry: Geometry from Images and Laser Scans, Kraus, K, Volume 1, De Gruyter, 2007
3. Digital photogrammetry, Kasser, M. and Egels, Y, Taylor & Francis, 2002.

Online Resources:

1. https://nptel.ac.in/courses/105/103/105103176/

Course Code: CE 5562	THERMAL, MICROWAVE AND HYPERSPECTRAL REMOTE SENSING	Credits 3-0-0: 3

Course Outcomes:

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

CO1	Analyze thermal and microwave remote sensing data
CO2	Identify the working mechanism and applications of active and passive microwave systems
CO3	Analyze thermal and microwave data for natural resources and disaster management
CO4	Classify and analyze Hyperspectral data

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	2	1	1
CO2	2		2	1		
CO3	2	1	2	2	1	2
CO4	3	2	2	1	1	1

Syllabus:

Chapter- 1 Thermal Remote Sensing: Thermal sensors and characteristics, Interpretation of thermal images, Emissivity conservation, Thermal inertia considerations, Factors effecting analysis of thermal images. Estimation of land surface temperature, applications of thermal remote sensing for geological studies, evapotranspiration etc.

Chapter- 2 Microwave Remote Sensing: Microwave Remote Sensing and its advantages. Active and passive systems. Platforms and sensors. Polarimetry – complimentary, Hybrid

Chapter- 3 Active Microwave systems: Basic principles of radar, radar equation, Resolution, Range, Phase and Angular measurements, Microwave scattering and its measurement, Relationships between scene and sensor parameters. Imaging systems, Imagery – their characteristics and interpretation, Applications in various fields, Land use/Land cover, Soil/ Rock, Hydrology and flood disaster applications

Chapter- 4 SAR Interferometry for DEM generation: Differential SAR Interferometry for surface displacement studies. Applications in land subsidence, landslide movements, glacier movements etc. Polarimetry in Radar Remote Sensing. Basic equations. Propagation of waves and wave polarization. HH, VV, HV and VH polarization data and their applications.

Chapter- 5Hyperspectral Remote Sensing: Principles of Hyperspectral Remote Sensing, Spectral Cube, Airborne and spaceborne hyperspectral sensors. Data correction – atmospheric, radiometric and geometric, Data visualization, animation, Multiple colour composites, Observing signatures of various features and comparing with spectral libraries, Comparison of PCA, MNF, ICA derived products, spectral mapping methods: Spectral Angle

Mapper (SAM), Spectral Correlation mapper, Spectral Feature Filtering (SFF), Linear Spectral Unmixing (LSU).

Learning Resources:

Text Books:

1. Hyperspectral Remote Sensing, Michael T, Eismann., SPIE press, USA, 2012
2. Hyperspectral Remote Sensing: Principles and Applications, Marcus Borengasser., William S Hungate and Russel Watkins., CRC Press, 2008

Reference Books:

1. Hyperspectral Image Processing, Liguo Wang and Chunhui Zhao., Springer, 2016
2. Advanced Image Processing Techniques for Remotely Sensed Hyperspectral Data, Varshney, P. K and Arora, M. K., Springer, 2014
3. Quantitative Remote Sensing in Thermal Infrared, Claudia, K., Stefan, D., Springer, 2014

Online Resources:

1. https://radar.community.uaf.edu/module-2-imaging-radar-systems/
2. https://earth.esa.int/documents/973910/1002056/CK3.pdf/4e5b4e5a-d898-43b8-9e5c-ba7494aa58c8
3. https://nptel.ac.in/courses/105/103/105103193/

Course Code: CE 5563	WEB AND MOBILE GIS	Credits 3-0-0: 3

Course Outcomes:

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

CO1	Publish geospatial data in web environment
CO2	Analyze the geospatial layers in web environment
CO3	Prepare and publish geospatial data in mobile applications
CO4	Develop applications in web and mobile platforms

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	2	3	2	1
CO2	1	2	2	2	3	1
CO3	2	2	1	1	3	2
CO4	3	2	3	2	2	3

Syllabus:

Chapter- 1 Web GIS: Definition, concept of Web GIS, History of Web GIS, components of web GIS, internet, web GIS v/s Internet GIS, Distributed GIS, users and stake holders of web GIS, advantages and limitations of web GIS, overview of Web GIS.

Chapter- 2 Web Mapping: static and interactive web mapping, Web-map services, open GIS web map server, Geographic Mark-up Language - principles and characteristics, commercial web mapping programs.

Chapter- 3 Functions of Web GIS: Hosting and Display of general information for the public, display of planning information, interactive display of spatial information, sharing and distribution of spatial data as well as management of spatial data, Style Layer Description (SLD), Open layers, Geo-server applications

Chapter- 4 Mobile GIS: Location based services, Case studies on Mobile Solutions; Mobile App Development Approaches, HTML5 Geolocation; Creating a Mobile App, jQuery Mobile - Components, Event Handling, Mobile Configuration Third-party APIs; Google Maps API; ArcGIS API; Leaflet API, Mobile App development in Android, IOS platforms

Learning Resources:

Text Books:

1. A. Web Cartography: Development and Prospects, Kraak, M. and Brown, Taylor and Francis, London, 2001.
2. Web GIS Application in Local Government, Tereshenkov, A., VDM Verlag, 2009.
3. GIS for Web Developers. Adding where to your web applications, Davis, S, First Edition, The Pragmatic Programmers LLC, 2007.

Reference Books:

1. Web GIS: Principles and Applications, Pinde Fu and Jiulin Sun, ESRI Press, 2011
2. Mobile: Up and Running, Maximiliano Firtman., jQuery, O'Reilly, 2012
3. Dynamic and Mobile GIS, Drummond, J., & Group, F., First Edition, CRC Press Taylor and Francis Group, 2007.

Online Resources:

1. https://felix-rz.github.io/pdf/2013_Tutorial_GIS.pdf

Course Code: CE 5564	ATMOSPHERIC REMOTE SENSING	Credits 3-0-0: 3

Course Outcomes:

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

CO1	Identify atmospheric parameters and its significance on climate change
CO2	Analyse atmospheric parameters from satellite images
CO3	Interpret satellite imageries for climate change
CO4	Assess atmospheric changes from satellite images

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	P05	PO6
CO1	2	1	2	3	2	1
CO2	2	1	3	3	2	1
CO3	2	1	3	2	2	2
CO4	1	1	3	2	1	1

Syllabus:

Chapter-1 Introduction: Characteristics of the atmosphere, satellite platforms and orbits, atmospheric inversion, Spectroscopy of atmospheric molecules, absorption and emission of radiation, blackbody emission, radiative transfer equation, polarization, refractive index, reflection and transmission at a plane boundary, particle scattering and extinction, Earth radiation budget, extinction and scattering based passive remote sensing of aerosol, ozone, trace gases, cloud properties, ocean color, sea-surface temperature, vertical profiles of temperature and humidity, limb sounding techniques

Chapter-2Satellite datasets: Types of parameters and its wavelengths, Earth observatory satellites, microwave remote sensing, hyperspectral remote sensing, Ground based sensors, interpretation strategies for atmospheric parameters, validation principles and validation errors, atmospheric sensors validation, advanced ground-based instruments.

Chapter-3 Remote sensing in atmospheric pollution monitoring: Environmental pollution and identification, point source pollution and non-point source pollution, air pollution, water pollution, soil pollution, solid waste pollution, radiation pollution-Urban heat Island, thermal pollution, noise pollution, oil spillage pollution on ocean, estimation of atmospheric parameters by radio occultation methods

Chapter-4 Climate change studies: Causes of Climate change, solar variability, orbital mechanics, greenhouse gases, atmospheric and oceanic circulation, and volcanic and soil aerosols and on evidence for past and present climate change. discuss material consequences of climate change, including sea level change, variations in precipitation, vegetation, storminess, and the incidence of disease. Identification using remote sensing techniques, mitigation and adaptation proposals, GCM and applications, EIA studies

Learning Resources:

Text Books:

1. Remote sensing of atmosphere and ocean from space: Models, instruments and techniques Marzano, F. S., & Visconti, G. (Eds.), Springer Science & Business Media, 2006.
2. Polar Remote Sensing: Volume I: Atmosphere and Oceans., Lubin, D., & Massom, R. Springer Science & Business Media, 2006
3. Introduction to the physics and techniques of remote sensing, Elachi, C., & Van Zyl, J., John Wiley & Sons, 2021.
4. Environmental Pollution Control Engineering. C. S. Rao. New age international pvt Ltd., Publishers, 2006

Reference Books:

1. Remote Sensing of the Lower Atmosphere, Stephens, G., Oxford Univ. Press, New York, 1994.
2. A Textbook of Environmental Chemistry and Pollution Control, S.S. Dara, 8th Edition, S. Chand and Sons, New Delhi, 2008

Online Resources:

1. https://www.nrsc.gov.in/sites/default/files/pdf/ebooks/Chap_10_Atmosphere.pdf

Course Code: CE 5565	AGRO REMOTE SENSING	Credits 3-0-0: 3

Course Outcomes:

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

CO1	Acquire state of art sensor data to retrieve crop parameters
CO2	Analyze the basic vegetation parameter and their interaction with different parts of Electromagnetic Spectrum
CO3	Assess the role of sensor data to study the crop conditions during various stages of agricultural practices.
CO4	Apply different sensors to predict and forecast the variables affecting the agricultural production

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	2	2	2
CO2	1	2	2	3	2	1
CO3	1	1	1	2	3	2
CO4	2	2	3	2	2	3

Syllabus:

Chapter-1 Introduction: Satellite sensors and their characteristics, Principles, instrumentation and approaches of estimating crop water requirement/ crop ET, Remote sensing of water stress (thermal/optical approaches), various crop parameters: albedo, leaf area index, fAPAR and evapotranspiration.

Chapter-2 Agro-Meteorological Applications of Optical, Microwave, Thermal and Hyperspectral Remote Sensing: Surface and vadose zone soil moisture estimation using microwave optical and hyperspectral remote sensing techniques; Soil mapping large-scale high spatial resolution mapping of soil texture information; Assessment, Prediction and Monitoring of Droughts through satellite retrieved causal variable information; Flood mapping and monitoring; Water resources mapping; Real-time weather monitoring.

Chapter-3 Crop condition and cropping system analysisusing different sensors: Crop classification and crop area estimation using digital analysis; Crop stress assessment using satellite data; Crop parameter retrieval, cropping pattern & cropping indices analysis, Crop yield modelling and estimation. Crop water requirements, Irrigation water requirements

Chapter-4 Crop Informatics: ICT application in agriculture at village/ block scale, Demonstration on DSS in agriculture; Precision farming.

Learning Resources:

Text Books:

4. Applications of remote sensing in agriculture., M.D. Steven, J.A. Clark, Butterworth publisher, London, 1990
5. Manual of Remote Sensing, Ustin, S, Remote Sensing for Natural Resource Management and Environmental Monitoring, 3rd Edition, Volume 4, Willey Publishing. 2001

6. Agrometeorology and sustainable agriculture. M.V.K. Sivakumar, R. Gommes, W. Baier Agricultural and Forest Meteorology 103 (2000) 11–26
7. Application radar in Agriculture, Holmes M.G., Remote sensing applications to agriculture, Butterworth publisher, London, 1990.

Reference Books:

1. Introduction to Agrometeorology (1994), Second edition by H.S. Mavi, Oxford & IBH Publishing Co. Pvt. Ltd.
2. Remote Sensing for Agriculture, Ecosystems, and Hydrology, Manfred Owe; Guido D'Urso (2005). Proceedings of SPIE Volume: 5976.

Online Resources:

1. https://appliedsciences.nasa.gov/join-mission/training/english/arset-satellite-remote-sensing-agricultural-applications
2. https://www.nrsc.gov.in/sites/default/files/pdf/ebooks/Chap_1_Agriculture.pdf https://www.nrsc.gov.in/sites/default/files/pdf/ebooks/Chap_13_AgricultureDroughtMonitoring.pdf

Course Code: CE 5554	SATELLITE IMAGE PROCESSING LABORATORY	Credits 0-1-2: 2

Course Outcomes:

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

CO1	Analyze satellite data using image processing techniques
CO2	Perform image pre-processing and post-processing techniques
CO3	Classify satellite data for thematic mapping
CO4	Perform change detection analysis

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	1	3	1	1
CO2	2	1	2	3	1	1
CO3	1	1	2	1	-	1
CO4	1	1	2	1	1	1

Syllabus:

1. Loading, Creating Image and Display Manipulation
2. Image Enhancement – Linear and Nonlinear
3. Geometric Correction and Mosaicing
4. Band Ratioing
5. Image Indices – NDVI, LAI, RVI etc.
6. Spectral Enhancement
7. Generation of Training Sets
8. Supervised Classification and Accuracy Assessment
9. Unsupervised Classification
10. Change Detection
11. Model Builder
12. Programs for Image Analysis

Learning Resources:

1. ERDAS IMAGINE 2018 user manuals

Course Code: CE 5555	ADVANCED GIS LABORATORY	Credits 3-0-0: 3

Course Outcomes:

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

CO1	Model Geospatial data
CO2	Perform advanced geospatial analysis
CO3	Develop programming tools for geospatial applications
CO4	Publish geospatial data in public domain

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	1	2	1	1
CO2	1	1	2	3	1	1
CO3	2	1	2	1	2	1
CO4	2	1	1	2	1	1

Syllabus:

Interpolation methods
Viewshed and watershed analysis
Modelling tools
Python and R programming geospatial tools
Web GIS Applications

Learning Resources:

1. ArcGIS Manual
2. QGIS Manual
3. Python and R Manuals

Course Code: CE 5598	Seminar – II	Credits 0-0-2: 1

Course Outcomes:

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

CO1	Select a topic relevant to geospatial technologies
CO2	Undertake a critical review of the literature on the chosen topic
CO3	Prepare and present a technical report
CO4	Present a technical talk on the chosen topic

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	-	-	2	-
CO2	2	-	-	-	2	-
CO3	1	1	1	1	2	2
CO4	2	2	2	1	-	1

Syllabus:

The student can choose any topic, of his choice, pertaining to Remote Sensing and GIS technologies. Topic should be a relevant and currently researched one. Students are advised to refer articles published in current journals in the area of geospatial applications for choosing their seminar topics. Student should review minimum of 5 to 6 research papers relevant to the topic chosen, in addition to standard textbooks, handbooks, etc. Students are required to prepare a seminar report, in the standard format and give presentation to the Seminar Assessment Committee (SAC) in the presence of their classmates.

Learning Resources:

1. Remote sensing, GIS and Photogrammetry Journals, Conference Proceedings
2. Research Articles / Reports available on Internet
3. Remote sensing and GIS Textbooks and Handbooks

Course Code: CE 6547	COMPREHENSIVE VIVA VOCE	Credits 0-0-0: 2

Course Outcomes:

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

CO1	Assimilate knowledge of different courses studied
CO2	Develop overall comprehension about remote sensing and GIS
CO3	Analyse real life geospatial problems with theoretical knowledge learned
CO4	Interpret and articulate solutions to real life geospatial problems

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2	2	-	-
CO2	2	2	2	2	-	-
CO3	3	2	-	-	2	2
CO4	2	2	2	2	2	2

Syllabus:

All the subjects studied in I year I semester and II semesters

Learning Resources:

1. Reading Material of all the courses
2. Case Studies

Course Code: CE 6549	Dissertation Part – A	Credits 0-0-0: 12

Course Outcomes:

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

CO1	Identify a topic related to social and engineering problems, hazard mitigation and decision support systems which can be addressed geospatial environment
CO2	Make a critical review of the available literature on the topic
CO3	Conduct independent research to formulate and solve the chosen problem
CO4	Prepare technical report on the study carried out and publish work in the journals and conference related specialization

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	2	1	2	2
CO2	1	1	1	1	2	-
CO3	3	3	3	3	2	3
CO4	-	-	-	-	2	2

Syllabus:

Students are required to search, collect and review various research articles published in chosen area of research. A student has to select a topic for his dissertation, based on his/her interest. A student shall be required to submit a dissertation report on the research work carried out by him/her.

Learning Resources:

1. Journal Publications
2. Conference / Seminar Proceedings
3. Handbooks / Research Digests
4. Research articles on internet.

Course Code: CE 6599	Dissertation Part – B	Credits 0-0-0: 20

Course Outcomes:

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

CO1	Analyze social and engineering problems, hazard mitigation and decision support systems which can be addressed geospatial environment
CO2	Make a critical review of the available literature on the topic
CO3	Conduct independent research to formulate and solve the chosen problem
CO4	Prepare technical report on the study carried out and publish work in the journals and conference related specialization

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	2	1	2	2
CO2	1	1	1	1	2	-
CO3	3	3	3	3	2	3
CO4	-	-	-	-	2	2

Syllabus:

Students are required to search, collect and review various research articles published in chosen area of research. A student has to select a topic for his dissertation, based on his/her interest. A student shall be required to submit a dissertation report on the research work carried out by him/her.

Learning Resources:

1. Journal Publications
2. Conference / Seminar Proceedings
3. Handbooks / Research Digests
4. Research articles on internet.

NOTE: Refer to the following link for the guidelines to prepare dissertation report:
https://www.nitw.ac.in/main/PGForms/NITW/