ACADEMIC CURRICULA

POST GRADUATE DEGREE PROGRAMMES

Master of Technology

(Choice Based Flexible Credit System)

Regulations 2021

Volume – 26
Syllabi for Civil Engineering and Nanotechnology Programmes

Professional Core and Elective Courses

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)

Kattankulathur, Chengalpattu District 603203, Tamil Nadu, India

ACADEMIC CURRICULA

Civil Engineering

Common Professional Elective Course

Regulations 2021

SRM INSTITUTE OF SCIENCE & TECHNOLOGY
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SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)

Kattankulathur, Chengalpattu District 603203, Tamil Nadu, India

Course Code	21MAE501T	Course Name	ADVANCED MATHEMATICAL TECHNIQUES	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Mathematics*	**Data Book / Codes/Standards**		*Statistical table*	

Course Learning Rationale (CLR)	***The purpose of learning this course is to:***
CLR-1:	*learn the concept of one dimensional wave equations and diffusion equation*
CLR-2:	*understand the concepts of Euler's equations*
CLR-3:	*learn concepts of Fredholm and Volterra integral equations*
CLR-4:	*study the sampling techniques to real world applications*
CLR-5:	*learn the concept of design of experiment and control charts*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	**2**	**3**
CO-1:	*solve one dimensional wave equations and diffusion equation by using Laplace and Fourier transform techniques*	*3*	*3*	-
CO-2:	*familiar with solving Euler's equations*	*3*	*3*	-
CO-3:	*solve Fredholm and Volterra integral equations*	*3*	*3*	-
CO-4:	*transfer the knowledge to model the sampling techniques*	*3*	*3*	-
CO-5:	*construct design of experiments and control charts*	*3*	*3*	-

Module 1: Transform Techniques	***9 Hour***
Laplace transform - Fourier transform - One-dimensional wave equation using Laplace transform methods - Displacements in long string - Longitudinal vibration of an elastic bar - One-dimensional diffusion equation using Fourier transform methods – One-dimensional diffusion equation using Fourier sine transform methods – One-dimensional diffusion equation using Fourier cosine transform methods.	
Module 2: Variational and Isoperimetric Problems	***9 Hour***
Euler's Equations - Functional involving x, y, y` - Functional on higher order derivatives - Functional dependent on functions of independent variables - Geodesics – Ritz method.	
Module 3: Integral Equations	***9 Hour***
Fredholm integral equations - Volterra integral equations - Integro- differential equation - Green's function - Fredholm equations with separable kernel - Iterative methods.	
Module 4: Testing of Hypothesis	***9 Hour***
Sampling distribution, Null hypothesis, Alternate hypothesis - One-tailed test, two-tailed test - Level of significance, Critical region - Large samples test - Student - t test - single Proportion - Two Sample proportions - Large sample test, Single Mean - Difference of Means - Paired `t` test - Applications of Difference of Means - small samples - F-test problems - Differences between two population variances - Differences between two Normal population variances - Applications of paired - t-test. - Chi-Square goodness of fit - Chi-square test - Independent Attributes.	
Module 5: Design of Experiments and Statistical Quality Control	***9 Hour***
Design of Experiments – Completely Randomized Design – Randomized Block Design – Latin Square Design - Control theory - Control charts for X and R - Control charts for X and S.	

Learning Resources	1. *Gupta, S.C., & Kapoor, V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, Edition 2018* 2. *Dr.B.S.Grewal., "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2019* 3. *M. B. K. Moorthy, "Advanced Mathematical Methods", Yesdee Publication, 2nd Edition, 2019.*	4. *B .V. Ramana, "Higher Engineering Mathematics", McGraw Hill Publication, 2017.* 5. *Vijay K. Rohatgi., A.K. Md. Ehsanes Saleh, An Introduction to Probability and Statistics, 2nd Edition, Wiley, 2008.* 6. *R.A.Johnson and C.B Gupta, " Miller & Freund`s Probability and Statistics for Engineers", Pearson Eduction, Asia, 7th Edition, 2007.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*15%*	-	*15%*	-	*15%*	-
Level 2	*Understand*	*15%*	-	*15%*	-	*15%*	-
Level 3	*Apply*	*20%*	-	*20%*	-	*20%*	-
Level 4	*Analyze*	*20%*	-	*20%*	-	*20%*	-
Level 5	*Evaluate*	*15%*	-	*15%*	-	*15%*	-
Level 6	*Create*	*15%*	-	*15%*	-	*15%*	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Madhan Shanmugasundaram, Infosys Technologies, madshan@gmail.com	1. *Prof. Y.V.S.S. Sanyasiraju, IIT Madras, sryedida@iitm.ac.in*	1. *Dr. V. Subburayan, SRMIST*
	2. *Prof. K.C. Sivakumar, IIT Madras, kcskumar@iitm.ac.in*	2. *Dr. G. Arul Joseph, SRMIST*

ACADEMIC CURRICULA

Remote Sensing and Geographical Information System

Professional Core Courses

Regulations 2021

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)

Kattankulathur, Chengalpattu District 603203, Tamil Nadu, India

Course Code	21CEC631T	Course Name	CARTOGRAPHY, PHOTOGRAMMETRY AND GNSS	Course Category	C	PROFESSIONAL CORE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	**Data Book / Codes / Standards**		*Nil*	

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*disseminate basic concepts and applications of cartography*
CLR-2:	*disseminate digital cartography, platforms, and their characteristics*
CLR-3:	*introduce the basic concept of photogrammetry and application*
CLR-4:	*upskill the knowledge digital maps and photogrammetry products for solving real life problems*
CLR-5:	*instill the importance of GNSS in various real-world applications*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*understand the physical principles of cartography*	*1*	*1*	*2*
CO-2:	*study different type of digital map and their characteristics*	*2*	*1*	*2*
CO-3:	*study the concept, types and application of photogrammetry*	*1*	*1*	*3*
CO-4:	*emphasized the digital photogrammetry and equipment used*	*1*	*1*	*3*
CO-5:	*study the modern tools in GNSS and their application*	*2*	*1*	*3*

Module-1 - Cartography	***9 Hour***
Definition, Nature and scope of cartography, History of cartography, map, Types of map design, Symbolization, Visual, Hierarchy, Scale and projection, Map media, Purpose of cartography, Mapping tools, Modern maps.	
Module-2 - Digital Cartography	***9 Hour***
Digital mapping, Principles of digital mapping, Difference between traditional and digital cartography, Digital mapping software, Components of a digital map, Process system, Components digital transformation, Application of GIS in digital Cartography.	
Module-3 - Photogrammetry	***9 Hour***
Fundamentals of photogrammetry, Fundamentals and geometry of photography, Scale, Advantages and disadvantages of small scale and large-scale aerial photographs, Terrestrial and aerial photographs; Vertical and oblique photographs, Height determination contouring, Photographic interpretations, Stereoscopy, Parallax bar, Flight planning, Photo interpretation, Applications of aerial Photos, Photo theodolite.	
Module-4 - Digital Photogrammetry	***9 Hour***
Digital Cameras: CCD Camera, Full frame CCD Frame transfer CCD, CCD cameras shift, Interline transfer CCD, Time delay, integration CCD sensor; Spectral Sensitivity of CCD sensor, Geometric problems of CCD images, Line jitter, Blooming, Warm up effect, Tailing, Typical CCD system.	
Module-5 - Introduction to GNSS	***9 Hour***
Basic GNSS concepts, GNSS satellites, GPS, GNSS error sources, Resolving errors, Sensor fusion, GNSS signals, GNSS applications and equipment.	

Learning Resources	1. *Niladri Das, Book on Cartography: Concept and Application, June 2020.* 2. *Winfried Linder, Digital Photogrammetry, Theory and Applications, 2013.* 3. *Jensen, J. R, Introductory Digital Image Processing: A Remote Sensing Perspective, Prentice Hall Series in GIS, USA, 1996*	4. *Lille sand, Thomas M. and Kiefer, Ralph, W, Remote Sensing and Image Interpretation, 4th Edition, John Wiley and Sons, New York, 2007.* 5. *Kegen Yu, Theory and Practice Of GNSS Reflectometry, 2021.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life-Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	*Remember*	*20%*	-	*20%*		*20%*	-
Level 2	*Understand*	*20%*	-	*20%*		*20%*	-
Level 3	*Apply*	*20%*	-	*20%*		*20%*	-
Level 4	*Analyze*	*20%*	-	*20%*		*20%*	-
Level 5	*Evaluate*	*10%*	-	*10%*		*10%*	-
Level 6	*Create*	*10%*	-	*10%*		*10%*	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Sainarayanan Gopalakrishnan, HCL Technologies*	1. *Dr. R. Kumar, NIT, Nagaland*	1. *Dr. R. Annadurai , SRMIST*
2. *Sricharan Srinivasan, Wipro Technologies*	2. *Dr. B. Surendira, NIT, Puducherry*	2. *Dr. Sachikanta Nanda, SRMIST*

Course Code	21CEC632J	Course Name	REMOTE SENSING FOR GEOSCIENCE	Course Category	C	PROFESSIONAL CORE	L	T	P	C
							3	0	2	4

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	**Data Book / Codes / Standards**		*Nil*	

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*interpret surface process and its interpretation from remote sensing data.*
CLR-2:	*study the spectral characteristics of common earth materials and its measurement in field*
CLR-3:	*relate how the spectral characteristics of ions on various wavelength regions*
CLR-4:	*study the role of remote sensing in lithological studies*
CLR-5:	*learn the role of remote sensing in geological structure interpretation*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*recognize landforms and interpret from satellite data based on origin*	*2*	*1*	*3*
CO-2:	*study how different field methods for collecting spectral signatures of earth materials*	*2*	*2*	*3*
CO-3:	*relate how the spectral characteristics of ions on various wavelength regions*	*1*	*1*	*3*
CO-4:	*understand how different rocks lithological units can be mapped from satellite data*	*2*	*1*	*3*
CO-5:	*acquire knowledge to interpret different geological structures from satellite data*	*1*	*2*	*3*

Module-1 - Surface Process and its Interpretation	***12 Hour***
Significance of landform, Drainage pattern, Interpretation from Satellite data, Fluvial landform, Denudational landforms, Aeolian landforms, Coastal landforms, Identifications from Satellite data, Groundwater Investigations – Practices: Interpretation of landforms (fluvial, coastal, denudational) from Satellite data	
Module-2 - Spectral Signature of Common Earth Materials and Field Spectroscopy	***12 Hour***
Introduction to electromagnetic spectrum, Interaction of EMR with atmosphere and earth surface, Basics concepts - Energy state and transitions, Laboratory spectroscopy, Spectral signature, Spectral reflectance of common earth materials, Spectroradiometer, Principles - Working - Field procedures for measuring reflectance spectra, Spectral response of vegetation for different biophysical features - Spectral response of soil for soil moisture, Soil texture, Organic matter, Minerals, Spectral response of water at the surface and from the bottom, Field measurement for suspended sediments, Turbidity, Secchi disc, Depth measurement - Practices: Spectral collection of common earth materials from the field.	
Module-3 - Spectral Signature of Minerals and Rocks	***12 Hour***
Characteristics of ions in the VNIR, SWIR region, and thermal region, Reflectance properties of minerals in visible, NIR, SWIR, and in TIR region - Reflectance properties of rocks in visible, NIR, SWIR and in TIR region - Mixtures – types, Emission spectra model for mixtures, Spectral reflectance curve for important minerals and rocks - Practices: Spectra collection, Spectral library creation.	
Module-4 - Interpretation of Rocks	***12 Hour***
Introduction on Igneous rocks, Image Characters of igneous rocks, Introduction on sedimentary rocks, Image characters of sedimentary rocks, Introduction on metamorphic rocks, Image characters of metamorphic rocks, Mapping of regional scale lithological units, Geobotanical indicators, Geological field data collection, Importance of ground truth, Digital image processing for mineral and rock. Practices: Rock and mineral mapping from satellite data.	

Module-5 - Interpretation of Geological Structures	***12 Hour***
Significance of geological structures, Interpretation characters from satellite images, Structural element mapping - Attitude of beds, Fold - Classification, Fold recognition from satellite data, Fault - classification, Fault recognition from satellite data, Lineaments, Types, Criteria to identify Lineament, Circular features, Fractures and Joint - Classification - Practices: Interpretation of geological structures (Fold, Fault/Lineament, Joints, Circular features) from satellite data.	

Learning Resources	1. *Gupta .R.P, Remote sensing Geology, Springer nature, 2018.* 2. *John J. Qu, Wei Gao, M. Kafatos, Robert E. Murphy, Vincent V. Salomonson, Earth Science Satellite Remote Sensing, Springer 2007.* 3. *Roger M. McCoy, Field Methods in Remote Sensing, The Guildford Press, New York, London, 2005* 4. *Weitao Chen, Xianju Li , Xuwen Qin, Lizhe Wang, Remote Sensing Intelligent Interpretation for Geology, From Perspective of Geological Exploration, Springer, 2024.*	5. *Steve Drury, Image interpretation in Geology, Third Edition, Blackwell Science Inc., 2001.* 6. *Jean-Yves Scanvik, Aerospatial Remote Sensing in Geology, A. A. Balakarma, Netherlands, 1997.* 7. *Floyd F. Sabins, Remote Sensing – Principles and Interpretation, Third Edition, W. H. Freeman and Company, New York, 1997.* 8. *Ramachandra Rao, Outline of Geophysical Prospecting -A Manual for Geologists, Welsey Press, Mysore, 1997.* 9. *Pandey S.N., Principles and Applications of Photogeology, Wiley Eastern. 1987.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (45%)		*Life-Long Learning CLA-2 (15%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	-	*20%*	*20%*	-
Level 2	*Understand*	*20%*	-	-	*20%*	*20%*	-
Level 3	*Apply*	*20%*	-	-	*20%*	*20%*	-
Level 4	*Analyze*	*20%*	-	-	*20%*	*20%*	-
Level 5	*Evaluate*	*10%*	-	-	*10%*	*10%*	-
Level 6	*Create*	*10%*	-	-	*10%*	*10%*	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Dr. Arindam Guha, Scientist, NRSC, Hyderabad*	1. *Dr. V. J Rajesh, Professor, IIST, Thiruvananthapuram*	1. *Dr. Aparna S. Bhaskar, SRMIST*
2. *Dr. Sarunjith K. J., Scientist, NCSCM, Chennai*	2. *Dr. C. Lakshumanan, Professor, Bharathidasan University, Trichy*	2. *Dr. R. Annadurai, SRMIST*

Course Code	21CEC633J	Course Name	REMOTE SENSING AND DIGITAL IMAGE PROCESSING	Course Category	C	PROFESSIONAL CORE	L	T	P	C
							3	0	2	4

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	**Data Book / Codes / Standards**		*Nil*	

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*study concepts of remote sensing.*
CLR-2:	*learn the various types of remote sensing systems*
CLR-3:	*study the preprocessing techniques*
CLR-4:	*perform different classification techniques*
CLR-5:	*understand the applications in remote sensing and digital image processing*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*understand the fundamentals principles of remote sensing*	*1*	*2*	*2*
CO-2:	*acquire knowledge about various types of remote sensing systems*	*1*	*2*	*3*
CO-3:	*infer various image analysis techniques*	*2*	*2*	*3*
CO-4:	*knowledge of various classification techniques*	*2*	*2*	*3*
CO-5:	*implement the remote sensing and digital image processing in various application*	*3*	*2*	*3*

Module-1 - Remote Sensing	***12 Hour***
Basic concepts of Remote sensing, Electromagnetic Energy, Energy Source, Blackbody Radiation, Energy interaction in Atmosphere, Ideal remote sensing system, Scattering and its Types, EMR interaction with Earth Surface Features, Spectral reflectance of soil, vegetation and water, Airborne and space borne platform, Different types of resolution, Scanning system, Advantage and disadvantages of Remote sensing - Practices: Spectral signature of Soil, Water and Vegetation, Multi-sensor data acquisition.	
Module-2 - Thermal Remote Sensing	***12 Hour***
Thermal remote sensing, Radiation principles, Radiation from real materials, Interaction of thermal radiation with terrain elements, Thermal scanners and calibration, Thermal imaging system, Microwave remote sensing, Advantages and disadvantages, Application of each band of microwave, RADAR equation, Geometry of RADAR spectra, SAR, SLAR, Different microwave missions, Hyperspectral remote sensing, History and developments of Spectroscopy, Applications of hyperspectral remote sensing - Practices: Different bands in thermal images, Different bands in microwave images.	
Module-3 - Digital Image Processing	***12 Hour***
Introduction to digital image processing, Digital image formats, Band sequential, Band interleaved line, Band interleaved pixel, and Hierarchical data formats, Digital image processing software, Radiometric correction, Geometric correction, Causes of distortion, Sensor characteristics, Multispectral & Hyperspectral data image statistics, Image compression - Practices: Layer stacking of satellite images, Image statistics of satellite image, Image compression.	
Module-4 - Satellite Image Classification	***12 Hour***
Different classification techniques, Training set and classification, Supervised classification, Unsupervised classification, Fuzzy classification, Super resolution techniques, Accuracy assessment of Classification, Subpixel classification, Selection of end member, Artificial Neural Network (ANN), Digital image interpretation, Level slicing, Image fusion – Practices: Digital image processing of supervised classification, unsupervised classification, Level slicing.	

Module-5 - Applications of Remote sensing and Digital Image Processing	***12 Hour***
Visual interpretation techniques, Digital image interpretation, Application in geological studies, Application in water resources, Application in agriculture studies, Image processing for mineral, Lithological mapping, Image processing techniques for snow cover mapping, Image processing techniques for soil studies, Image processing techniques for urban studies, Image processing techniques for flood mapping - Practices: Visual interpretation of satellite images, Image processing techniques for snow cover mapping, Image processing techniques for flood mapping.	

Learning Resources	1. *Gupta. R.P, Remote sensing Geology, Springer nature, 2018.* 2. *John J. Qu, Wei Gao, M. Kafatos, Robert E. Murphy, Vincent V. Salomonson, Earth Science Satellite Remote Sensing, Springer 2007.* 3. *John R. Jenson, Introducing Digital Image Processing - Prentice Hall, New Jersey 1986.* 4. *Robert A. Schowengerdt, Techniques for Image Processing and Classification in Remote Sensing; 1984.*	5. *Pramod K. Varshney and Manoj K. Arora, Advanced Image Processing Techniques for Remotely Sensed Hyperspectral Data, Springer publication, 2004.* 6. *Floyd F. Sabins, Remote Sensing – Principles and Interpretation, Third Edition, W. H. Freeman and Company, New York, 1997.* 7. *https://nptel.ac.in/courses/105107160/* 8. *Thomas M. Lillesand, Ralph W. Kiefer, Jonathan W. Chipman, Remote sensing and image interpretation John Wiley & Sons, 2008.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (45%)		*Life-Long Learning CLA-2 (15%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	-	*20%*	*20%*	-
Level 2	*Understand*	*20%*	-	-	*20%*	*20%*	-
Level 3	*Apply*	*20%*	-	-	*20%*	*20%*	-
Level 4	*Analyze*	*20%*	-	-	*20%*	*20%*	-
Level 5	*Evaluate*	*10%*	-	-	*10%*	*10%*	-
Level 6	*Create*	*10%*	-	-	*10%*	*10%*	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Dr. S. Vijayan Scientist Physical Research Laboratory*	1. *Dr. C. Lakshumanan, Professor, Bharathidasan University*	1. *Dr. J. Satish Kumar, SRMIST*
2. *Dr. K.J. Sarunjith, Scientist, NCSCM, Chennai*	2. *Dr Girish Gopinath, Professor, Kerala university of fisheries*	2. *Dr. Aparna S. Bhaskar, SRMIST*

Course Code	21CEC634J	Course Name	GIS AND DATA ANALYSIS	Course Category	C	PROFESSIONAL CORE	L	T	P	C
							3	0	2	4

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	**Data Book / Codes / Standards**		*Nil*	

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*learn the basic concepts of GIS and geospatial data*
CLR-2:	*understand the data models and structure in GIS*
CLR-3:	*learn the vector and raster analysis in GIS*
CLR-4:	*study the interpolation techniques and modeling in GIS*
CLR-5:	*explore more on terrain modelling and open-source GIS*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*understand the concepts and data representation of geospatial data*	*1*	*1*	*2*
CO-2:	*learn how geospatial data are stores in GIS*	*1*	*1*	*2*
CO-3:	*understand the operation with vector and raster data*	*2*	*2*	*3*
CO-4:	*analyze the various interpolation techniques and modeling in GIS*	*2*	*2*	*3*
CO-5:	*study the terrain modelling and open-source GIS*	*2*	*2*	*3*

Module-1 - Introduction to GIS and Geospatial Data	***15 Hour***
GIS introduction, components, Functionalities, Datum, Coordinate system, Projection, Maps-types, Cartography - generalization, symbolization, lay out, Spatial, non-spatial data, Vector data and raster data format, Data quality, Data accuracy, Data standards, Topology, Data sources, Input methods, output methods. Practices - Georeferencing, Geodatabase creation, Digitization of features by Polygon, line and point.	
Module-2 - GIS Data Representations and Data Models	***12 Hour***
Vector data model – Georelational model – Coverage data model – shape file – TIN, Object based vector data model - Geodatabase, Raster data model –Elements of raster data, Data compression, Raster data types, Raster data structure, Data conversion, Practices - Rasterization, Vectorization.	
Module-3 - GIS Data Analysis	***12 Hour***
Data Retrieval, Query, Spatial and Non-Spatial Query, Reclassification, Proximity Analysis – Buffering, Distance measurement, Overlay, Network Analysis, Raster data analysis – Raster operations. Network Analysis. Practices - Query, Reclassification, Buffering, Measurements and Overlay Operations.	
Module-4 - Advanced Data Analysis	***9 Hour***
Interpolation, Modelling, Multi-criteria analysis - Decision Support Systems (DSS) and Location-Based Services (LBS) with case studies. Practices: Spatial maps, Interpolation - Thiessen polygon and Inverse Distance Weighted (IDW)	
Module-5 - GIS Applications	***12 Hour***
DEM , Sources - Generation – Terrain Parameters, Open sources software, Open-Source GIS, Open Geospatial Consortium (OGC), Import and Export, Meta data, Applications, Practices - DEM Analysis Slope- Aspect – Drainage order – Contour – Flow Direction, TIN – Generation, Metadata editing, Import and Export	

Learning Resources	1. *Paul Bolstad, GIS Fundamentals: A First Text on Geographic Information Systems, 5th Edition, Eider Press, Minnesota 2016.* 2. *Burrogh P. A, Principles of Geographical Information System for Land Resources Assessment, Oxford Publications, | ISBN-13: 978-0198545927, 1986.* 3. *Kang Tsung Chang, Introduction to Geographical Information System, Tata McGraw Hill, 9th edition, 2019.* 4. *Paul A. Longley, Michael F. Goodchild, David J. Maguire, David W. Rhind, Geographic Information Science & Systems, Fourth Edition, John Wiley & Sons, Inc., 2015.* 5. *Chandra. A. M. and Ghosh S. K, Remote Sensing and GIS, Narosa Publishing House, New Delhi, 2000.*	6. *Anji Reddy .M, Textbook of Remote Sensing and Geographical Information Systems, BS Publications, Hyderabad. 2011.* 7. *Rolf A. de, Principles of Geographic Information Systems An introductory textbook, The International Institute for Aerospace Survey and Earth Sciences (ITC), The Netherlands, 2001.* 8. *Lo. C. P. and Albert K. W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice Hall; 2 Edition, 2006.* 9. *Michael N. DeMers, Fundamentals of Geographic Information Systems, 2008.* 10. *https://nptel.ac.in/courses/105107155/*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (45%)		*Life-Long Learning CLA-2 (15%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	-	*20%*	*20%*	-
Level 2	*Understand*	*20%*	-	-	*20%*	*20%*	-
Level 3	*Apply*	*20%*	-	-	*20%*	*20%*	-
Level 4	*Analyze*	*20%*	-	-	*20%*	*20%*	-
Level 5	*Evaluate*	*10%*	-	-	*10%*	*10%*	-
Level 6	*Create*	*10%*	-	-	*10%*	*10%*	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Dr. Tune Usha, Scientist, NCCR, Chennai*	1. *Dr. C. Lakshumanan, Professor, Bharathidasan University*	1. *Dr. Aparna S. Bhaskar, SRMIST*
2. *Dr. V. S. Jayakanthan, Scientist, NIH, Andra Pradesh*	2. *Dr. Rajesh Raghunath, Professor, University of Kerala*	2. *Dr. J. Satish Kumar, SRMIST*

Course Code	21CEC635J	Course Name	GEOSPATIAL DATABASE MANAGEMENT	Course Category	C	PROFESSIONAL CORE	L	T	P	C
							3	0	2	4

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	**Data Book / Codes / Standards**	*Nil*		

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*introduce the basic concepts of data and information*
CLR-2:	*understand the geospatial database and data files organization*
CLR-3:	*explain the operators and functions of DBMS*
CLR-4:	*understand geospatial data processing with SQL*
CLR-5:	*upskill the knowledge in advancers in geospatial database management and programming*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*understand the data types and data models*	*1*	*1*	*2*
CO-2:	*study the database file organization and formats*	*1*	*1*	*3*
CO-3:	*knowledge in various DBMS functions*	*2*	*1*	*3*
CO-4:	*understand and apply various SQL functions and statements*	*2*	*2*	*3*
CO-5:	*apply the knowledge in geospatial database management and analysis*	*2*	*2*	*3*

Module-1 - Data and Information	***12 Hour***
Definition, Data -Types, Database, Attribute – Types, Hardware and software requirements - Database management systems -Examples- Types of DBMS and model - Hierarchical, Network, Relational Models - Distributed databases - Client server databases - Knowledge based systems -Geographic Databases - Entity- Relationship diagram	
Module-2 - Geospatial Database and Database File Organisation	***12 Hour***
Introduction- Geospatial database – File structures: Raster – Vector- Hybrid- File extension- File organization - Sequential, Index sequential, Random, Multikey file organisation -Advantages -Relational Database Management System - Normalization -First, Second, Third, Boyce-Codd, Fourth and Fifth normalizations- Multidimensional data format	
Module-3 - Operators and Functions	***12 Hour***
DBMS Functions- Data definition, data manipulation, retrieval and reporting, concurrency, multi-user access control, data integrity management, communication and application programming interfaces Oracle Spatial geospatial data features -Oracle operators -Arithmetic, Comparison, Logical operators - Operator precedence -Privilege commands - SQL functions -Single row, data, character and numeric functions -Group functions - Count functions- Triggers in oracle. Oracle spatial and graph	
Module-4 - SQL Functions and Procedures	***12 Hour***
Geospatial data processing and SQL functions- Structured query language - Data definition language, Data query language, Data manipulation language, Data control language, Transaction control language, Basic constraints – Change statements – Basic queries in SQL – Complex queries – Nested, Correlated nested queries –Table joins – Insert, Delete, Update and related statements in SQL.	
Module-5 - Advances in Geospatial Database Management and Programming	***12 Hour***
Introduction to modeling and simulation- Spatial modeling – Query building-Indexing, Meta data analysis – Network analysis- Data mining and warehousing- Learning Open source GIS: Spatial SQL w/ Postgres/PosGIS- Case studies – Geospatial database challenges and management	

Learning Resources	1. *Jagdish Chandra Patni, Hitesh Kumar Sharma, Ravi Tomar and Avita Katal, Database Management System – An Evolutionary approach- CRC Press, Taylor &Francis Group, 2022* 2. *Philippe Rigaux, Michel Scholl and Agnès Voisard, Spatial Databases: With Application to GIS (The Morgan Kaufmann Series in Data Management Systems) 1st Edition, Kindle Edition, 2001*	3. *Byrla, Oracle 12C The Complete Reference, McGraw Hill Education ISBN 978-9351343707, 2017.* 4. *Abraham Silberschatz, Henry F. Korth and, S. Sudarshan, Database System Concepts, 7th Edition, McGraw Hill, 2011* 5. *Remez Elmasri and Shamkant B. Navathe, "Fundamentals of Database Systems", Fourth Edition, Published by Pearson Education (Singapore) Pvt. Ltd., 6th Edition,2011.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (45%)		*Life-Long Learning CLA-2 (15%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	-	*20%*	*20%*	-
Level 2	*Understand*	*20%*	-	-	*20%*	*20%*	-
Level 3	*Apply*	*20%*	-	-	*20%*	*20%*	-
Level 4	*Analyze*	*20%*	-	-	*20%*	*20%*	-
Level 5	*Evaluate*	*10%*	-	-	*10%*	*10%*	-
Level 6	*Create*	*10%*	-	-	*10%*	*10%*	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Dr. Manthira Moorthi, Scientist G, SAC ISRO, Ahmedabad*	1. *Dr. C. Lakshmanan, Professor, Bharathidasan University, Trichy*	1. *Dr. R. Sivakumar, SRMIST*
2. *Mr. R.Jaikumar, NeoGeoInfo Technologies Pvt Ltd, Chennai*	2. *Dr. K. Srinivasa Raju, Professor, IRS, Anna University, Chennai*	2. *Dr. Karuppusamy Sudalaimuthu, SRMIST*

ACADEMIC CURRICULA

Remote Sensing and Geographical Information System

Professional Elective Courses

Regulations 2021

SRM INSTITUTE OF SCIENCE & TECHNOLOGY
(Deemed to be University u/s 3 of UGC Act, 1956)

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)

Kattankulathur, Chengalpattu District 603203, Tamil Nadu, India

Course Code	21CEE631T	Course Name	REMOTE SENSING FOR PLANETARY GEOSCIENCE	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	**Data Book / Codes / Standards**		*Nil*	

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*learn the basic concepts of planetary science.*
CLR-2:	*understand the earth and moon*
CLR-3:	*learn the earth and mars*
CLR-4:	*understand asteroids, meteorites, comets*
CLR-5:	*study the applications and various mission of mar, moon*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*understand the concepts of planetary science*	*1*	*2*	*2*
CO-2:	*acquire knowledge on earth and moon*	*1*	*1*	*3*
CO-3:	*interpretate the earth and mars*	*2*	*2*	*3*
CO-4:	*infer asteroids, meteorites, comets*	*1*	*1*	*3*
CO-5:	*knowledge on the various applications mission mars and moon*	*2*	*2*	*3*

Module-1 - Introduction to Planetary Science	***9 Hour***
Planetary Science, introduction, Origin of Universe, Solar system and Planets, Satellites, Asteroids, Meteorites and Comets, Surface features of the terrestrial planets, Inner planets, Tectonic and volcanic landforms, Impact craters, Aeolian landforms, Fluvial and glacial landforms, Possible lacustrine and marine processes, Outer planets – Formation, Outer planets – Evolution processes.	
Module-2 - Earth and Moon	***9 Hour***
Earth in space– Satellite Characteristic features– Internal structure of Moon – Surface features of Moon – Crater Studies in Moon - Morphology of impact crater, Ejecta deposits –Tectonic landforms in Moon, Fluvial landforms in Moon, Compression, Analogue study of Earth and moon, Various rocks analogue study of Earth in impact Crater.	
Module-3 - Earth and Mars	***9 Hour***
Surface composition of Mars– Surface features and geological process- Internal structure of Mars, Mineralogy and atmospheric conditions– Surface composition of Mars – Dunes in Mars– Landslides in Mars – Tectonic landforms in Mars, Important landforms in Mars, Important minerals in Mars– Igneous, sedimentary and metamorphic rocks in Mars. Spectroscopy studies for Mars	
Module-4 - Asteroids, Meteorites, Comets	***9 Hour***
Introduction to Asteroids, Meteorite and Comets –Difference between Asteroids, Comets geochemistry- Difference between Comets, Meteorites geochemistry, Spectroscopy of Asteroids- Important minerals in Meteorite, Surface composition of Asteroids	
Module-5 - Planetary Remote Sensing Applications and Mission	***9 Hour***
Spectral studies of mineral in Moon– Spectral studies of rocks in Mars, Applications of crater studies using images in Mars, Case study of Valles Marineris in Mars using planetary images, Missions to Venus for geological exploration – Indian missions on Moon–Indian mission on Mars	

Learning Resources	1. *Thomas A. Mutch, "Geology of the Moon: A Stratigraphic View", Princeton University Press,1992.* 2. *Mary Chapman. 2007. The Geology of Mars, Cambridge Planetary Science (No. 5)* 3. *The Surface of Mars, Yale Univ. Press, New Haven CT, 232 pp. Carr, M.H., 1981.* 4. *The Spatial Distribution of Rocks on Mars, Icarus, 68, 217-238. Christensen, P.R., 1986* 5. *Burns R.G., Origin of Electronic Spectra of Minerals in the Visible-Near Infrared Region. In Remote Geochemical Analysis: Elemental and Mineralogical Composition, C.M. Pieters and P.A.J. Englert, ed., Cambridge: Cambridge Univ. Press. 1993*	6. *Christensen, P.R. The Spatial Distribution of Rocks on Mars, Icarus, 1986.* 7. *Carr, M.H., R.S. Saunders, R.G. Strom, and D.E. Wilhelms, The Geology of the Terrestrial Planets, NASA Special Publication 469, U.S. Government Printing Office, Washington, DC, 1984* 8. *Evans, L.G., R.C. Reedy, and J.I. Trombka, Introduction to Planetary Remote Sensing Gamma Ray Spectroscopy, In Remote Geochemical Analysis: Elemental and Mineralogic Composition, C.M. Pieters and P.A.J. Englert, eds., Cambridge Univ. Press, pp. 167-198., 1993.* 9. *Angelo Pio Rossi, Stephan Van Gasselt, Planetary Geology, Springer 2018.* 10. *https://nptel.ac.in/courses/105107155/*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*20%*	-	*20%*	-	*20%*	-
Level 4	*Analyze*	*20%*	-	*20%*	-	*20%*	-
Level 5	*Evaluate*	*10%*	-	*10%*	-	*10%*	-
Level 6	*Create*	*10%*	-	*10%*	-	*10%*	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Dr. S. Vijayan, Scientist, Physical Research Laboratory*	1. *Dr. Girish Gopinath, Professor, Kerala Fisheries University, Kochi*	1. *Dr. J Satish Kumar, SRMIST*
2. *Dr. Sarunjith K J, Scientist, NCSCM, Chennai*	2. *Dr. C. Lakshumanan, Professor, Bharathidasan University, Trichy*	2. *Dr. Aparna S. Bhaskar, SRMIST*

Course Code	21CEE632T	Course Name	MICROWAVE REMOTE SENSING AND PROCESSING	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	**Data Book / Codes / Standards**		*Nil*	

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*understanding the basic concepts of microwave remote sensing*
CLR-2:	*understanding the radiometry and antenna*
CLR-3:	*learning the RADAR and types of RADAR*
CLR-4:	*learning microwave data processing*
CLR-5:	*studying microwave remote sensing applications*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*understand the principles of microwave remote sensing*	*1*	*1*	*2*
CO-2:	*understand the radiometry and antenna theory*	*2*	*2*	*3*
CO-3:	*familiarize to types of RADAR*	*1*	*1*	*3*
CO-4:	*acquire knowledge on microwave data processing*	*2*	*2*	*2*
CO-5:	*gain exposure to applications of microwave remote sensing*	*3*	*2*	*3*

Module-1 - Basics of Microwave Remote Sensing	***9 Hour***
Fundamentals – EMR-Electromagnetic Spectrum - Microwave Band Designation Microwave, Interaction with atmospheric constituents, Earth's surface, vegetation, and ocean	
Module-2 - Radiometry and Antenna Systems	***9 Hour***
Basics - Theory of Radiometry - Sensors applications in atmosphere, ocean and land, Antenna types and functions of different types of antennas.	
Module-3 - RADAR	***9 Hour***
Radar-Real and synthetic aperture radars, - Principles - different platforms and sensors, System parameters, Target parameters, Radar equation measurement and discrimination, Airborne Data products and selection procedure - SEASAT, SIRA, SIRB, ERS, JERS, RADARSAT missions.	
Module-4 - RADAR Data Processing	***9 Hour***
Radar grammetry, Image processing, SAR interferometry – Polarimetry interpretation of microwave data - Physical mechanism and empirical models for scattering and emission, volume scattering.	
Module-5 - Applications of Microwave Remote Sensing	***9 Hour***
Geological interpretation of RADAR –Sites-default-files, Application in agriculture -forestry, Hydrology - Ice studies – Land use mapping and ocean related studies.	

Learning Resources	1. *Thomas M. Lillesand, Ralph W. Kiefer, Jonathan W. Chipman, Remote Sensing and Image Interpretation, John Wiley & Sons, 2015.* 2. *Floyd F. Sabins Remote Sensing – Principles and Interpretation Third Edition, W. H. Freeman and Company, New York, 1997.* 3. *John R. Jensen, Remote sensing of the Environment: "An Earth Resource Perspective", Prentice Hall, 2007.*	4. *John R. Jensen, Introductory Digital Image Processing: "A Remote Sensing Perspective", Prentice Hall, 2005. Fahlstrom, P. and Gleason, T. 2012. Introduction to UAV Systems. 4th edition. United Kingdom. John Wiley & Sons Ltd.* 5. *Iain H. Woodhouse, Introduction to Microwave Remote Sensing, CRC Press, 2017.* 6. *NPTEL Course, Introduction to remote sensing, https://nptel.ac.in/courses/105108077/*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*		*Final Examination (40% weightage)*	
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*20%*	-	*20%*	-	*20%*	-
Level 4	*Analyze*	*20%*	-	*20%*	-	*20%*	-
Level 5	*Evaluate*	*10%*	-	*10%*	-	*10%*	-
Level 6	*Create*	*10%*	-	*10%*	-	*10%*	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Dr. Tune Usha, Scientist, NCCR, Chennai*	1. *Dr. C. Lakshumanan, Professor, Bharathidasan University, Trichy*	1. *Dr. Sachikanta Nanda, SRMIST*
2. *Dr. Sarunjith K J, Scientist, NCSCM, Chennai*	2. *Dr. M. C. Sashikumar, Associate Professor, CEG, Chennai*	2. *Dr. Karuppasamy Sudalaimuthu, SRMIST*

Course Code	21CEE633T	Course Name	HYPERSPECTRAL REMOTE SENSING AND DATA PROCESSING	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	Data Book / Codes / Standards	*Nil*		

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*study the basic concepts of hyperspectral remote sensing.*
CLR-2:	*understanding various hyperspectral data formats*
CLR-3:	*learn the various atmospheric correction and radiometric correction*
CLR-4:	*studying the techniques of hyperspectral data*
CLR-5:	*learn the various applications of hyperspectral remote sensing*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*understand the basic concepts of hyperspectral remote sensing*	*2*	*1*	*2*
CO-2:	*acquire knowledge of hyperspectral data formats*	*2*	*1*	*3*
CO-3:	*acquire knowledge on atmospheric correction and radiometric correction*	*2*	*2*	*3*
CO-4:	*understand the knowledge on techniques of hyperspectral data*	*3*	*2*	*3*
CO-5:	*interpretate various applications of hyperspectral remote sensing*	*3*	*3*	*3*

Module-1 - Introduction to Hyperspectral Remote Sensing	***9 Hour***
Introduction, Spectroscopy, Imaging spectroscopy, Multispectral remote sensing, Hyperspectral remote sensing, History and current scenario of hyperspectral remote sensing, Difference of multispectral and Hyperspectral data, Spectral signature of Soil, Water, Snow and Vegetation, Field spectroscopy, Surface radiance – Surface reflectance	
Module-2 - Hyperspectral Sensors and Mission	***9 Hour***
Data formats for hyperspectral sensor–Ground based hyperspectral imaging–Whiskbroom and push broom imaging spectrometer– Space borne hyperspectral imaging- HYSI, CHRIS–MERIS, MODIS, ENMAP, Airborne hyperspectral sensors, AVIRIS, AIS, CASI, CHRISS, HYDICE, HYMAP	
Module-3 - Atmospheric and Radiometric Correction	***9 Hour***
Study of Hyperspectral data cube- Radiometric correction– Hyperspectral profiles – Data redundancy– Atmospheric effects – Atmospheric correction methods, Empirical methods, Radiative Transfer methods–ACORN, ATCORN, ATREM, FLAASH, Comparison of atmospheric Correction methods	
Module-4 - Techniques for Analysis of Hyperspectral Data	***9 Hour***
Techniques for analysis of hyperspectral data–Spectral derivative analysis–First and second order derivative spectra, Spectral angle mapper –Euclidian distance – Spectral information divergence – Principal component analysis – End member extraction - Mixture tuned matched filtering –Hyperspectral image classification – Support vector machine	
Module-5 - Hyperspectral Remote Sensing Applications	***9 Hour***
Hyperspectral applications to Geology– Soil Science- Agriculture- snow and ice- Biophysical parameters, Spectral characteristics of soils, Hyperspectral applications to coastal and inland water – Disaster studies – Urban environment- Environment hazards	

Learning Resources	1. *Jensen J R, Introductory Digital Image Processing: A Remote Sensing Perspective", Pearson Education Inc, 4th edition 2015* 2. *Dimitris Manolakis, Ronald Lockwood and Thomas Cooley," Hyperspectral Imaging Remote Sensing- Physics, Sensors and Algorithms", Cambridge University Press,2016* 3. *Pramod K. Varshney and Manoj K. Arora, Advanced Image Processing Techniques for Remotely Sensed Hyperspectral Data", Springer publication, 2004.*	4. *Thomas M. Lillesand, Ralph W Kiefer; Jonathan Chipman, "Remote Sensing and Image Interpretation", John Wiley& Sons Inc,7th edition,2015* 5. *Ruiliang Pu, "Hyperspectral Remote Sensing: Fundamentals and Practices", CRC Press, Taylor & Francis group, 2017.* 6. *Marcus Borengasser, William S. Hungate, Russell Watkins, Hyperspectral Remote Sensing- Principles and Applications, CRC Press, Taylor & Francis group,2008* 7. *https://nptel.ac.in/courses/105/107/105107160/#* 8. *https://nptel.ac.in/courses/105/103/105103193/* 9. *https://nptel.ac.in/courses/105/107/105107201*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life-Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-
Level 3	Apply	20%	-	20%	-	20%	-
Level 4	Analyze	20%	-	20%	-	20%	-
Level 5	Evaluate	10%	-	10%	-	10%	-
Level 6	Create	10%	-	10%	-	10%	-
	Total	100 %		100 %		100 %	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Dr. S. Vijayan Scientist, Physical Research Laboratory, Ahmedabad*	1. *Dr. Girish Gopinath, Professor, Kerala fisheries University*	1. *Dr. J Satish Kumar, SRMIST*
2. *Dr. Sarunjith K J, Scientist, NCSCM, Chennai*	2. *Dr. C. Lakshumanan, Professor, Bharathidasan University*	2. *Dr. R. Sivakumar. SRMIST*

Course Code	21CEE634T	Course Name	LiDAR REMOTE SENSING AND PROCESSING	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	**Data Book / Codes / Standards**		*Nil*	

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*understand the terrestrial, airborne and spaceborne LiDAR sensing and data products*
CLR-2:	*study the LiDAR platforms and scanning mechanism*
CLR-3:	*study the about the LiDAR data products and processing*
CLR-4:	*study the LiDAR data products*
CLR-5:	*study the applications of LiDAR Data*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*develop the methodology to classify data based on the Earth's surface interaction*	*1*	*1*	*2*
CO-2:	*create the plan for data acquisition based on ground measuring pattern*	*1*	*1*	*3*
CO-3:	*apply the concepts for georeferencing*	*2*	*2*	*3*
CO-4:	*develop the methodology for LiDAR data classification*	*2*	*1*	*2*
CO-5:	*apply the techniques on various applications*	*3*	*2*	*3*

Module-1 - LiDAR System Design	***9 Hour***
Introduction to laser and LiDAR, Definitions of LiDAR, History of LiDAR and development, Types of LiDAR, Examples , LiDAR types based on eye safety, LiDAR technology and components, Examples of LiDAR components, Types of LiDAR sensors, Discussion on LiDAR sensor characteristics, Working principle of LiDAR, LiDAR waveform and generation, Photon counting	
Module-2 - LiDAR Remote Sensing Platform	***9 Hour***
Introduction to the LiDAR remote sensing platform - Historical development of LiDAR remote sensing platforms airborne platforms, Laser scanning, Fixed-wing platforms, Rotary Wing platforms - Terrestrial, airborne, and spacebar types – Spaceborne platforms – Orbits- Bathymetric mapping, Types of scanning mechanism, Ground measuring pattern	
Module-3 - Georeferencing and LiDAR Errors	***9 Hour***
Direct georeferencing technology – Methodology adopted for georeferencing, Boresight calibration - Project coverage verification - Review LiDAR data against field control - LiDAR data errors and rectifications, - processes calibration of LiDAR data - artifacts and anomalies –LiDAR data errors - LiDAR error budget.	
Module-4 - LiDAR Data Processing and Classification	***9 Hour***
Introduction to LiDAR data formats, Examples of data format, Types of data format - Terrestrial, Types of data format - Airborne, Storing Lidar data, LiDAR data preprocessing –LiDAR filtering, Layer Extraction - Automated filtering -. Manual editing and product generation - Surface editing, LiDAR data products, Definitions, LiDAR data classification and accuracy assessment.	
Module-5 - LiDAR Application	***9 Hour***
Introduction to LiDAR application, Corridor mapping using terrestrial LiDAR & mobile LiDAR with case study, 3-D urban mapping using airborne LiDAR with case study, Flood inundation analysis, Biomass estimation using LiDAR, Significance of LiDAR in electrical line mapping with case study, Glacier mapping using Spaceborne LiDAR, Integration of LiDAR and aerial photo for feature extraction.	

Learning Resources	1. *Floyd M. Henderson, "Principles & Applications of Imaging Radar", John Wiley & Sons, New York, 1998.* 2. *Alexay Bunkin& Konstantin Volia.K, "Laser Remote Sensing of the Ocean Methods", Publications. John & Wiley & Sons, New York, 2001.* 3. *Cheng Wang, Xuebo Yang, Xiaohuan Xi, Sheng Nie, Pinliang Dong, Introduction to LiDAR Remote Sensing, CRC press, 2024.*	4. *Raymond M. Measures, "Laser Remote Sensing: Fundamentals and Applications", John Wiley & Sons, New York, 1984.* 5. *Robert M. Haralick and Simmonett, "Image Processing for Remote Sensing", 1983.* 6. *Cracknell, Arthur .P, Hayes, Ladson, "Introduction to Remote Sensing (2 ed.)", London: Taylor and Francis 2007.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*20%*	-	*20%*	-	*20%*	-
Level 4	*Analyze*	*20%*	-	*20%*	-	*20%*	-
Level 5	*Evaluate*	*10%*	-	*10%*	-	*10%*	-
Level 6	*Create*	*10%*	-	*10%*	-	*10%*	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Sainarayanan Gopalakrishnan, HCL Technologies	*1. Dr. J. Rajesh Banu, Associate Professor Central University Tiruvarur*	*1. Dr. Karuppasamy Sudalaimuthu, SRMIST*
2. Mr. Vinu Dhanapalan, DSM Soft Pvt Ltd	*2. Dr. M. C. Sashikumar, Associate Professor, CEG, Chennai*	*2. Dr. R. Sivakumar. SRMIST*

Course Code	21CEE635T	Course Name	THERMAL REMOTE SENSING	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	**Data Book / Codes / Standards**		*Nil*	

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*study the advanced theoretical background of thermal infrared remote sensing*
CLR-2:	*study the application of hyperspectral remotes sensing*
CLR-3:	*understand the data correction and its geometric parameter from the spectral library*
CLR-4:	*communicate the knowledge of microwave remote sensing and its applications*
CLR-5:	*study the fundamentals of LiDAR, RADAR, SLAR and SAR system*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*understanding theoretical background of thermal backscattering signals involved in remote sensing.*	*1*	*1*	*2*
CO-2:	*apply the knowledge on data processing, classification, analysis the different application of hyperspectral remotes sensing*	*2*	*1*	*3*
CO-3:	*classify and analysis the different hyperspectral remote sensing data in the real-world applications*	*3*	*1*	*3*
CO-4:	*classify and analysis the different microwave remote sensing data in the real-world applications*	*3*	*2*	*2*
CO-5:	*identify Apply the knowledge of the working mechanism on applications of LiDAR, RADAR, SLAR and SAR techniques*	*3*	*2*	*3*

Module-1 - Thermal Remote Sensing	***9 Hour***
Introduction to thermal IR radiation properties and law, Thermal radiation principle, Interpretation of thermal images, Determination of emissivity conservation, Thermal properties of terrains elements and materials, Characteristics of thermal IR images and Factors affecting thermal imagery- atmospheric and other factors, Thermal remote sensing sensors, Thermal data sets: Landsat and ASTER, Application of thermal remote sensing, Qualitative and quantitative analysis for geological studies, evapo-transpiration, Urban heat island effect, Coal fire extent, Energy balance.	
Module-2 - Hyperspectral Remote Sensing	***9 Hour***
Principles of hyperspectral remote sensing, Spectral radiometry difference between remote sensing, Spectral Cube, Airborne and spaceborne hyperspectral sensors, Comparison of Multispectral and Hyperspectral image data, Spectral signature, Hyperspectral types and characterization, Hyperspectral remote sensing atmosphere, Data format and system, Hyperspectral data processing techniques software, Hyperspectral data classification, Techniques for analysis of data, imagining spectrometers, Sensors, System and Mission, Application of Hyperspectral remote sensing	
Module-3 - Hyperspectral Data Correction	***9 Hour***
Data correction –atmospheric, radiometric, and geometric, Data visualization, animation, Multiple color 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), Dimensionality reduction – Linear methods and Non-Linear methods.	
Module-4 - Microwave Remote Sensing	***9 Hour***
Microwave remote sensing – Concepts, Principle and its components, Active and Passive microwave sensors system, Backscattering, Range and Azimuth resolution Direction, Geometric characteristics, Cross-Section, Wavelength, Incidence, Depression and aspect angle, aircraft radar system; Interactions between radar and surface materials, Propagation of waves and wave Polarization, Complex dielectric properties, Surface roughness polarization, Speckle noise and Its Reduction, Surface geometry, Volume scattering, Application of microwave remote sensing.	

Module-5 - LiDAR	***9 Hour***
LiDAR Concepts and its components, LiDAR types of sensor system, Basic concepts and Accuracy of LiDAR measurements, High Resolution Satellites (IKONOS, Quick bird, etc.). Microwave satellite in operation: Seasat, Radarsat, Shuttle, Imaging Radar (SIR). Microwave radar interferometer with equation, RADAR operating principles, Radar return and Image signature- System parameters and Target parameters, Advanced Processing Techniques such as InSAR, differential InSAR or Polarimetric InSAR. SLAR: system components, spatial resolution, Synthetic Aperture Radar (SAR): SAR Interferometry for DEM generation: Differential SAR Interferometry for surface displacement studies, Geometric characteristics of SLAR imagery, Earth surface features influencing radar returns, Interpretation of SLAR imagery.	

Learning Resources	1. *Claudia Kuenzer, and Stefan Dech, Thermal Infrared Remote Sensing Sensors, Methods, Applications, Springer Netherlands, 2015,* 2. *Huajun Tang,Zhao-Liang Li, Quantitative Remote Sensing in Thermal Infrared Theory and Applications, Springer Berlin Heidelberg, 2013* 3. *Dale A. Quattrochi, Jeffrey C. Luvall, Thermal Remote Sensing in Land Surface Processing, CRC Press, 2004.* 4. *John A. Richards, Remote Sensing Digital Image Analysis, Springer-Verlag Berlin and Heidelberg GmbH & Co. KG, ISBN: 9783642441011, 2022*	5. *Ravi P. Gupta, Remote Sensing Geology, Springer Berlin Heidelberg, 2017* 6. *Abhshek Sharmaand Lester Hanks, Quantitative Remote Sensing in Thermal Infrared, Scitus Academics LLC, 2016* 7. *https://nptel.ac.in/courses/105101206* 8. *https://nptel.ac.in/courses/105101213* 9. *https://nptel.ac.in/courses/105105211* 10. *https://nptel.ac.in/courses/105107201* 11. *https://nptel.ac.in/courses/105108077*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*20%*	-	*20%*	-	*20%*	-
Level 4	*Analyze*	*20%*	-	*20%*	-	*20%*	-
Level 5	*Evaluate*	*10%*	-	*10%*	-	*10%*	-
Level 6	*Create*	*10%*	-	*10%*	-	*10%*	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Dr. Sainarayanan Gopalakrishnan, HCL Technologies*	1. *Dr. R. Kumar, NIT Nagaland*	*1. Dr. A. Manimaran, SRMIST*
2. *Dr. Sricharan Srinivasan, Wipro Technologies,*	2. *Dr. B. Surendiran, NIT Puducherry*	*2. Dr. S. Durgadevagi, SRMIST*

Course Code	21CEE636T	Course Name	DRONE TECHNOLOGY AND DATA PROCESSING	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co- requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Civil Engineering	Data Book / Codes / Standards	Nil		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*understand the basics and classifications of UAV's*
CLR-2:	*familiarize with UV mission for ground survey*
CLR-3:	*acquire the knowledge in software processing*
CLR-4:	*practice the UAV survey using drone*
CLR-5:	*discern the applications of drone*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	*Programme Outcomes (PO)*		
		1	*2*	*3*
CO-1:	*explore the basics, safety and liability in using UAV*	*1*	*1*	*2*
CO-2:	*develop the methodology for UAV mission planning for survey*	*2*	*1*	*3*
CO-3:	*develop the workflow for UAV data processing*	*3*	*2*	*2*
CO-4:	*expertise in using drone for survey*	*3*	*2*	*3*
CO-5:	*expertise in using software for data processing*	*3*	*2*	*2*

Module-1 - Drone and Basics ***9 Hour***

Overview and background of Drone (UAV), Discussion of definition and concepts, History of UAV's, Discussion on the development of UAV, Classification of UAV, Examples of UAV, Operational requirements of UAV, Discussion on operational requirements, UAV sensors, Examples of UAV sensor, Sensors calibration and bore sighting, Discussion on Calibration, Sensors calibration and bore sighting, Converse on sensor bore sighting, Liability and legal issue in India, Conversation on liability, Liability and legal issue in India, Discussion of legal issues, Maintenance operation of drone, Discussion on maintenance of drone, Safety measure parameters, Conversation on safety measure parameters.

Module-2 - Drone Data Acquisition ***9 Hour***

Introduction to UAV data acquisition, Discussion on method of data acquisition, UAV data acquisition components, Examples of data acquisition components, UAV mission, Prerequisites for UAV survey planning , Converse on prerequisites for UAV survey, Establishment of Ground Control Point (GCP), Discussion on Ground Control Point, Establishment of Ground Control Point (GCP), Conversation on Establishment of GCP, Necessity in selecting DGPS for GCPs measurement Discussion on availability of high accuracy survey instruments Necessity in selecting DGPS for GCPs measurement, Conversation on necessity in selecting DGPS instruments, Types of DGPS survey, Examples of DGPS survey, Static DGPS , Discussion on procedure followed in static survey, Kinematic DGPS, Discussion on procedure followed in Kinematic survey, Accuracy requirements of GCPs, Conversation on accuracy of GCP's

Module-3 - Drone Data Processing ***9 Hour***

Introduction to UAV data processing, Discussion on concepts of data processing, Concepts of UAV data formats, Conversation on data formats, Types of UAV data formats, Examples of UAV data formats, Data processing software's, Discussion on data processing software, Conversation on available software, Workflow of UAV data processing, Analyzing the UAV workflow of data processing, UAV data preprocessing, Discussion on UAV data, UAV data post processing, UAV data products, Examples of UAV data products, Types of data products, Review on types of data products, Data products accuracy, Examine the data products accuracy, Data products accuracy, Examine the data products accuracy

Module-4 - Drone data Acquisition and Processing – Practical Demo	***9 Hour***
UAV survey - Practical demo, Triangulation of UAV photos - software demo, Point cloud generation - software demo, Hands-on exposure on point cloud generation, DTM and DSM generation - Software demo, Hands-on exposure on DTM and DSM generation, Orthophoto generation - software demo, Hands-on exposure on Orthophoto generation, Topographical Map compilation - Software demo, Hands-on exposure on Map compilation.	
Module-5 - Applications of Drone with Case Study	***9 Hour***
Introductions to UAV applications, Applications on Contour generations, Applications on 3D urban planning, Conversation on requirement of 3D urban planning, Applications on 3D urban planning (Case study), Applications on volume calculations, Applications on volume calculations (Case study), Applications on 3D building extraction, Applications on 3D building extraction (case study), Applications on 3D terrain mapping, Applications on 3D terrain mapping (case study), Precision farming using UAV, Precision farming using UAV (case study)	

Learning Resources	1. *Austin, Unmanned Aircraft Systems: UAVS Design, Development and Deployment. Wiley, 2010.* 2. *Baichtal, Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs. Que Publishing, 2016.* 3. *Cares & Dickmann, Operations Research for Unmanned Systems. Wiley, 2016.*	4. *Beard & McLain, Small Unmanned Aircraft: Theory and Practice. Princeton University Press, 2012* 5. *Y. Mohamed Sirajudeen, Sachi Nandan Mohanty, Chinmaya Ranjan Pattnaik, G. Surya Narayana, J. V. R. Ravindra, Drone Technology: Future Trends and Practical Applications, Willey, 2023.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*20%*	-	*20%*	-	*20%*	-
Level 4	*Analyze*	*20%*	-	*20%*	-	*20%*	-
Level 5	*Evaluate*	*10%*	-	*10%*	-	*10%*	-
Level 6	*Create*	*10%*	-	*10%*	-	*10%*	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Dr. Sainarayanan Gopalakrishnan, HCL Technologies*	1. *Dr. J. Rajesh Banu, Associate Professor, Central University Tiruvarur*	1. *Dr. Karuppasamy Sudalaimuthu, SRMIST*
2. *Mr. Vinu Dhanapalan, DSM Soft Pvt Ltd*	2. *Dr. M. C. Sashikumar, Associate Professor, CEG, Chennai*	2. *Dr. J. Satish Kumar, SRMIST*

Course Code	21CEE637T	Course Name	NON – TOPOGRAPHIC PHOTOGRAMMETRY	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	**Data Book / Codes / Standards**		*Nil*	

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*study the basics principles of non-topographic photogrammetry*
CLR-2:	*study the fundamental aspects on survey of historic monuments applications*
CLR-3:	*study the planimetric measurements and principles with reference to hologram metric applications*
CLR-4:	*study the basic principles of stereo X-Ray photogrammetry analysis*
CLR-5:	*understand the forensic photogrammetric applications usage*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*understand theoretical background of non – topographic photogrammetry techniques*	*1*	*1*	*2*
CO-2:	*understand the concepts of electron microscopy system with its applications*	*1*	*1*	*3*
CO-3:	*overcome the geomatics engineering application*	*1*	*1*	*3*
CO-4:	*apply the knowledge on using X-ray Photogrammetry and different classification approaches with respect to diverse applications*	*3*	*1*	*2*
CO-5:	*apply the knowledge of forensic photogrammetric applications studies*	*3*	*1*	*3*

Module-1 - Non- Topographic Photogrammetry	***9 Hour***
Fundamentals on non-topographic photogrammetry - Brief history -Potential of close-range photogrammetry - Instrumentation for data acquisition - Phototheodolite, Metric Camera, Non - metric camera, Stereometric camera, Digital camera - Instrumentation for data analysis - Analog and analytical stereo plotters - Software in non - topographic photogrammetry.	
Module-2 - Applications of Non- Topographic Photogrammetry	***9 Hour***
Applications in architecture and archaeology - Survey of historic monuments - Conservation and preservation - Photomontage by inverse photogrammetry - Electron microscopy - Systems and applications using SEM and TEM.	
Module-3 - Measurement and Monitoring	***9 Hour***
Aerospace industry, Automobile industry - Measuring communication antennas - Measurement of storage tanks and cooling tower, Model studies - Hologram metric Applications for vibration and stress concentration studies.	
Module-4 - Bio-Medical Applications	***9 Hour***
Biomedical application using x-ray photogrammetry systems. Principle point location in radiographs - Stereo X-ray photogrammetry - Analysis - Bio - Stereometrics - Whole body form, Trunks and limbs. Moire topography -Systems and applications.	
Module-5 - Forensic Applications	***9 Hour***
Forensic photogrammetric applications -Mapping crime scene using conventional photogrammetry -Reverse projection technique in accident investigations. Under water photogrammetry.	

Learning Resources	1. *Karara. H. M, Handbook of Non – Topographic Photogrammetry, American Scoiety of Photogrammetry and Remote Sensing, 2nd Edition, 1989* 2. *Hallert, Bertil, X-ray Photogrammetry:Basic Geometry and Quality, Amsterdam;Barking: Elsevier Publishing Company, 1970.* 3. *Thomas Luhmann,Stuart Robson,Stephen KyleandJan Boehm, Close-Range Photogrammetry and 3D Imaging, De Gruyter STEM, 2023, https://doi.org/10.1515/9783111029672.* 4. *Karl Kraus and Walter de Gruyter, Photogrammetry: Geometry from Images and Laser Scans, Volume 1, 2nd Edition, 2007.*	5. *Slama, Chester C; Theurer, Charles; Henriksen, Soren W ,Manual of photogrammetry – Handbook, Falls Church, Va. : American Society of Photogrammetry and Remote Sensing, 1980* 6. *https://nptel.ac.in/courses/105104167* 7. *https://www.domestika.org/en/courses/666-introduction-to-3d-photogrammetry* 8. *https://accupixel.co.uk/photogrammetry-training-courses/* 9. *https://www.udemy.com/course/photogrammetry-turn-images-into-3d-models/* 10. *https://www.udemy.com/course/essentials-of-photogrammetry/* 11. *https://www.udemy.com/course/drone-photogrammetric-image-processing-beginner-to-expert*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life-Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-
Level 3	Apply	20%	-	20%	-	20%	-
Level 4	Analyze	20%	-	20%	-	20%	-
Level 5	Evaluate	10%	-	10%	-	10%	-
Level 6	Create	10%	-	10%	-	10%	-
	Total	100 %		100 %		100 %	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Dr. Sainarayanan Gopalakrishnan, HCL Technologies*	1. *Dr. R. Kumar, NIT Nagaland*	1. *Dr. A. Manimaran, SRMIST*
2. *Dr. Sricharan Srinivasan, Wipro Technologies*	2. *Dr. B. Surendiran, NIT Puducherry*	2. *Dr. S. Durgadevagi, SRMIST*

Course Code	21CEE638T	Course Name	REMOTE SENSING AND GIS FOR ENVIRONMENTAL IMPACT ASSESSMENT	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	**Data Book / Codes / Standards**		*Nil*	

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*conversant with basics of ecosystem its functions and energy resources*
CLR-2:	*possess knowledge in environmental impact assessment and application of remote sensing and GIS applications*
CLR-3:	*understand RS&GIS techniques on land and soil environment*
CLR-4:	*understand RS&GIS techniques on water environment*
CLR-5:	*understand RS&GIS techniques on air and other environment*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*describe basics of environment, its resources and human impact on them*	*1*	*1*	*2*
CO-2:	*apply RS&GIS knowledge on environmental impact assessment and management plan*	*3*	*2*	*3*
CO-3:	*apply RS&GIS techniques in understanding impact of land and soil environment*	*3*	*2*	*3*
CO-4:	*apply RS&GIS techniques in understanding impact of water environment*	*3*	*2*	*3*
CO-5:	*apply RS&GIS techniques in understanding impact of air and other environment*	*3*	*2*	*3*

Module-1 - Environment and Ecosystem	***9 Hour***
Definition, Scope and importance of environment; Ecosystems - Introduction, Types, Characteristic features, structure and functions of Ecosystems – Forest, Grassland, Desert, Aquatic (lakes, rivers and estuaries); Energy resources – Energy needs; Renewable and non-renewable energy sources; Impact of energy use on environment.	
Module-2 - Environmental Impact Assessment	***9 Hour***
Concepts, methods; Environmental analysis and environmental monitoring for sustainable development through RS & GIS; Environmental management plan (EMP), Its importance and role of GIS in preparation of EMP	
Module-3 - Land and Soil Application	***9 Hour***
Land Use Land Cover mapping, Natural Resources, Census, wetland mapping, land/soil degradation and irrigability mapping, desertification mapping, soil quality, soil erosion and deposition modeling, land capability maps.	
Module-4 - Water Resources	***9 Hour***
Siltation estimation and mapping, water colour, turbidity, water quality index mapping, point source pollution mapping, non-point source pollution modeling, eutrophication and water vegetation mapping, oil slicks tracing and monitoring sea turbidity; coastal, river and reservoir sedimentation mapping; ground water level, potential zones, vulnerability, contamination studies.	
Module-5 - Air and Other Pollutions	***9 Hour***
Aerosol remote sensing, air quality indexing and mapping, dynamic air pollution modeling, mapping and measuring troposphere pollutants, spread and dispersion of smoke plumes from industries and power plants, forest fires, oil wells, bioterrorism, ecology of vectors of epidemics, mapping epidemics vulnerable zones.	

Learning Resources	1. 1.Gupta, R.P. 1990: Remote Sensing Geology. Springer Verlag. 2. 2.Skidmore A. 2002: Environmental Modeling with GIS and Remote Sensing. Taylor and Francis 3. Heywood I., Cornelius S., Crever Steve. 2003: An Introduction to Geographical Information Systems. Pearson Education 4. Jensen J. R. 2000: Remote Sensing of the Environment - An Earth Resources Perspective, Pearson Education, Inc. (Singapore) Pvt. Ltd., Indian edition, Delhi 5. John Wainwright and Mark Mulligan (Eds). 2004: Environmental modeling - finding simplicity in complexity. John Wiley & Sons Ltd	6. Jorgensen S. E., Chon T. S., and Recknage F. A., 2009: Handbook of Ecological Modeling and Informatics. WIT Press, 448 pages, ISBN-13: 978-1845642075 7. Maguire D., Batty M., and Goodchild M. (Eds.) 2005: GIS, Spatial Analysis, and Modeling. Esri Press, 496 pages, ISBN-13: 978-1589481305. 8. Steven E. Franklin. 2001: Remote Sensing for Sustainable Forest management. Lewis publishers 9. NPTEL courses: NOC: Remote sensing and GIS 9. NPTEL courses: NOC: Digital image processing of remote sensing data 10. NPTEL courses: NOC: Environmental quality monitoring & analysis

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life-Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-
Level 3	Apply	20%	-	20%	-	20%	-
Level 4	Analyze	20%	-	20%	-	20%	-
Level 5	Evaluate	10%	-	10%	-	10%	-
Level 6	Create	10%	-	10%	-	10%	-
	Total	100 %		100 %		100 %	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Rajkumar Samuel, Hubert Enviro-Care Systems, Chennai,	1. Dr. S. Madhava Kumar, IIT Madras	1. Dr. R. Sivakumar, SRMIST
2. Mr. A. Abdul Rasheed, CMWSS Board,	2. Dr. G. Dhinagaran, Anna University, Chennai	2. Dr. P. Purushothaman, SRMIST

Course Code	21CEE639T	Course Name	EARTH OBSERVATION FOR NATURAL RESOURCE MANAGEMENT	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	**Data Book / Codes / Standards**	*Nil*		

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*learn the concepts of natural resources management*
CLR-2:	*acquire knowledge in geological resource mapping*
CLR-3:	*study the water resources and its monitoring and mapping*
CLR-4:	*study the resources of forest and agriculture*
CLR-5:	*learn the resources of coastal zones and its management*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*understand the concepts of natural resources management*	*1*	*1*	*2*
CO-2:	*acquire knowledge in applicability of GIS and concepts of natural resource*	*1*	*1*	*3*
CO-3:	*explore the geological resource its mapping and management*	*2*	*1*	*3*
CO-4:	*explore the resources of forest and agriculture and its mapping*	*2*	*1*	*2*
CO-5:	*use of remote sensing and GIS in coastal zone management*	*3*	*1*	*3*

Module-1 - Overview of Natural Resources Management	***9 Hour***
Resource management paradigms, Evolution and history of resource management paradigms, Objectives, Resource conflicts: Resource extraction, access and control system, Approaches in resource Management: Ecological approach, Economic approach, Ethnological approach, Implications of the approaches; Integrated resource management strategies. Role of remote sensing for resource management.	
Module-2 - Geological Resource Mapping	***9 Hour***
Mineral resources identification and mapping, Mapping of lithology - Igneous, sedimentary and metamorphic rocks, Geological structures and interpretation and its significance, Soil mapping and classification –Soil conservation – Monitoring of non-renewable energy resources	
Module-3 - Water Resource Mapping	***9 Hour***
Surface and ground water, Detection of surface water bodies, Mapping of water quality parameters, Ground water potential mapping, Surface water mapping, Mapping and monitoring of water resources, Floods and Drought mapping, Applications of topographic mapping in natural resource management.	
Module-4 - Vegetation Resource Mapping	***9 Hour***
Techniques for monitoring vegetation dynamics, Spectral properties of vegetation, Digital change detection of vegetation cover, Crop monitoring, Assessment of vegetation health and biomass estimation, Forest cover mapping –-Fire mapping and risk modeling, Resource management in mountain ecosystem.	
Module-5 - Coastal Resource Management	***9 Hour***
Coastal zone, Coastal regulation zones, Coastal zone management plan, Monitoring of sea surface temperature, Remote sensing for coastal ecosystem mapping – Costal dunes, Mangroves, Corals, Sea grass.	

Learning Resources	1. *Jensen, John R. 2009. Remote Sensing of the Environment: An Earth Resource Perspective, 2nd Edition. Dorling Kindersley.* 2. *Joseph, George. 2005. Fundamentals of Remote Sensing, 2nd Edition. University Press India.* 3. *Francois Ramade 1984. Ecology of Natural Resources. John Wiley & Sons Ltd.* 4. *Murthy, V.V.N. 2009. Land and Water Management, 5th Edition.Kalyani Publishers* 5. *Mahesh Gaur , C.B. Pandey & R.K. Goyal, Remote sensing for natural resources management & monitoring, 2021.*	6. *Tang, Danling, "Remote Sensing of the Changing Ocean", Springer, 2011. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p* 7. *Coastal Ecology & Management, Mann, K.H. 2000. Ecology of Coastal Waters with Implications for Management (2nd Edition).Chap. 2-5, pp.18-78 & Chap. 16, pp.280-303.* 8. *Global Change and Natural Resource Management, Vitousek, P.M. 1994. Beyond global warming: Ecology and global change. Ecology 75, 1861-1876.* 9. *Heathcote, I.W. 1988. Integrated Watershed Management: Principles and Practice, John Wiley.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	*-*	*20%*	*-*	*20%*	*-*
Level 2	*Understand*	*20%*	*-*	*20%*	*-*	*20%*	*-*
Level 3	*Apply*	*20%*	*-*	*20%*	*-*	*20%*	*-*
Level 4	*Analyze*	*20%*	*-*	*20%*	*-*	*20%*	*-*
Level 5	*Evaluate*	*10%*	*-*	*10%*	*-*	*10%*	*-*
Level 6	*Create*	*10%*	*-*	*10%*	*-*	*10%*	*-*
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Dr. Sarunjith K. J., Scientist, NCSCM, Chennai*	1. *Dr. Rajesh Raghunath, Professor, University of Kerala*	1. *Dr. Aparna S. Bhaskar, SRMIST*
2. *Dr. Arindam Guha, Scientist, NRSC, Hyderabad*	2. *Dr. V. J Rajesh, Professor, IIST, Thiruvananthapuram*	2. *Dr. J. Satish Kumar, SRMIST*

Course Code	21CEE640T	Course Name	REMOTE SENSING AND GIS APPLICATIONS FOR WATER RESOURCE	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	**Data Book / Codes / Standards**	*Nil*		

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*create insights into the role of RS and GIS on surface water hydrology*
CLR-2:	*address concepts on groundwater hydrology and studying case studies using RS and GIS*
CLR-3:	*explore the concepts of drainage basin assessment using RS and GIS*
CLR-4:	*comprehend watershed conservation and management using RS and GIS*
CLR-5:	*understand the importance of irrigation and water quality mapping / monitoring using RS and GIS*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*analyze various water losses and apply RS and GIS in hydrological investigations*	*1*	*1*	*2*
CO-2:	*illustrate RS and GIS application in ground water hydrology*	*2*	*1*	*3*
CO-3:	*analyze drainage basin assessment through RS and GIS*	*2*	*1*	*3*
CO-4:	*apply RS and GIS in watershed management*	*3*	*2*	*2*
CO-5:	*understand the application of RS and GIS in irrigation and water quality assessment*	*3*	*2*	*3*

Module-1 - Surface Water Hydrology	***9 Hour***
Hydrological cycle – World Water Balance – Precipitation – Measurement – Mean areal depth of precipitation using GIS –Water losses – Interception, Evaporation, Transpiration, Consumptive use, Infiltration – Spectral properties of water and snow – Hydrological response to climate change and Land use/Land cover change - Relevance of Remote Sensing techniques for hydrological investigations	
Module-2 - Ground Water Hydrology	***9 Hour***
Occurrence of groundwater – Movement of groundwater – Factors affecting groundwater occurrence - Darcy's law – Aquifer and their types – Well hydraulics – Estimation of groundwater potential –Seawater intrusion - Mathematical models – Groundwater modeling – Case studies using Remote Sensing and GIS	
Module-3 - Drainage Basin Assessment	***9 Hour***
Watershed – Watershed divide – Stream networks – Morphometric analysis – Linear, areal and relief aspects – Prioritization of watershed using RS and GIS - Runoff – Components of stream flow –Runoff Estimation - Rainfall-runoff modeling – Mapping of snow-covered area – Snow melt runoff –Flood plain mapping, monitoring and zoning - Drought forecasting and damage assessment	
Module-4 - Watershed Management	***9 Hour***
Geospatial methods for watershed mapping –Watershed conservation, planning and management – Conjunctive use of surface water and ground water – Artificial recharge of groundwater – Water harvesting structures and site selection for rainwater harvesting using RS and GIS – Sediment yield – Universal soil loss equation – Modeling of reservoir siltation – Modeling of sustainable development	
Module-5 - Irrigation and Water Quality	***9 Hour***
Irrigation – Necessity – Methods of applying water to the fields – Soil-water-plant relationship – Crop season –Duty & Delta – Crop yield modeling using RS - Canal – Types of alignment – Water logging: causes, effects and remedial measures – Water quality – Physical, chemical and biological properties – Water quality mapping and monitoring using RS and GIS – Model for pollution detection	

Learning Resources	1. *Raghunath, H.M., Hydrology, New Age International Publishers, New Delhi, 2022.* 2. *Subramanya, K., Engineering Hydrology, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2017* 3. *Andy D. Ward and Stanley W. Trimble, Environmental Hydrology, 3rd Edition, Lewis Publishers, 2015.* 4. *Ramasamy .S.M, "Remote sensing in water resources", Rawat publications, New Delhi ,2005.*	5. *Murty.V.V.N, "Land and Water Management Engineering", Kalyani Publishers, New Delhi – 2013.* 6. *Agarwal C.S and Garg.P.K, "Text Book on Remote Sensing in Natural Resources, Monitoring and Management", Wheeler publishing Co & Ltd., New Delhi, 2010.* 7. *Chow, V.T., and Maidment, Hydrology for Engineers, McGraw Hill Inc., Ltd., 2000*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*20%*	-	*20%*	-	*20%*	-
Level 4	*Analyze*	*20%*	-	*20%*	-	*20%*	-
Level 5	*Evaluate*	*10%*	-	*10%*	-	*10%*	-
Level 6	*Create*	*10%*	-	*10%*	-	*10%*	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Dr. Sainarayanan Gopalakrishnan, HCL Technologies*	1. *Dr. R. Kumar, NIT Nagaland,*	1. *Dr. R. Sathyanathan, SRMIST*
2. *Dr. Sricharan Srinivasan, Wipro Technologies*	2. *Dr. B.Surendiran, NIT Puducherry*	2. *Dr. R. Annadurai SRMIST*

Course Code	21CEE641T	Course Name	REMOTE SENSING AND GIS FOR ENVIRONMENTAL APPLICATIONS	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	**Data Book / Codes / Standards**	*Nil*		

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*identify the environmental problems using remote sensing*
CLR-2:	*apply the principle of RS and GIS for solving environmental problems*
CLR-3:	*assess the Environmental Impacts using RS and GIS*
CLR-4:	*employ modern engineering tools in environmental studies*
CLR-5:	*function on a multi-disciplinary team*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*know the remote sensing principle and the different stages of remote sensing*	*1*	*1*	*2*
CO-2:	*understand the various type remote sensing technology.*	*1*	*1*	*3*
CO-3:	*apply the knowledge of satellite sensing system for different environmental issues.*	*3*	*2*	*3*
CO-4:	*apply the knowledge of GIS and image analysis for environmental applications.*	*3*	*2*	*2*
CO-5:	*develop the GIS data base, and work with multi-disciplinary team*	*3*	*2*	*3*

Module-1 - Remote Sensing Elements	***9 Hour***
Historical perspective, Principles of remote sensing, Components of remote sensing, Energy source and electromagnetic radiation, Electromagnetic spectrum, Energy interaction, Spectral response pattern of earth surface features, Energy recording technology	
Module-2 - Remote Sensing Technology	***9 Hour***
Classification of Remote Sensing Systems, Aerial photographs, Photographic systems – Across track and along track scanning, Multispectral remote sensing, Thermal remote sensing, Microwave remote sensing – Active and passive sensors, RADAR, LIDAR	
Module-3 - Satellite Remote Sensing	***9 Hour***
Satellites and their sensors, satellite orbits, Indian space programme - Research and development - ISRO satellites, LANDSAT, ERS, SPOT, TERRA and NOOA satellite series, Characteristics of Remote Sensing data, Satellite data Products.	
Module-4 - Remote Sensing Applications and Case Studies	***9 Hour***
Visual image interpretation, Digital image processing – Image rectification, Enhancement, transformation, Classification, Data merging – Remote sensing applications in monitoring and management of environment – Conservation of resources, Disaster management, Sustainable urban land use, Agriculture, EIA, Marine and coastal zone management – Case studies	
Module-5 - Geographical Information System Case Studies	***9 Hour***
GIS – Concepts and components, Spatial and non-spatial data, Vector and raster data structures, Data analysis, Database management – RS – GIS Integration, Image processing software, GIS software GIS applications in monitoring and management of environment – Case studies.	

Learning Resources	1. *Lillesand, T.M. and Kiefer, R.W, Remote Sensing and Image Interpretation, John Wiley and sons, New York, 2007.* 2. *Golfried Konechy, Geoinformation: Remote Sensing, Photogrammetry and Geographical Information Systems, CRC press, 1st Edition, 2002.* 3. *Burrough, P.A. and McDonnell, R.A., Principles of Geographic Information systems, Oxford University Press, New York, 2001.*	4. *Lintz, J. and Simonet, Remote sensing of Environment, Addison Wesley Publishing Company, New Jersey, 1998* 5. *Floyd M. Henderson and Anthony J. Lewis, Principles and Applications of Imaging RADAR, Manual of Remote Sensing, Vol.2, ASPR, 2001.* 6. *Maged Marghany, Environmental Applications of Remote Sensing, Science Direct, 2016.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*20%*	-	*20%*	-	*20%*	-
Level 4	*Analyze*	*20%*	-	*20%*	-	*20%*	-
Level 5	*Evaluate*	*10%*	-	*10%*	-	*10%*	-
Level 6	*Create*	*10%*	-	*10%*	-	*10%*	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Dr. Sainarayanan Gopalakrishnan, HCL Technologies*	1. *Dr. R. Kumar, NIT, Nagaland*	1. *Dr. S. Durgadevagi SRMIST*
2. *Dr. Sricharan Srinivasan, Wipro Technologies*	2. *Dr. B. Surendiran, NIT, Puducherry*	2. *Dr. R. Annadurai, , SRMIST*

Course Code	21CEE642T	Course Name	REMOTE SENSING AND GIS FOR URBAN AND REGIONAL PLANNING	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	**Data Book / Codes / Standards**		*Nil*	

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*obtain basic knowledge about remote sensing utilization in urban studies*
CLR-2:	*gain knowledge about urban region mapping*
CLR-3:	*understand the pre-requisite and types of urban growth required for urban planning*
CLR-4:	*study the urban design methods for sustainability*
CLR-5:	*learn the application of RS and GIS in urban studies*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*understand Remote sensing data and perform preliminary analysis.*	*2*	*1*	*2*
CO-2:	*understand and can perform urban mapping*	*2*	*1*	*3*
CO-3:	*identify the types of urban growth and can prepare the plans accordingly*	*3*	*3*	*3*
CO-4:	*perform various urban analysis.*	*3*	*2*	*3*
CO-5:	*utilization of RS and GIS in urban studies.*	*3*	*2*	*3*

Module-1 - Introduction to Urban and Regional Planning	***9 Hour***
Requirements for urban & regional planning, Definitions -Identification of settlement features in various datasets. Land Use, Land Cover & space use–various schemes (USGS, NRSC, etc.,) requirements & and considerations of schemes, Types of data requirements for various Levels in LU/LC., Relevance of remote sensed data for Urban & Regional analysis and planning-National data products, Types of data products-International, Data file formats–BSQ,BIL&BIP, Image quality & Statistics- Histogram, Univariate & Multivariate-Min, Max, Mean, Mode, Median, Standard deviation, Variance, Covariance, Skewness, kurtosis, Correlations & Regression., Visual and digital analysis techniques: Elements of interpretation keys with examples. Classifications: – Supervised –Concepts and Procedures, Unsupervised-Concept and Procedures & Object oriented based classification systems., Accuracy assessment–Error matrix-Commissions, Omissions, Types of accuracies-Overall accuracies, Producers accuracy Average accuracy, users accuracy, Kappa coefficient of agreement, Principal Component Analysis(PCA), Scale of the photographs–Definitions, Types–Large scale, Medium scale & Small- Scale, Scope & limitations, Resolution in images – Definition, Types – Spatial, Spectral, Radiometric, Temporal, Scope and limitations	
Module-2 - Urban Mapping	***9 Hour***
Urban regional mapping, City mapping, Intra-city mapping, Delineation of area: Introduction, Definition-Urban agglomeration, Pre-requisites for delineation, Mapping–Definition-Types of maps-Basemap–Definition–Parameters-Base map preparation–Methodology-Change Detection and mapping– Introduction, Definition & Importance, Types of change detection techniques., Case studies on change detections, Urban sprawl–Introduction, Definition & its Effects forms of sprawl–Low density sprawl, Ribbon sprawl, Leap frog sprawl, Causes of sprawl, Importance of sprawl indicators, studies on urban sprawl. CBD–Introduction, Characteristics of CBD, CBD parameters & Case studies- classification-Urban fringe- Case studies	
Module-3 - Urban Development Planning	***9 Hour***
Sustainable development plans, Urban planning–Definition–Objectives, Principles–Urban growth, Types of urban growth– Natural growth, Concentric spread–ribbon–Satellite growth, Planned growth–Horizontal - vertical Growth, Surveys for data collection-Functional surveys– Social surveys–Territorial surveys, Other surveys, Masterplan–Definition–Components, Parameters to be considered. Preparation of area plan- Preparation of zonal plans, Setting-out of plans–Case studies, regional plan–Definition–Principles detailed development plan, Types of functional zones zoning districts, Case studies on regional plans -	

Case studies on detail development plans-urban design methods for sustainability- Objectives–Surveys–Analysis- Plan & Design statements–Evaluation of plans– Alternative plans–Design presentations–Choice of plans– Implementations – Project managements
Module-4 - Urban Analysis **9 Hour**
Urban studies-Urban theories–General-Historical background urban analysis–Theoretical principles- Aesthetic observation-Scientific observation - Integrative observation, Methods of analysis–Historical analysis-Analysis of Land Use structures – Analysis of open space and green structures-Analysis of construction and housing structure-Slum development: Slum definition- Characteristics of slum–Risk action plan–Case studies, Site selection for urban development, Density analysis population estimations–Case studies transportation networks–Components- Network–Route- Transportation structure–Node–Link–Flows Hub/Interface–Feeder Corridor, Transportation structures: Spatial integration topology–Types of network structures–Centralized–Decentralized- Distributed–Centripetal–Centrifugal network strategies: Minimum construction cost- Minimum operation cost-Maximum accessibility, Least length–Nodal
Module-5 - RS and GIS in Urban Studies **9 Hour**
GIS In urban studies, Definition–Workflow-Components of GIS data input types, Types of output products geo-referencing of GIS data, Spatial data errors–Sources, Spatial data models–Object based models, Field based models spatial data structures–Raster data structures-Run-length encoding-Chaincode Block code–Quadtree. Vector data structures–Spaghetti–Topological DIME–TIGER. Modeling surfaces–Raster approach- Vector approach, GIS database: Simple list- Ordered sequential files–Indexed files, DBMS: Introduction, Hierarchical database structure, Network data structures, Relational database structures, Object-oriented database structures, Suitability of GIS software for urban analysis-modeling with GIS, Decision support systems for urban studies.

Learning Resources	1. *Brench M. C., City Planning & Aerial Information, Harvard University, Cambridge,1971.* 2. *Mehebub Sahana, Remote Sensing and GIS in Peri-Urban Research, Perspectives on Global Change, Sustainability and Resilience, Elsevier, 2024.* 3. *Gautam N.C., Urban land Use Interpretation through Arial Photograph Interpretation, NRSA.* 4. *IRSRS Applications to Urban Planning and Development, InstituteofRemoteSensing*	5. *Margaret Roberts, An Introduction to Town Planning Techniques, Hutchinson, London, 1980.* 6. *M. Chandra, S K. Gosh, Remote Sensing and Geographical Information System, Narosa Publishing House Pvt Ltd., India* 7. *SWAYAM: https://swayam.gov.in/nd1_noc20_ce24/preview* 8. *NPTEL: https://nptel.ac.in/courses/105/103/105103176*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*20%*	-	*20%*	-	*20%*	-
Level 4	*Analyze*	*20%*	-	*20%*	-	*20%*	-
Level 5	*Evaluate*	*10%*	-	*10%*	-	*10%*	-
Level 6	*Create*	*10%*	-	*10%*	-	*10%*	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Mr. Pravesh Iyer, Hexagon, Chennai*	1. *Dr. K. Srinivasa Raju, IRS, Anna University, Chennai*	1. *Dr. Sachikanta Nanda, SRMIST*
2. *Dr. Tune Usha, NCCR, Chennai*	2. *Dr. S. Ramesh, NIOT*	2. *Dr. R. Sivakumar, SRMIST*

Course Code	21CEE643T	Course Name	REMOTE SENSING AND GIS FOR MARINE SCIENCES	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	**Data Book / Codes / Standards**	*Nil*		

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*introduce the basic concept of marine science and its importance*
CLR-2:	*instruct the importance of marine processes and properties*
CLR-3:	*know about important marine satellite sensors*
CLR-4:	*disseminate basic concepts and applications of remote sensing and GIS in marine sciences*
CLR-5:	*address to different case studies in marine sciences and advance technological solutions*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*understand the importance of marine sciences*	*1*	*1*	*2*
CO-2:	*understand the different marine processes and properties*	*1*	*1*	*3*
CO-3:	*gain knowledge about marine satellite and sensors*	*1*	*1*	*3*
CO-4:	*enhance knowledge about remote sensing and GIS for various marine applications*	*2*	*2*	*2*
CO-5:	*utilize the knowledge of satellite remote sensing to tackle a variety of case studies*	*3*	*2*	*3*

Module-1 - Marine Sciences	***9 Hour***
Introduction to Marine science and its importance, Ocean topography, CRZ, Marine and coastal ecosystems: Phytoplankton, Zooplankton, Fisheries, Mangroves, Seagrass, Seaweed, Coral reef and Coastal wetlands, Factors affecting marine ecosystems.	
Module-2 - Marine Processes, Properties and Marine Impacts	***9 Hour***
Ocean currents, Tides, Sea waves, Storm surges, Cyclones, Sediment transportation, Physical & chemical properties of seawater, Marine pollution, Climate change impacts on marine environment, Introduction to remote sensing and GIS applications in marine science	
Module-3 - Marine Observation Satellites/Sensors	***9 Hour***
Marine Observation Satellite (MOS-1), Coastal Zone Colour Scanner (CZCS), Ocean Color Monitor- IRS-P4, Wide Field Sensor- I RS-1C, IRS-1D, IRS-P3 RS-1C, IRS-1D, IRS-P3, Scatterometer (OSCAT), Very High-Resolution Radiometer - INSAT-1, INSAT-2, INSAT-3, RISAT–Radar Imaging Satellite, SCATSAT-1 (Scatterometer Satellite)	
Module-4 - Remote sensing and GIS applications in Marine Sciences	***9 Hour***
Oceanographic application of remote sensing, Sea surface temperature, Ocean color monitoring, Fishery potential zone, Sea surface height, Mapping of shallow-water bathymetry and bottom type, Mapping and monitoring of marine ecosystems: Coral reefs, Mangroves and Seagrass bed, Detection and monitoring of marine pollution: Oil spills, Marine debris, Harmful algal bloom, Change detection analysis, Sea level rise, Coastal zone management, Marine conservation planning for aquaculture.	
Module-5 - Case Studies – Marine Sciences and Advance Technological Solutions for Current Scenario	***9 Hour***
Different resources mapping – Mangroves, Corals, Fisheries and Aquaculture, Marine hotspots, Coastal wetland, Coastal flooding, Sea level rise, Marine debris, algal bloom, Oil spill, Ocean acidification,	

Learning Resources	1. *David W. Townsend, Oceanography and Marine Biology: An Introduction to Marine Science, 2011.* 2. *Richard C. Olsen and Hans W. Paerl, Remote Sensing and GIS for Coastal Ecosystem Assessment and Management, 2013.* 3. *John R. Jensen, Remote Sensing of the Environment: An Earth Resource Perspective, 2006.* 4. *David Wright, Darius Bartlett, and E. J. F. Wood, Geographic Information Systems in Oceanography and Fisheries, 1996.*	5. *Darius Bartlett, Jennifer Smith, and Dawn J. Wright, GIS for Coastal Zone Management,1998.* 6. *Seelye Martin, Introduction to Ocean Remote Sensing, Cambridge University Press. 2016* 7. *Robin Davidson-Arnott, Introduction to Coastal Processes and Geomorphology, 2010.* 8. *Xiaojun Yang, Kishore Kumar, and Dongmei Chen, Remote Sensing of Coastal Environments, 2009.* 9. *William M. Muir, GIS and Remote Sensing Techniques in Land- and Water-Management, 2001.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*20%*	-	*20%*	-	*20%*	-
Level 4	*Analyze*	*20%*	-	*20%*	-	*20%*	-
Level 5	*Evaluate*	*10%*	-	*10%*	-	*10%*	-
Level 6	*Create*	*10%*	-	*10%*	-	*10%*	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Dr. D. Adhavan, Lead - Coastal and Marine Conservation HCL Foundation.*	1. *Dr. Shailesh Nayak, Director, NIAS*	1. *Dr. R. Nagalakshmi, SRMIST*
2. *Dr. Ponnambalam Chandramohan, Managing Director, Indomer Coastal Hydraulics P(Ltd)..*	2. *Dr. Tune Usha, Scientist G, NCCR, Chennai*	2. *Dr. P. Purushothaman, SRMIST*

Course Code	21CEC644T	Course Name	REMOTE SENSING AND GIS FOR FORESTRY AND MANAGEMENT	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	**Data Book / Codes / Standards**		*Nil*	

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*study the spectral characteristics and forest*
CLR-2:	*learn the vegetation indices of vegetation*
CLR-3:	*study the forest management*
CLR-4:	*understand the remote sensing technology in forestry*
CLR-5:	*learn the application areas of forestry and forest management*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*understand the spectral characteristics and forest*	*1*	*1*	*2*
CO-2:	*study various vegetation indices*	*2*	*1*	*3*
CO-3:	*acquire knowledge for forest management*	*1*	*1*	*3*
CO-4:	*understand Remote sensing technology role in forestry*	*2*	*2*	*2*
CO-5:	*understand and apply the remote sensing and GIS for forestry and management*	*3*	*2*	*3*

Module-1 - Introduction to Forest and Spectral Characteristics	***9 Hour***
Forest: introduction and distribution of forests in India, Structure of leaf - Spectral behavior of leaf – Electromagnetic radiation interaction with vegetation and Characteristics of various types of vegetation, Spectral library for vegetation.	
Module-2 - Vegetation Indices	***9 Hour***
Vegetation indices – NDVI, TVI, SVI, PCA – Vegetation classification and mapping - Estimation of leaf area index, Canopy density and Biomass estimation – Estimation of terrestrial carbon assimilation in forests, Forest Type, Factors for degradation of Forest, Indian forest fire alarm, Forest fire and Burnt area identification.	
Module-3 - Forest Management	***9 Hour***
Forest values, Sustainable forest, Forest economics, Forest surveying, Forest land management, Forest monitoring, Forest production management, Forest protection, Significance of remote sensing, and GIS for Forest management, Reducing emission from deforestation and forest degradation.	
Module-4 - Remote Sensing Technology for Forestry	***9 Hour***
Microwave sensor for canopy penetration and biomass estimation, Microwave Remote sensing for forest study, RADAR for forest mapping, Airborne LiDAR for forest classification, Mobile LiDAR for forest mapping	
Module-5 - Remote Sensing and GIS Applications for Forestry and Management	***9 Hour***
Forest cover change detection, Mapping of stressed vegetation, Biomass estimation with case study, Forest density and stock mapping using RS and GIS technique, Biodiversity studies using RS and GIS, Forest fire and damage assessment with case study using RS and GIS, Wildlife habitat analysis using RS and GIS, Role of remote sensing and GIS Forest Management Information System (FMIS) with suitable case study.	

Learning Resources	1. *Anji Reddy,M. 2004 : Geoinformatics for Environmental Management's.* 2. *Franklin S.E. Remote Sensing for Sustainable Forest Management, 2001.* 3. *Iain H. Woodhouse, Introduction to Microwave Remote Sensing, 1st Edition, 2005,*	4. *Radar Remote Sensing Application and Challenges, First edition, August 2022* 5. *LiDAR Principles , Processing Applications in Forest Ecology, 2023*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*20%*	-	*20%*	-	*20%*	-
Level 4	*Analyze*	*20%*	-	*20%*	-	*20%*	-
Level 5	*Evaluate*	*10%*	-	*10%*	-	*10%*	-
Level 6	*Create*	*10%*	-	*10%*	-	*10%*	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Dr. Sarunjith K. J., Scientist, NCSCM, Chennai,*	1. *Dr. J. Rajesh Banu, Central University Tiruvarur*	1. *Dr. Karuppasamy Sudalaimuthu, SRMIST*
2. *Dr. Tune Usha, Scientist G, NCCR, Chennai*	2. *Dr. R. Kanmani Shanmuga Priya, Assistant Professor, Anna University*	2. *Dr. M. Kamalanandhini, SRMIST*

Course Code	21CEE645T	Course Name	GEOSPATIAL TECHNOLOGY FOR ATMOSPHERIC STUDIES	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	**Data Book / Codes / Standards**		*Nil*	

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*disseminate fundamentals of atmospheric sciences*
CLR-2:	*disseminate the data acquisition and preprocessing techniques*
CLR-3:	*introduce the spatial analysis techniques for atmospheric data*
CLR-4:	*up skill the knowledge of remote sensing and GIS applications for climate modeling*
CLR-5:	*instill the importance of emerging trends in atmospheric studies*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*understand the fundamentals of atmospheric sciences*	*1*	*1*	*2*
CO-2:	*study the data acquisition and preprocessing using remote sensing techniques*	*2*	*1*	*3*
CO-3:	*analyze the spatial atmospheric data*	*2*	*1*	*3*
CO-4:	*explain the climate modeling using remote sensing and GIS applications*	*3*	*2*	*2*
CO-5:	*apply the knowledge of emerging trends in atmospheric studies*	*3*	*2*	*3*

Module-1 - Fundamentals of Atmospheric Sciences	***9 Hour***
Importance and relevance of Remote Sensing and GIS in atmospheric studies, Atmospheric composition and structure, Meteorological parameters and their significance, Processes influencing atmospheric dynamics and behavior, Types of remote sensing platforms: satellites, aircraft, and drones, Sensors for atmospheric studies: Optical, Thermal, Microwave, and LIDAR.	
Module-2 - Data Acquisition and Preprocessing	***9 Hour***
Data types and formats used in geospatial technology for atmospheric studies, Spatial data acquisition methods: satellite imagery, weather radar, ground-based sensors, Preprocessing of atmospheric data by radiometric, geometric and atmospheric correction, Quality assessment and validation of remote sensing data, Remote sensing of meteorological variables such as temperature, humidity, and pressure.	
Module-3 - Spatial analysis of Atmospheric Data	***9 Hour***
Techniques for spatial analysis of meteorological and atmospheric data, Spatial interpolation methods for generating continuous surfaces of atmospheric variables, Visualization and interpretation of spatially distributed atmospheric data, GIS-based modeling and simulation of atmospheric processes, Case studies related to remote sensing and GIS in atmospheric studies.	
Module-4 - Remote Sensing and GIS for Climate Modeling	***9 Hour***
Use of remote sensing and GIS data in numerical weather prediction models, Applications of geospatial technology for short-term weather forecasting and monitoring, Case studies on using remote sensing and GIS for weather prediction and analysis, Remote sensing and GIS applications in climate change research, Monitoring and analysis of climate change impacts.	
Module-5 - Emerging Trends in Atmospheric Studies	***9 Hour***
Remote sensing and GIS techniques for air quality monitoring, Spatial analysis of air pollution data and identification of pollution hotspots, Use of geospatial technology in assessing the impact of air quality on human health and the environment, Hyperspectral RS and LIDAR techniques for atmospheric studies, Emerging trends in GIS applications for atmospheric sciences: spatiotemporal analysis and machine learning techniques.	

Learning Resources	1. *Agnès Perrin, Najate Ben Sari-Zizi, Jean Demaison, Remote Sensing of the Atmosphere for Environmental Security, Editon 1, 2006.* 2. *John R. Jensen, Remote Sensing of the Environment: An Earth Resource Perspective, Pearson Prentice Hall, 2007* 3. *Eric C. Barrett, Leonard F. Curtis, Introduction to Environmental Remote Sensing, Routledge, 2013* 4. *Shailesh Nayak, Sisi Zlatanova, Remote Sensing and GIS Technologies for Monitoring and Prediction of Disasters, Springer Berlin, Heidelberg, 2008*	5. *Andrew C. Millington, Stephen J. Walsh, Patrick E. Osborne, GIS and Remote Sensing Applications in Biogeography and Ecology, Springer New York, NY, 2001* 6. *John M. Wallace and Peter V. Hobbs, Atmospheric Science: An Introductory Survey, Academic Press, 2006* 7. *Chakraborty, S., Remote Sensing and GIS in Environmental Management. In: Sikdar, P.K. (eds) Environmental Management: Issues and Concerns in Developing Countries. Springer, 2021.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*20%*	-	*20%*	-	*20%*	-
Level 4	*Analyze*	*20%*	-	*20%*	-	*20%*	-
Level 5	*Evaluate*	*10%*	-	*10%*	-	*10%*	-
Level 6	*Create*	*10%*	-	*10%*	-	*10%*	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Dr. Tune Usha, Scientist G, NCCR, Chennai*	1. *Dr. K. Nagamani, Scientist-D/Head, Sathyabama Institute of Science and Technology*	1. *Dr. M. Kamalanandhini, SRMIST*
2. *Dr. T. Mayamanikandan, Project Scientist, NCCR, Chennai*	2. *Dr. R. Kanmani Shanmuga Priya, Assistant Professor, Anna University*	2. *Dr. Karuppasamy Sudalaimuthu, SRMIST*

Course Code	21CEE646T	Course Name	DIGITAL PHOTOGRAMMETRY AND ITS APPLICATIONS	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	**Data Book / Codes / Standards**		*Nil*	

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*disseminate advancement, evolution of digital Photogrammetry*
CLR-2:	*enlighten the digital cameras, scanner in high resolution satellites*
CLR-3:	*introduce the digital image processing tools and techniques*
CLR-4:	*upskill the knowledge, generation of DEM*
CLR-5:	*instill the importance application of digital photogrammetry in various real-world applications*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*understand the evolution of digital photogrammetry and their advantages*	*1*	*1*	*2*
CO-2:	*study different types of camera and scanner used in photogrammetry*	*1*	*1*	*3*
CO-3:	*analyze preprocessing techniques and discuss various digital image processing techniques*	*3*	*1*	*3*
CO-4:	*develop various terrain models*	*2*	*1*	*2*
CO-5:	*apply the knowledge of digital photogrammetry and its application in different fields*	*3*	*1*	*3*

Module-1 - Evolution of Digital Photogrammetry	***9 Hour***
Principles, Evolution, Comparison- Analog, Analytical and Digital system- Advantage	
Module-2 - Digital Camera and Scanner	***9 Hour***
Platform, CCD , types, system, use, CCD Scanners-high resolution satellites	
Module-3 - Image Generation	***9 Hour***
Data procuring, Display modes, Image measurements. Editing various format of map data	
Module-4 - Model Generation	***9 Hour***
DEM, accuracy, orthorectification-regular and Irregular data collection methods, contour, stereo maps, products, 3D/4D mpas	
Module-5 - Digital Photogrammetry Applications	***9 Hour***
Applications of artificial intelligence and remote sensing – Environmental studies – Smart city planning – Disaster management – Smart transport planning – Health applications – Water resource management – Agricultural studies – Forest mapping – Soil studies. Engineering design, Architecture	

Learning Resources	1. *Joseph George and Jeganathan, C, Fundamentals of Remote Sensing, 3rd Edition, Universities press (India) Pvt. Ltd., Hyderabad, 2017* 2. *John A. Richards, Remote Sensing Digital Image Analysis, Springer-Verlag Berlin and Heidelberg GmbH & Co. KG, ISBN: 9783642441011, 2022* 3. *Jensen, J.R, Introductory Digital Image Processing: A remote sensing perspective, Prentice Hall Series in GIS, USA, 1996*	4. *Lillesand, Thomas M. and Kiefer, Ralph, W, Remote Sensing and Image Interpretation, 4th Edition, John Wiley and Sons, New York, 2007* 5. *D. Jude Hemanth, Artificial Intelligence Techniques for Satellite Image Analysis, Springer Nature Switzerland, Indian Edition.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*20%*	-	*20%*	-	*20%*	-
Level 4	*Analyze*	*20%*	-	*20%*	-	*20%*	-
Level 5	*Evaluate*	*10%*	-	*10%*	-	*10%*	-
Level 6	*Create*	*10%*	-	*10%*	-	*10%*	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Dr. Sainarayanan Gopalakrishnan, HCL Technologies*	1. *Dr. R. Kumar, NIT, Nagaland*	1. *Dr. R. Annadurai, SRMIST*
2. *Dr. Sricharan Srinivasan, Wipro Technologies*	2. *Dr. B. Surendiran, NIT, Puducherry*	2. *Dr. S. Durgadevagi, , SRMIST*

Course Code	21CEE647T	Course Name	OPEN SOURCE GIS SOFTWARE AND ITS PROCESSING	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	**Data Book / Codes / Standards**		*Nil*	

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*understand the concepts and protocols used in opensource GIS.*
CLR-2:	*know the functionalities of opensource GIS software in desktop and web based environments.*
CLR-3:	*understand the GIS data models*
CLR-4:	*understand the concepts of DBMS and user interface*
CLR-5:	*acquire the knowledge of open-source software in web mapping*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*utilize Opensource GIS for practical applications*	*1*	*2*	*2*
CO-2:	*work on Opensource GIS software in desktop and web based environments.*	*2*	*2*	*3*
CO-3:	*create a GIS data models*	*3*	*2*	*3*
CO-4:	*develop DBMS and user interface projects*	*2*	*3*	*3*
CO-5:	*publish the projects done on Open-source software in journals*	*2*	*3*	*3*

Module-1 - Basics	***9 Hour***
Open-source software and freeware, Open source licensing models, W3C and Protocols-Software standards and opensource GIS-OGC, GDAL and OSGeo, FOSS4G-Opensource software for Desktop GIS and WEB mapping- Proprietary vs Opensource- OGC Standards.	
Module-2 - Development Environment	***9 Hour***
Linux and Windows-PostgreSQL and Database Engines-C,C++, OOP and Java streams-GNU, Mosix-WAP and Android stack-Scripts and Macros.	
Module-3 - GIS Models	***9 Hour***
Introduction to QGIS, Introduction to PostGIS and SpatiaLite, Spatial database and data management, Data formatting, Conversion, and Integration, Advanced applications of desktop FOSS GIS and Spatial databases, Introduction to Geo webservices and WebGIS, Geo webservices, CartoDB, Google My Maps, ArcGIS Map Stories, Geospatial data in python web services, GeoServer, MapServer, Preparing, Processing, and Visualizing spatial data in R, Web mapping and Leaflet.js, Advanced applications of web-based FOSS GIS	
Module-4 - Database Management and User Interface	***9 Hour***
Files vs Database-Distributed operations and architecture-ODBC-Open-source Database management tools- Database: Spatial and attribute queries Spatial functions and analysis-Map server, Application Server and Database server concepts.	
Module-5 - Open Software and Web Mapping	***9 Hour***
Open-source software: GRASS, QGIS, OSSIM, PostgreSQL and R Environment-WEB mapping architecture and components-WEB mapping servers-Thin clients in WEB mapping-WMS, WFS, WCS, WPS and Restful web services- Open API.	

Learning Resources	1. Peng, Z.R. and Tsou, M.H. Internet GIS : distributed geographic information services for the Internet and wireless networks. New York: John Wiley and Sons, New york, 2003 2. QGIS Training Manual: https://docs.qgis.org/testing/en/docs/training_manual/index.html	3. Using SpatiaLite: http://www.gaia-gis.it/gaia-sins/spatialite-cookbook/index.html 4. Introduction to PostGIS: http://workshops.boundlessgeo.com/postgis-intro/ Open Geo Suite: http://workshops.boundlessgeo.com/suiteintro/index.html

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life-Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-
Level 3	Apply	20%	-	20%	-	20%	-
Level 4	Analyze	20%	-	20%	-	20%	-
Level 5	Evaluate	10%	-	10%	-	10%	-
Level 6	Create	10%	-	10%	-	10%	-
	Total	100 %		100 %		100 %	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Sainarayanan Gopalakrishnan, HCL Technologies	1. Dr. R. Kumar, NIT Nagaland	1. Dr. S. Durgadevagi, SRMIST
2. Dr. Sricharan Srinivasan, Wipro Technologies,	2. Dr. B. Surendiran, NIT Puducherry	2. Dr. R. Annadurai, SRMIST

Course Code	21CEE648T	Course Name	SPATIAL DATA SCIENCE FOR SUSTAINABLE DEVELOPMENT	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	**Data Book / Codes / Standards**		*Nil*	

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*introduce the basic concepts of spatial data science*
CLR-2:	*understand the significance of developments in spatial science and SDG*
CLR-3:	*create knowledge on geospatial data generation for SDG*
CLR-4:	*explain the application of spatial science for SDG*
CLR-5:	*understanding the user generated data and its advantage*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*understand the SDG and role of geospatial science*	*1*	*1*	*2*
CO-2:	*study the significant development in spatial science and sustainability*	*2*	*1*	*3*
CO-3:	*understand the generation of spatial data specific to sustainability*	*2*	*1*	*3*
CO-4:	*understand and apply geospatial science in achieving SDG*	*3*	*1*	*2*
CO-5:	*explain the role of user generated spatial data for crisis management*	*2*	*1*	*3*

Module-1 - Spatial Data Science and Sustainability	***8 Hour***
Definition, Data science and Spatial data science- Sustainable development- Environment- Society- Economy - SDG –Themes- sustainability related problem- role of geospatial data -Competency – Analysis – Significance of SDG themes	
Module-2 - Significant Developments	***8 Hour***
Spatial data technology and development- Open source- Software- Data Retrieval and reproduction- Derivative database- Storage -Cloud computing- data integration- 2D and 3D Visualization- SDG and Spatial information – Data quality- utilities- Economic inequality studies- Ecosystem services	
Module-3 - Spatial Data Generation for Sustainable Development	***9 Hour***
Spatial Mapping and Sustainable Resource Management- Data preparation for working in digital and GIS environments-Choice of database for a GIS environment-Sources- Types- Geo-referencing or transforming scanned maps into real coordinate systems, Spatial and non-spatial database creation-Correction of spatial databases by editing features, Edge matching, tolerance setting and topology building-Creating a non-spatial database by adding and joining with a spatial database-Linkage of GIS databases.	
Module-4 - Application of Geospatial Science in SDG	***11 Hour***
Policy Interface-Analyzing Sustainable Development Goals (SDG)- Case studies of different disciplines-Disaster management application- Flood – earthquake – Forest fire- Landslides-Sustainable planning land use- Resource mapping- Sustainable watershed characterization, Resource allocation and infrastructure assessment.	
Module-5 - Role of User Generated Geospatial Data for SDG	***9 Hour***
Geospatial data generation – Participatory approach -Individual- group and Community- Geotagged information- Dimension of the data- Interdisciplinary approach for SDG and geospatial application- RAV – Retrieval – Analysis and Visualization- Challenges and Errors –Role of Social media spatial and Non spatial data-Text- Image – Charts- video- time – location– crisis and measures	

Learning Resources	1. *Dilip Kuma, R. B. Singh, and Ranjeet Kaur, Spatial Information Technology for Sustainable Development Goals, Springer International Publishing AG 2019, ISBN 978-3-319-58038-8,2019* 2. *Edzer Pebesma and Roger Bivand, Spatial Data Science With Applications in R, CRC press, Taylor& Francis, 2023*	3. *Paul Holloway , Understanding GIS through Sustainable Development Goals, CRC press, Taylor&Francis, 2023* 4. *Abraham Silberschatz, Henry F. Korth and, S. Sudarshan, Database System Concepts, 7th Edition,, McGraw Hill, 2011* 5. *Alexander J. Kent and Doug Specht, The Routledge Handbook of Geospatial Technologies and Society, Routledge publishers.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*20%*	-	*20%*	-	*20%*	-
Level 4	*Analyze*	*20%*	-	*20%*	-	*20%*	-
Level 5	*Evaluate*	*10%*	-	*10%*	-	*10%*	-
Level 6	*Create*	*10%*	-	*10%*	-	*10%*	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Dr. Anand, Scientist E, SAC, ISRO, Ahmedabad*	1. *Dr. D.Ramesh, Professor, Dept.of Remote Sensing, Bharathidasn University, Tiruchirappalli,*	1. *Dr. R. Sivakumar, SRMIST*
2. *Mr. R. Jaikumar, NeoGeoInfo Technologies Pvt Ltd, Chennai*	2. *Dr.K.Srinivasa Raju, Professor, Institute of Remote Sensing, Anna University, Chennai*	2. *Dr .P. Purushothaman, SRMIST*

Course Code	21CEE649T	Course Name	GEOSPATIAL TECHNOLOGY FOR SOIL AND AGRICULTURE	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	**Data Book / Codes / Standards**	*Nil*		

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*disseminate the fundamentals of soil science*
CLR-2:	*disseminate the spatial analysis techniques*
CLR-3:	*identify the damages caused due to flood and drought using RS application*
CLR-4:	*introduce the concepts of precision agriculture, web and mobile GIS*
CLR-5:	*learn geostatistics techniques and spatial modeling in soil and agriculture*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*understand the fundamentals of soil science*	*1*	*1*	*2*
CO-2:	*study the techniques for spatial analysis*	*2*	*1*	*3*
CO-3:	*assess the damages caused due to flood and drought using remote sensing techniques*	*3*	*2*	*3*
CO-4:	*explain the importance of precision agriculture, web and mobile GIS in agriculture*	*2*	*1*	*2*
CO-5:	*apply the knowledge of geostatistics and spatial modeling in soil and agriculture*	*3*	*2*	*3*

Module-1 - Fundamentals of Soil Science	***9 Hour***
Soil composition, structure, and properties, Soil classification systems, Soil processes and their significance in agriculture, Introduction to Geographic Information Systems (GIS), Remote Sensing (RS), and Global Positioning Systems (GPS), Data types and formats used in geospatial technology, Spatial data acquisition methods: satellite imagery, aerial photography, and GPS.	
Module-2 - Spatial Analysis Techniques	***9 Hour***
Spatial data manipulation: data integration, conversion, and transformation, Spatial analysis tools: overlay analysis, proximity analysis, interpolation techniques, Application of spatial analysis in soil and agricultural research and management, Principles of remote sensing and its applications in agriculture, Remote sensing techniques for soil mapping, crop monitoring, and yield estimation, Image classification methods for land cover classification and crop identification.	
Module-3 - Damage Assessment	***9 Hour***
Flood mapping and Assessments of crop loss, Drought assessment and monitoring through remote sensing, Remote sensing capabilities & contribution for drought management, Land degradation due to water logging & Salinity, Crop stresses reflectance properties of stressed plants and stress detection.	
Module-4 - Precision Agriculture, Web GIS and Mobile GIS	***9 Hour***
Concepts and principles of precision agriculture, Role of geospatial technology in precision farming: variable rate technology, site-specific management, Case studies and applications of precision agriculture using geospatial technology, Introduction to Web GIS and Mobile GIS technologies, Web-based and mobile applications for soil and agricultural management, Real-time data collection and monitoring using mobile GIS platforms.	

Module-5 - Geostatistics and Spatial Modeling in Soil and Agriculture	***9 Hour***
Introduction to geostatistical techniques for spatial data analysis, Spatial interpolation methods for soil property mapping and crop yield estimation, Spatial modeling approaches for agricultural decision-making, Hyperspectral remote sensing techniques and UAV-based monitoring for agricultural studies, Integration of geospatial technology with emerging technologies: Internet of Things (IoT) and Artificial Intelligence (AI).	

Learning Resources	1. *Sharon A. "GIS Applications in Agriculture, Volume Three: Invasive Species", Clay, CRC Press, 2011* 2. *Tom Mueller, Gretchen F. Sassenrath "GIS Applications in Agriculture, Volume Four: Conservation Planning", , CRC Press, 2015* 3. *Christopher M. U. Neale, Antonino Maltese,"Remote Sensing for Agriculture, Ecosystems, and Hydrology", SPIE Remote Sensing 2021*	4. *Nancy Hoalst-Pullen, Mark W. Patterson "Geospatial Technologies in Environmental Management", , Springer Dordrecht, 2010* 5. *Murty.V.V.N, "Land and Water Management Engineering", Kalyani Publishers, New Delhi – 2013.* 6. *Agarwal C.S and Garg.P.K, "Text Book on Remote Sensing in Natural Resources, Monitoring and Management", Wheeler publishing Co & Ltd., New Delhi, 2010.* 7. *Chow, V.T., and Maidment, Hydrology for Engineers, McGraw Hill Inc., Ltd., 2000*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	*-*	*20%*	*-*	*20%*	*-*
Level 2	*Understand*	*20%*	*-*	*20%*	*-*	*20%*	*-*
Level 3	*Apply*	*20%*	*-*	*20%*	*-*	*20%*	*-*
Level 4	*Analyze*	*20%*	*-*	*20%*	*-*	*20%*	*-*
Level 5	*Evaluate*	*10%*	*-*	*10%*	*-*	*10%*	*-*
Level 6	*Create*	*10%*	*-*	*10%*	*-*	*10%*	*-*
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Dr. N.R. Patel, Scientist/Engineer - SG, IIRS,*	1. *Dr. C. Lakshumanan, Professor, Bharathidasan University*	1. *Dr. M. Kamalanandhini, SRMIST*
2. *Dr. Gejo Anna G, Scientist D, NCSCM,*	2. *Dr. S.T. Ramesh, NIT Trichy*	2. *Dr. R. Nagalakshmi, SRMIST*

Course Code	21CEE650T	Course Name	REMOTE SENSING AND GIS IN DISASTER RISK REDUCTION AND MANAGEMENT	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	**Data Book / Codes / Standards**	*Nil*		

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*introduce the basic concept of disaster management*
CLR-2:	*instruct the different disasters and their impacts*
CLR-3:	*know about remote sensing and GIS application in disaster management*
CLR-4:	*disseminate various field management for risk reduction*
CLR-5:	*address to different technical solution for risk reduction*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*explain various types of disasters and responsible factors.*	*1*	*1*	*2*
CO-2:	*interpret and discriminate different stages of disaster management planning and utility of geomatics tools in every stage.*	*2*	*1*	*3*
CO-3:	*gain knowledge about remote sensing and GIS in Disaster Management*	*2*	*1*	*3*
CO-4:	*enhance knowledge about remote sensing and GIS for real time applications during disaster*	*3*	*1*	*2*
CO-5:	*utilize the knowledge of RS & GIS mapping*	*2*	*2*	*3*

Module-1 - Introduction to Hazards and Disasters	***9 Hour***
Concepts, Definitions, Understanding of key concepts in disasters management, Hazards, Disasters, Vulnerability, Resilience, Types of disasters (natural and man-made), Disaster management, Overview of disaster management principles, Disaster risk management frameworks and approaches, Disaster cycle, Risk, Prevention, Mitigation, Relief and response, Recovery and rehabilitation, Brief history of disaster management in India and world.	
Module-2 - Consequences and Impact of Disasters	***9 Hour***
Flood, Cyclones, Tsunamis, Earthquakes, Landslides, Volcanic eruption, Desertification, Drought, Salinity ingress, Overview through case studies	
Module-3 - RS & GIS for Hazard, Risk and Damage Assessment	***9 Hour***
Hazard evaluation: Zonation – Risk assessment and vulnerability, Damage assessment: Land use planning and regulation for sustainable development, Potential of GIS application in disaster mapping – Disaster management plan, Incident command systems and emergency response coordination, Rehabilitation of affected communities and infrastructure.	
Module-4 - Disaster Management Planning	***9 Hour***
Spatial and non-spatial data bank creation, Natural disaster management plans, Shelterbelts, Special structures, Disaster, preparedness and Mitigation. Information needs of Disaster management, Operational emergency management, Vulnerability analysis of infrastructures, Settlements and population, Pre-disaster and post disaster planning for relief operations, Satellite communications during disasters: networks, use of Internets, Warning system - rehabilitation - Post disaster review, Global Disaster Alert and Coordination System	
Module-5 - Case Studies – GIS Mapping	***9 Hour***
Concepts and Overview of agriculture drought, Flood mapping and monitoring, Forest fire mapping and assessment, Potential of RS, GIS and GNSS technology, Geo-spatial data requirement, Existing methodologies and tools with reference to disaster management, Potential of GIS based decision support system in management of emergencies. Cost effective analysis – Utilization of resource, Training, Education.	

Learning Resources	1. *Anji Reddy, M. Geoinformatics for environmental Management. B. S. Publication (2004)* 2. *Bankoff, G., Frerks, G. and Hilhorst, D. (eds.) Mapping Vulnerability: Disasters, Development, and People, Earthscan, London. (2004)* 3. *Bhattacharya, Tushar Disaster Science and Management, McGraw Hill Education (India) Pvt. Ltd ISBN-10: 1259061302; ISBN-13: 978-1259061301 2. UN (2015).* 4. *Birkmann, J. "Risk and vulnerability Indicators at Different Scales: Applicability, Usefulness and Policy Implications", Environmental Hazards, 7 (1): 20-31. 3. (2007)* 5. *Donald Hyndman and David Hyndman. Natural hazards and disasters. Brooks/Cole. 555p (2009)*	6. *Edward A Keller and Robert H Blodgett. Natural hazards. Pearson Prentice Hall, 488p (2008) Murthy, D.B.N. - Disaster Management - Deep & Deep Publication (2008)* 7. *Pandey, Mrinalini Disaster Management, Willey India Pvt.Ltd* 8. *Remote Sensing: Principles and Interpretation, 3 rd Ed., Freeman & Co., New York. 4. Berke PR, Lyles W, Smith G Impacts of Federal and State Hazard Mitigation Policies on Local Land Use Policy. J Plann Educ Res 34(1):60–76 (2014),* 9. *Roy, P.S. Natural Disaster and their mitigation. Published by Indian Institute of Remote Sensing (IIRS) 2000.* 10. *Sdidmore, A. Environmental Modeling with GIS and Remote Sensing, Taylor &* 11. *Shukla, Shailesh, and Hussain, Shamna Biodiversity, Environment and Disaster Management Unique Publications, 2013.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	*-*	*20%*	*-*	*20%*	*-*
Level 2	*Understand*	*20%*	*-*	*20%*	*-*	*20%*	*-*
Level 3	*Apply*	*20%*	*-*	*20%*	*-*	*20%*	*-*
Level 4	*Analyze*	*20%*	*-*	*20%*	*-*	*20%*	*-*
Level 5	*Evaluate*	*10%*	*-*	*10%*	*-*	*10%*	*-*
Level 6	*Create*	*10%*	*-*	*10%*	*-*	*10%*	*-*
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Germanamali Jacintha, GIS Specialist, TNSDMA*	1. *Dr. T. V. S. Bhaskar, Scientist G, INCOIS*	1. *Dr. R. Nagalakshmi, SRMIST*
2. *Dr. Sarunjith K. J., Scientist, NCSCM, Chennai*	2. *Dr.S. K Das, Scientist E, NCCR*	2. *Dr. P. Purushothaman, SRMIST*

Course Code	21CEE651T	REMOTE SENSING AND GIS FOR PUBLIC HEALTH	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
						3	0	0	3

Pre-requisite Courses	Nil	Co- requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Civil Engineering	Data Book / Codes / Standards	Nil		

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*introduce the basic concepts of public health*
CLR-2:	*understand the role of remote sensing in public health*
CLR-3:	*identify uses for GIS data in public health studies*
CLR-4:	*explain modelling and prediction of health risk*
CLR-5:	*understanding then recent trends in public health studies*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*understand basic concepts of public health*	*1*	*1*	*2*
CO-2:	*study the role of remote sensing in public health*	*1*	*1*	*3*
CO-3:	*understand the GIS application in public health studies*	*3*	*1*	*3*
CO-4:	*understand and apply prediction models*	*3*	*2*	*2*
CO-5:	*explain the recent trends in public health studies*	*2*	*1*	*3*

Module-1 - Introduction to Public Health	***9 Hour***
Definition and Key Terms, Mission, History of Public Health, Approach, Core Functions, Epidemiology, Essential Services of Public Health, Partners, Stakeholder Roles in Public Health, Health Impact Pyramid, Determining and Influencing the Public's Health	
Module-2 - Remote Sensing in Public Health	***9 Hour***
Introduction -Sensors and high-resolution data – Photogrammetry in Public health- Environmental factor studies- disease vectors-Population density - predicting disease outbreaks, planning health interventions-Monitoring Air Quality and Pollution- Health Impact-Tracking Vector-Borne Diseases- Mapping Urban Heat Islands-Impact-Mapping Infectious Disease Risks-Optimizing Healthcare Access-Predicting Public Health Trends - Practice	
Module-3 - GIS in Public Health	***9 Hour***
Spatial Mapping of Health Data- Non spatial Health data Integration- Concerns associated with mapping and using health data in GIS -Collecting health and disease data- Health Risk assessment-visualizations for examining disease- Forensic investigation- Apply complex map algebra operations to model health risk- Cluster Analysis- Case studies	
Module-4 - Modelling and Prediction	***9 Hour***
Public health decision- Health Risk Analytics, Decision support system – Customized tool development- Geostatistical analysis for public health studies- Temporal analysis- Time series prediction modelling-Case studies	
Module-5 - Recent Trends in Public Health Studies	***9 Hour***
Geospatial visualization- shortest path identification- Mobile mapping- Data Mining Techniques- Geotagged information- Dimension of the data- Interdisciplinary approach–Role of Social media -Cloud computing applications Location based information system- crisis and measures- GeoAI applications in health and healthcare- Case studies	

Learning Resources	1. *Roger Detels , Quarraisha Abdool Karim, Fran Baum , Liming Li and , Alastair H LeylandOxford Textbook of Public Health, Oxford University Press,ISBN: 9780198816805, 2021* 2. *Ellen K. Cromley and Sara L. McLafferty, GIS and Public Health, Guilford Press,2011*	3. *James F. McKenzie, Robert R. Pinger and Denise M. Seabert, An Introduction to Community medicine and Public health, Jones & Bartlett Learning, USA, 2018* 4. *Martin Kappas, Geospatial Data Science in Healthcare for Society 5.0, Springer, ISBN 978-981-16-9475-2, 2022* 5. *Fazlay S Faruque, Remote Sensing and Geospatial Technologies in Public Health, Mdpi AG, 978-3038971726, 2018*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life-Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-
Level 3	Apply	20%	-	20%	-	20%	-
Level 4	Analyze	20%	-	20%	-	20%	-
Level 5	Evaluate	10%	-	10%	-	10%	-
Level 6	Create	10%	-	10%	-	10%	-
	Total	100 %		100 %		100 %	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Dr. Tune Usha Scientist G, NCCR, Chennai*	1. *Dr. D. Ramesh, Professor, Dept. of Remote Sensing, Bharathidasn University, Tiruchirappalli,*	1. *Dr. R. Sivakumar, SRMIST*
2. *Mr. R. Jaikumar, NeoGeoInfo Technologies Pvt Ltd, Chennai*	2. *Dr. K. Srinivasa Raju, Professor, Institute of Remote Sensing, Anna University, Chennai*	2. *Dr. M. Kamalanandhini, SRMIST*

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)

Kattankulathur, Chengalpattu District 603203, Tamil Nadu, India