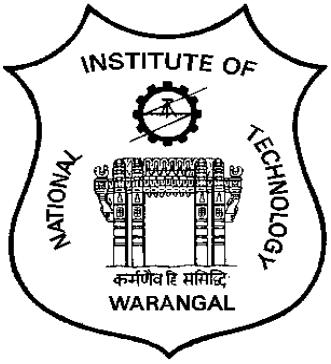
NATIONAL INSTITUTE OF TECHNOLOGY WARANGAL



SCHEME OF INSTRUCTION AND SYLLABI

FOR

M.TECH PROGRAM IN REMOTE SENSING AND GIS

Effective from 2019-20

DEPARTMENT OF CIVIL ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY WARANGAL

VISION

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

MISSION

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

DEPARTMENT OF CIVIL ENGINEERING

VISION

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

MISSION

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

GRADUATE ATTRIBUTES

The Graduate Attributes are the knowledge skills and attitudes which the students have at the time of graduation. These attributes are generic and are common to all engineering programs. These Graduate Attributes are identified by National Board of Accreditation.

1. **Scholarship of Knowledge**: Acquire in-depth knowledge of specific discipline or professional area, including wider and global perspective, with an ability to discriminate, evaluate, analyze and synthesize existing and new knowledge, and integration of the same for enhancement of knowledge.
2. **Critical Thinking**: Analyze complex engineering problems critically, apply independent judgment for synthesizing information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.
3. **Problem Solving**: Think laterally and originally, conceptualize and solve engineering problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors in the core areas of expertise.
4. **Research Skill**: Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyze and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in one or more domains of engineering.
5. **Usage of modern tools**: Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities with an understanding of the limitations.
6. **Collaborative and Multidisciplinary work**: Possess knowledge and understanding of group dynamics, recognize opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis in order to achieve common goals and further the learning of themselves as well as others.
7. **Project Management and Finance**: Demonstrate knowledge and understanding of engineering and management principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economical and financial factors.
8. **Communication**: Communicate with the engineering community, and with society at large, regarding complex engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.
9. **Life-long Learning**: Recognize the need for, and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.
10. **Ethical Practices and Social Responsibility**: Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.
11. **Independent and Reflective Learning**: Observe and examine critically the outcomes of one's actions and make corrective measures subsequently, and learn from mistakes without depending on external feedback.

DEPARTMENT OF CIVIL ENGINEERING
M.TECH. REMOTE SENSING AND GIS

PROGRAM EDUCATIONAL OBJECTIVES

PEO1	Apply principles of Remote sensing and GIS to collect, map and retrieve spatial information.
PEO2	Plan, assess and evaluate natural and manmade systems using geospatial models and methods
PEO3	Use geospatial tools and techniques for hazard mitigation and resource planning.
PEO4	Pursue research and develop capabilities to handle multi-disciplinary field projects
PEO5	Work in teams and demonstrate leadership skills with professional ethics.

PROGRAM OUTCOMES: At the end of the program, the student will be able to:

PO1	Engage in critical thinking and pursue research/ investigations and development to solve practical problems.
PO2	Communicate effectively on complex engineering activities with the engineering community and with society at large, write and present substantial technical reports.
PO3	Demonstrate higher level of professional skills to tackle multidisciplinary and complex problems related to “Remote Sensing and GIS”.
PO4	Apply principles of Remote sensing and GIS to collect, map and retrieve spatial information
PO5	Plan, assess and evaluate natural and manmade systems using geospatial models and methods
PO6	Develop geospatial models and tools to address the social and engineering problems

CURRICULAM COMPONENTS

The total course package M.Tech. Degree program will typically consist of the following components.

a) Core Courses = 30 Credits
(Core subjects = 18; Laboratory = 8; Seminar = 2; Comprehensive = 2)

b) Elective Courses ≥ 18 Credits

c) Dissertation = 27Credits

Degree Requirements for M.Tech in RS&GIS

Category of Courses	Credits Offered	Min. credits to be earned
Program Core Courses (PCC)	30	30
Departmental Elective Courses(DEC)	>18	18
Dissertation	27	27
Total	75	75

SCHEME OF INSTRUCTION AND EVALUATION

M.Tech. Remote Sensing and GIS

I Year M. Tech. I – Semester

S. No.	Course code	Course Title	L	T	P	Credits	Cat. Code
1	CE5501	Principles of Remote Sensing	3	0	0	3	PCC
2	CE5502	Geographical Information Systems	3	0	0	3	PCC
3	CE5503	Photogrammetry	3	0	0	3	PCC
4		Elective – I	3	0	0	3	DEC
5		Elective – II	3	0	0	3	DEC
6		Elective – III	3	0	0	3	DEC
7	CE5504	Remote Sensing and Photogrammetry Laboratory	0	1	2	2	PCC
8	CE5505	Geographical Information System Laboratory	0	1	2	2	PCC
9	CE5541	Seminar-I	0	0	2	1	PCC
		Total	**18**	**2**	**6**	**23**	

I Year M. Tech. II – Semester

S.No.	Course Code	Course Title	L	T	P	C	Cat. Code
1	CE5551	Geospatial data Processing and Modelling	3	0	0	3	PCC
2	CE5552	Satellite Image Processing	3	0	0	3	PCC
3	CE5553	Global Navigation Satellite System	3	0	0	3	PCC
4		Elective – IV	3	0	0	3	DEC
5		Elective – V	3	0	0	3	DEC
6		Elective – VI	3	0	0	3	DEC
7	CE5554	Satellite Image Processing Laboratory	0	1	2	2	PCC
8	CE5555	Advanced GIS Laboratory	0	1	2	2	PCC
9	CE5591	Seminar – II	0	0	2	1	PCC
		Total	**18**	**2**	**6**	**23**	

II Year M. Tech. I – Semester				
Sl. No.	**Course Code**	**Course Title**	**Credits**	**Cat. Code**
1		Industrial Training (8-10 weeks) Optional		
2	CE6542	Comprehensive Viva	2	PCC
3	CE6549	Dissertation Part – A	9	PCC
II Year M. Tech. II – Semester				
4	CE6599	Dissertation Part – B	18	PCC

LIST OF ELECTIVES

Sl. No.	Course Code	Course Title
FOR ELECTIVES – I, II & III		
1	CE5511	Programming Methods for Geospatial Systems
2	CE5512	Database Management Systems
3	CE5513	Remote Sensing Geology
4	CE5621	Transportation Data Analysis
5	CE5701	Applied Hydrology
6	CE5704	Stochastic Hydrology
7	CE5713	Watershed Management
FOR ELECTIVES – IV, V & VI		
8	CE5561	Close Range Photogrammetry and Laser Scanning
9	CE5562	Thermal, Microwave and Hyperspectral Remote Sensing
10	CE5563	Web and Mobile GIS
11	CE5765	Applications of Soft Computing Techniques
12	CE5662	GIS for Transportation
13	CE5353	Environmental Impact Assessment and Management
14	CE5767	Climate Systems
15	CE5762	Urban Water Management
*Electives subjects from allied specialisations of Civil Engineering Department		

Detailed Syllabus

CE 5501	PRINCIPLES OF REMOTE SENSING	PCC	3-0-0	3 Credits

Prerequisites: None

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

CO1	Select the type of remote sensing technique / data for required purpose
CO2	Analyze the energy interactions in the atmosphere and earth surface features
CO3	Identify the earth surface features from satellite images
CO4	Apply remote sensing techniques in the fields of Geology, Agriculture, Urban, Forestry, Water resources etc.

Mapping of course outcomes with program outcomes

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

Detailed Syllabus:

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

Platforms and Sensors: Various types of platforms, different types of aircraft, manned and unmanned spacecrafts used for data acquisition - characteristics of different types of platforms - airborne and spaceborne, IRS Satellite Sensors, LANDSAT, SPOT, IKONOS, Quickbird, Geoeye, Kompsat, Worldview II & III etc.

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

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

Reading:

1. James B. Campbell & Randolph H. Wynne., Introduction to Remote Sensing, The Guilford Press, 2011.
2. Charles Elach & Jakob van Zyl., Introduction to the physics and techniques of Remote Sensing, John Wiley & Sons publications, 2006.
3. Lillesand T.M & Kiefer R.W., Remote Sensing and Image Interpretation, John Wiely and Sons, 2008.
4. Chritian Matzler., Thermal microwave radiation: Applications for remote sensing, The institution of Engineering and Technology, London, 2006.
5. Rees, W. G., Physical principles of Remote Sensing, Cambridge University Press, 2001

CE 5502	GEOGRAPHICAL INFORMATION SYSTEM	PCC	3-0-0	3 Credits

Prerequisites: None

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

CO1	Analyse the basic components of GIS
CO2	Classify the maps, coordinate systems and projections
CO3	Process spatial and attribute data and prepare thematic maps
CO4	Identify and rectify mapping inaccuracies
CO5	Conceptualization of GIS project

Mapping of course outcomes with program outcomes

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

Detailed Syllabus:

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

Fundamentals of GIS – Information Systems, Modeling Real World Features Data, Data Models – Spatial and Non-spatial, Components, Data Collection and Input, Data Conversion, Metadata

Database Management – Database Structures, Files; Standard Data Formats, Compression Techniques, Hardware and Software

Topology – Types of Errors, Editing and Error Rectification, Types of Topology, Modeling topological Relationships, Tolerances.

Spatial Analysis – Proximity Analysis, Overlay Analysis, Buffer Analysis, Network Analysis, Digital Elevation Models

Map composition, Preparation of qualitative and quantitative maps, levels of maps, map elements and map scales

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

Reading:

1. Paul Longley., Geographic Information systems and Science, John Wiley & Sons, 2005
2. John E. Harmon & Steven J. Anderson., The design and implementation of Geographic Information Systems, John Wiley & Sons, 2003.
3. Kang Tsung Chang., Introduction to Geographic Information Systems, Tata Mc Graw Hill Publishing Company Ltd, New Delhi, 2008.
4. Burrough, P.A., Principles of GIS for Land Resource Assessment, Oxford Publications, 2005.
5. C.P.Lo & Albert K. W.Yeung, Concepts and Techniques of Geographic Information Systems, Prentice Hall India Pvt.Ltd, 2002.

CE 5503	PHOTOGRAMMETRY	PCC	3-0-0	3 Credits

Prerequisites: None

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

CO1	Classify the photogrammetry methods and their applications
CO2	Determine the scale, ground coordinates and the aerial extent of aerial photographs
CO3	Demonstrate interior and exterior orientation on two overlapping aerial photographs
CO4	Measure parallax and compute elevations from parallax measurements
CO5	Prepare mosaics, orthophotos and photomaps for mapping of resources, assess their usage in a range of applications

Mapping of course outcomes with program outcomes

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

Detailed Syllabus:

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

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

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

Digital Photogrammetry: Automatic DTM acquisition from stereo pairs or image blocks, Colour balancing, Digital image enhancement, Feature extraction

Reading:

1. Wolf P. R., Elements of Photogrammetry with Application in GIS, McGraw Hill International Book Company, Fourth Edition, 2014.
2. Moffitt, Francis H. & Mikhail, Edward M., Photogrammetry, Harper and Row Publishers, 1980.
3. Sanjib K Ghosh., Fundamentals of Computational Photogrammetry, Concept Publishing Company, 2005
4. Wilfried Linder., Digital Photogrammetry Theory and Applications, Springer 2003

CE 5504	REMOTE SENSING AND PHOTOGRAMMETRY LABORATORY	PCC	0-1-2	2 Credits

Prerequisites: None

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

CO1	Read ancillary information of remotely sensed data
CO2	Identify the different features from imageries based on visual interpretation keys
CO3	Perform basic photogrammetry analysis

Mapping of course outcomes with program outcomes

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

Detailed Syllabus:

Remote Sensing Laboratory:

Creation of spectral signature curves of various features

Mapping of

- Land use and land cover
- Geological and structural features
- Drainage pattern and surface water bodies
- Hydro-geomorphology for ground water potential zones
- Urban growth and transportation network

Photogrammetry Laboratory:

- Importing Satellite/Aerial data, performing interior and exterior orientation
- Automatic, Semi Automatic feature extraction
- DEM generation from stereo satellite images, Editing, Accuracy aspects
- Ortho image generation

Reading:

1. Lillesand T.M and Kiefer R.W., Remote Sensing and Image Interpretation, John Wiley and Sons, 2008.
2. Lueder, D.R., Aerial Photographic Interpretation, Mc Graw Hill Book Company, New York, 1959.

CE 5505	GEOGRAPHICAL INFORMATION SYSTEMS LABORATORY	PCC	0-1-2	2 Credits

Prerequisites: None

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

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

Mapping of course outcomes with program outcomes

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

Detailed Syllabus:

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

Reading:

1. ArcGIS user manuals,
2. QGIS User Manuals

CE 5551	GEOSPATIAL DATA PROCESSING AND MODELING	PCC	3-0-0	3 Credits

Prerequisites: CE 5502: Geographical Information System

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

CO1	Conduct advanced spatial analyses using GIS tools
CO2	Study GIS data with complex geospatial models
CO3	Solve the geospatial problems using programming tools
CO4	Develop models in GIS using appropriate GIS software
CO5	Analyse GIS data and generate applications

Mapping of course outcomes with program outcomes

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

Detailed Syllabus:

Interpolation Methods: Local and Global methods of Interpolation, Kriging methods

Geostatistical Methods

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

GIS models: Modelling Process; Classification; Model builder tools;

Programming Tools: Python, R programming and MATLAB concepts for geoprocessing tools;

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

Reading:

1. Burrough, P. A and Racael A. McDonnell, Principles of Geographical Information Systems, Oxford University Publications, 1998.
2. C.P.Lo., Albert K and W.Yeung, Concepts and Techniques of Geographic Information Systems, Prentice Hall India Pvt.Ltd, New Delhi, 2002.
3. ArcGIS 10.3 User Manuals, ESRI, 2018.

CE 5552	SATELLITE IMAGE PROCESSING	PCC	3-0-0	3 Credits

Prerequisites: CE5501: Principles of Remote Sensing

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

CO1	Process the remotely sensed with satellite image processing techniques
CO2	Classify the processed remote sensing data
CO3	Evaluate the accuracy of image classification
CO4	Apply the advanced processing methods for deriving the useful information

Mapping of course outcomes with program outcomes

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

Detailed Syllabus:

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

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

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

Advanced classification techniques: Learning methods, Object, Texture, Object based Fuzzy, ANN and SVM classification techniques, sub-pixel mixture analysis

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

Reading:

1. John R Jensen, Introductory Digital Image Processing, Prentice Hall, New Jersey,2004.
2. Robert G Reeves, Manual of Remote Sensing Vol. I & II, American Society of Photogrammetry, Falls Church, USA, 1983.
3. Florence Tupin, Jordi Inglada and Jean-Marie Nicolas, Remote Sensing Imagery, ISTE and Wiley, 2014
4. Nello Cristiani and John Shawe Taylor., An Introduction to Support Vector Machines, Cambridge University Press, 2000

CE5553	GLOBAL NAVIGATION SATELLITE SYSTEM	PCC	3-1-0	3 Credits

Prerequisites: None

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

CO1	Identify GNSS components and their functions
CO2	Select GNSS survey method
CO3	Interpret the navigational message and signals received by the GNSS
CO4	Identify error sources in GNSS observations, and apply the corrections for accurate positioning
CO5	Map the geospatial features

Mapping of course outcomes with program outcomes

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

Detailed Syllabus:

Introduction: History of GNSS; GPS system - Services and Segments, GLONASS system- Services and Segments, Galileo System- Services and Segments, Regional Navigation Satellite Systems (RNSS), Augmentation Systems, GAGAN, IRNSS systems

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

Satellite Orbits: Orbit - Description, Determination and Dissemination

Satellite Signal: Structure of Signal, Navigation messages

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

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

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

Reading:

1. Bradford W. Parkinson & James Spilker., Global Positioning System: Theory and Applications, Vol I,1996
2. Hofmann-Wellenhof, Lichtennegger and Wasle., GNSS: Global Navigation Satellite Systems, Springer-Verlag Wein, New York, 2008.
3. Gunter Seeber., Satellite Geodesy Foundations-Methods and Applications,2003.
4. Shuanggen Jin, Estel Cardellach adn Feiqin Xie., GNSS Remote Sensing: Theory, Methods and Applications, Springer, London, 2014.

CE 5554	SATELLITE IMAGE PROCESSING LABORATORY	PCC	0-1-2	2 Credits

Prerequisites: None

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

CO1	Analyse temporal, spectral and spatial differences of satellite data using image processing software
CO2	Perform image pre-processing and post-processing techniques on a given satellite data
CO3	Classify given satellite data for thematic mapping process

Mapping of course outcomes with program outcomes

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

Detailed Syllabus:

Loading, Creating Image and Display Manipulation
Image Enhancement – Linear and Nonlinear
Geometric Correction and Mosaicing
Band Ratioing
NDVI Images
Spectral Enhancement
Generation of Training Sets
Supervised Classification and Accuracy Assessment
Unsupervised Classification
Change Detection
Model Builder
Programs for Image Analysis

Reading:

1. ERDAS IMAGINE 2018 user manuals

CE 5555	ADVANCED GIS LABORATORY	PCC	0-1-2	2 Credits

Prerequisites: CE 5505: Geographical Information Systems Laboratory

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

CO1	Perform advanced geospatial analysis
CO2	Modeling GIS data
CO3	Use programming tools for geospatial applications

Mapping of course outcomes with program outcomes

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

Detailed Syllabus:

Interpolation methods
Viewshed and watershed analysis
Modeling tools
Python and R programming geospatial tools

Reading:

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

CE5511	PROGRAMMING METHODS FOR GEOSPATIAL SYSTEMS	DEC	3-0-0	3 Credits

Prerequisites: None
Course Outcomes: At the end of the course the student will be able to:

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

Mapping of course outcomes with program outcomes

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

Detailed Syllabus:
Oops concepts – Classes, Objects, Polymorphism, Inheritance, Encapsulation, Overloading. Basic elements of C++, input and output statements, decision making, functions, iterations and loops. Objects and Classes. Arrays and Strings. Operator Overloading.
Inheritance. Pointers. Virtual Functions and Other Subtleties; Streams and Files;
Multifile Programs, Templates and Exceptions, Object-Oriented Software Development.
Java Programming: data types, variables and arrays, operators, control statements, classes, objects, methods – Inheritance; Packages and Interfaces, Exception handling, Multithreaded programming, Strings, Input /Output.

Reading:

1. E. Balagurusamy - Object Oriented Programming with C++ - TMH, fourth edition, 2008.
2. Herbert Schildt - C++ The complete Reference,1999.
3. Herbert Schildt - The Java 2 : Complete Reference - Fourth edition, TMH, 2002.
4. H.M.Deitel, P.J.Deitel - Java: How to program - Fifth edition, Prentice Hall of India private limited, 2003.
5. Robert Lafore, Object Oriented Programming in C++ , 4th Edition, Pearson Pub., 2002.

CE5512	DATABASE MANAGEMENT SYSTEMS	DEC	3-0-0	3 Credits

Prerequisites: None

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

C01	Understand the components of Database management system and file management methods
CO2	Apply the concepts of SQL and its use to manage the databases
CO3	Carry out the Query, update a databases using SQL
CO4	Design and build a simple database system using DBMS software for GIS Databases

Mapping of course outcomes with program outcomes

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

Detailed Syllabus:

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

File Organization, Constituents of file, Operations on files, Sequential files, Index- Sequential files, Direct files

Relational Database, Attributes and domains, Tuples, Relations and their schemes, Relation Representation, Relational operations, Relational algebra, Relational calculus, Implementation

Relational Database Manipulation, Structured Query Language (SQL), Query Language (QUEL) Query-by-Example (QBE), Data Manipulation and retrieval using SQL, QUEL and QBE, Concepts of Relational database design.

Geospatial databases, database management in GIS

Introduction to Big Data Management, Data warehouse

CE5513	REMOTE SENSING GEOLOGY	DEC	3-0-0	3 Credits

Prerequisites: CE5501: Principles of Remote Sensing

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

C01	Interpret the satellite imageries for geological features using remote sensing principles
CO2	Identify and analyze various structural features from satellite images
CO3	Apply geophysical principles for subsurface exploration
CO4	Identify ground water potential zones, landslide hazard zones and mineral resources

Mapping of course outcomes with program outcomes

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

Detailed Syllabus:

General: General Geology, Geomorphology, satellite data interpretation for geological mapping.

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

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

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

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

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

Reading:

1. Ravi P. Gupta - Remote Sensing Geology - Springer Verlag Publications, 2005.
2. Floyd F. Sabins:*Remote sensing*: Principles and Interpretation, W.H. Freeman and Company, 2007.
3. Verstappean H.T, Remote Sensing in Geomorphology,Elsevier Scientific Publications,1977.
4. Druary, S.A - Image Interpretation in Geology - Allen and Unwin Ltd,2004.

5561	CLOSE RANGE PHOTOGRAMMETRY AND LASER SCANNING	DEC	3-0-0	3 Credits

Prerequisites: None

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

CO1	Acquire, measure and analyze the data taken with any sensor
CO2	Apply the technique for archaeological, civil engineering and other structures
CO3	Generate orthophotos, DEM and 3D models for topographical mapping
CO4	Analyze the point cloud data for documentation and archiving of features

Mapping of course outcomes with program outcomes

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

Detailed Syllabus:

Close Range Photogrammetry: Photogrammetric process, Coordinate systems, Coordinate transformations, Image acquisition, Imaging systems – stereometric cameras, digital cameras, Thermal imaging cameras, 3D cameras, UAVs, Terrestrial laser scanners

Image measurement systems, Control for terrestrial photogrammetry, Interior orientation, Resolution, Imaging systems – Analogue, Digital, Laser based measuring systems, Orientation methods,

Applications – Architecture and cultural heritage, Archaeological applications, Monitoring Civil Engineering Structures,

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

Laser Scanning: Concept, Instruments, Specifications, Capabilities, Data acquisition and processing. Applications – Interior, exterior of monuments and structures, 3D visualization and analysis, generation of archives towards planning and development

Reading:

1. Popescu, S. C. LiDAR: Remote Sensing of Terrestrial Environments. 1st edition, CRC Press. ISBN 978-1420047639, 2012.
2. Paul Gerin Fahlstrom & Thomas James Gleason., Introduction to UAV Systems, Wiley Publications, 2012
3. Reg Austin, Unmanned Aircraft Systems, Wiley Publications, 2010
4. George Vosselman & Hans-Gerd Maas., Airborne and Terrestrial Laser Scanning., CRC Press, 2010
5. Thomas Luhmann, Stuart Robson, Stephen Kyle & Jan Boehm., Close Range Photogrammetry and 3D Imaging., Walter de Gruyter GmhH, 2nd Edition, 2014
6. Atkinson, K B (Ed), Close Range Photogrammetry and Machine Vision, Whittles Publishing, 1996.

CE5562	THERMAL, MICROWAVE AND HYPERSPECTRAL REMOTE SENSING	DEC	3-0-0	3 Credits

Prerequisites: CE5501: Principles of Remote Sensing

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

CO1	Understand the principles of thermal and microwave remote sensing
CO2	Identify the working mechanism and applications of active and passive microwave systems
CO3	Interpret Hyperspectral images
CO4	Classify and analyze Hyperspectral data

Mapping of course outcomes with program outcomes

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

Detailed Syllabus:

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

Microwave Remote Sensing: Microwave Remote Sensing and its advantages. Active and passive systems. Platforms and sensors.

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

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

HyperSpectral Remote Sensing: Principles of Hyperspectral Remote Sensing, Spectral Cube, Airborne and spaceborne hyperspectral sensors. Data correction – atmospheric, radiometric and geometric, Data visualization, animation, Multiple colour composites, Observing signatures of various features and comparing with spectral libraries, Comparison of PCA, MNF, ICA derived products, spectral mapping methods: Spectral Angle Mapper (SAM), Spectral Correlation mapper, Spectral Feature Filtering (SFF), Linear Spectral Unmixing (LSU)

Reading:

1. Ulaby, F.T., Moore, R.K., and Fung, A.K., Microwave Remote Sensing – Active and Passive – Wesley Publishing,1986.
2. Michael T, Eismann., Hyperspectral Remote Sensing, SPIE press, USA, 2012
3. Marcus Borengasser., William S Hungate and Russel Watkins., Hyperspectral Remote Sensing: Principles and Applications, CRC Press, 2008
4. Liguo Wang and Chunhui Zhao., Hyperspectral Image Processing, Springer, 2016
5. Varshney, P. K and Arora, M. K., Advanced Image Processing Techniques for Remotely Sensed Hyperspectral Data, Springer, 2014

CE5563	WEB AND MOBILE GIS	PCC	3-0-0	3 Credits

Prerequisites: CE5502: Geographical Information System

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

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

Mapping of course outcomes with program outcomes

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

Web GIS: Definition, concept of Web GIS, History of Web GIS, components of web GIS, internet, web GIS v/s Internet GIS, Distributed GIS, users and stake holders of web GIS, advantages and limitations of web GIS, overview of Web GIS. Web mapping: static and interactive web mapping, Webmap services, open GIS web map server, Geographic Markup Language - principles and characteristics, commercial web mapping programs.

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

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

Mobile App development in Android, IOS platforms

Reading:

1. Kraak, M. and Brown, A. Web Cartography: Development and Prospects, Taylor and Francis, London, 2001.
2. Tereshenkov, A., Web GIS Application in Local Government, VDM Verlag, 2009.
3. Pinde Fu and Jiulin Sun, Web GIS: Principles and Applications, ESRI Press, 2011
4. Maximiliano Firtman., jQuery Mobile: Up and Running, O'Reilly, 2012

CE5541 & CE5591	Seminar – I & Seminar – II	PCC	0-0-2	1 Credits

Prerequisites: None.

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

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

Mapping of course outcomes with program outcomes

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

Detailed Syllabus:

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

Reading:

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

CE6542	Comprehensive Viva Voce	PCC	0-0-0	1 Credits

Prerequisites: None.

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

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

Mapping of course outcomes with program outcomes

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

Detailed Syllabus:

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

Reading:

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

CE6549 & CE6599	Dissertation Part – A & Dissertation Part – B	PCC	0-0-0	27Credits (9 + 18)

Prerequisites: None.

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

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

Mapping of course outcomes with program outcomes

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

Detailed Syllabus:

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

Reading:

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