NATIONAL INSTITUTE OF TECHNOLOGY WARANGAL

Honors in

Remote Sensing and GIS

SCHEME OF INSTRUCTION AND SYLLABI

(for students of B.Tech., Civil Engineering)

(Effective from 2021-22)

DEPARTMENT OF CIVIL ENGINEERING

SCHEME OF INSTRUCTION

Honours Program – RS& GIS

S. No.	Course Code	Name of the Course	L	T	P	Credits	Sem.
1	CE5502	Geographical Information Systems	3	0	0	3	V
2	CE5551	Geospatial data Processing and Modelling	3	0	0	3	VI
3	CE5552	Satellite Image Processing	3	0	0	3	VI
4	CE5503	Photogrammetry	3	0	0	3	VII
5	CE5511	Programming Methods for Geospatial Systems	3	0	0	3	VII
6	CE5553	Global Navigation Satellite System	3	0	0	3	VIII
		Total				**18**	

DETAILED SYLLABUS

Honors

Remote Sensing and GIS

Course Code: CE5502	GEOGRAPHICAL INFORMATION SYSTEMS	Credits 3-0-0: 3

Pre-requisites: 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	Conceptualize a GIS project

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, Modelling 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, Modelling topological Relationships, Tolerances.

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

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

Learning Resources:

Text Books:

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

Reference Books:

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

Online Resources:

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

Course Code: CE5551	GEOSPATIAL DATA PROCESSING AND MODELING	Credits 3-0-0: 3

Pre-requisites: None

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

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

Syllabus:

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

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

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

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

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

Learning Resources:

Text Books:

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

Reference Books:

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

Online References:

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

Course Code: CE5552	SATELLITE IMAGE PROCESSING	Credits 3-0-0: 3

Pre-requisites: None

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

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

Syllabus:

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

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; Object Oriented Image Classification

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

Learning Resources:

Text Books:

1. Digital Image Processing, John R J, Introductory Prentice Hall, New Jersey,2016.
2. Remote Sensing Imagery, Florence Tupin, Jordi Inglada and Jean-Marie Nicolas, ISTE and Wiley, 2014.
3. Remote Sensing and Digital Image Processing, Jarocińska, Anna, van der Meer, Freek D., Springer, 2016

Reference Books:

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

Online References:

1. https://www.nrcan.gc.ca/maps-tools-publications/satellite-imagery-air-photos/tutorial-fundamentals-remote-sensing/9309
2. https://nptel.ac.in/courses/105/107/105107160/

Course Code: CE5512	PHOTOGRAMMETRY	Credits 3-0-0: 3

Pre-requisites: None

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

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

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, DEM Applications in Civil Engineering

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

Learning Resources:

Text Books:

1. Elements of Photogrammetry with Application in GIS, Wolf P. R., McGraw Hill International Book Company, Fourth Edition, 2014.
2. Photogrammetry, Moffitt, Francis H. & Mikhail, Edward M., Harper and Row Publishers, 1980.
3. Fundamentals of Computational Photogrammetry, Sanjib K Ghosh, Concept Publishing Company, 2005
4. Introduction to UAV Systems, Paul Gerin F & Thomas James Gleason., Wiley Publications, 2012

Reference Books:

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

Online Resources:

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

Course Code: CE5511	PROGRAMMING METHODS FOR GEOSPATIAL SYSTEMS	Credits 3-0-0: 3

Pre-requisites: 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

Syllabus:

Oops Concepts: Classes, Objects, Polymorphism, Inheritance, Encapsulation, Overloading.

Basics of C++: 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; Multi-file 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.

Learning Resources:

Text Books:

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

Reference Books:

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

Online Resources:

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

Course Code: CE5553	GLOBAL NAVIGATION SATELLITE SYSTEM	Credits 3-0-0: 3

Pre-requisites: Geographical Information System

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

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

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, and Field data collection.

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

Learning Resources:

Text Books:

1. GNSS: Global Navigation Satellite Systems, Hofmann-Wellenhof, Lichtennegger and Wasle, Springer-Verlag Wein, New York, 2008.
2. Satellite Geodesy Foundations-Methods and Applications, Gunter Seeber., 2003.
3. GNSS Remote Sensing: Theory, Methods and Applications, Shuanggen Jin, Estel Cardellach adn Feiqin Xie., Springer, London, 2017.

Reference Books:

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

Online Resources:

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