सत्यमेव जयते

Department of Science & Technology
Govt. of India

Winter School In Geospatial Science and Technology (Level 1)

15 November - 09 December 2021

In Online Mode

Organized by

Multidisciplinary Centre for Geoinformatics, Delhi Technological University, New Delhi, India

Supported by

National Geospatial Program, Department of Science and Technology, Government of India, New Delhi

at

Multidisciplinary Centre for Geoinformatics, Delhi Technological University, New Delhi, India

Patron

Prof. Yogesh Singh, Hon'ble Vice Chancellor, Delhi Technological University, New Delhi

Principal Investigator

Dr. K.C. Tiwari, Professor, Multidisciplinary Centre of Geoinformatics, Delhi Technological University, New Delhi

Delhi Technological University, New Delhi

With a history stretching over 75 years, providing an academic milieu amid adequate space for ingenious research as an integral part of curriculum design, Delhi Technological University (DTU) is strongly identified with engineering education in India. The University has been a forerunner, and led the way in reform movement maintaining a compatibility with values and professional morality. DTU takes pride in being one of the major contributors in planning and construction of India's infrastructure. In DTU, we endorse and cultivate the purity of mind as the strongest currency, with an impressive resolve to renovate and upgrade our knowledge infrastructure. DTU aspires to be ranked amongst the leading universities globally. Consequently, DTU's mission is to edify individuals to be competitive not only in India, but all over the world. Visit us on: http://www.dtu.ac.in/

Multidisciplinary Centre for Geoinformatics

Multidisciplinary Centre for Geoinformatics (MCG) was established at DTU on 5th March 2019 with a vision to excel in the field of Geospatial education, research and consultancy. It is currently running Ph.D and an AICTE approved M.Tech program in Geoinformatics. Visit us on: http://www.dtu.ac.in/Web/Departments/MCG/about/index.php

What is the Summer/Winter Schools (Level 1)Capacity Building Program in Geospatial Science and Technology

Recently knowledge has been identified as the most important driving factor for India's sustainable economic growth. India has adopted a new information regime for sustainable economic growth through its 'Digital India' program to support good governance, sustainable development goals and empowerment of its citizens. Over the last three decades, the widespread adoption of geospatial technologies into various sectors have proven to be an effective enabler to meet these challenges. The capacity building program initiatives of the National Geospatial Program (NGP) erstwhile Natural Resource Data Management System (NRDMS) Department of Science and Technology, Government of India to develop national capacity for geospatial science and technology development through diverse programs in collaboration with various partner organizations adaptation capacity of geospatial science and technology at across the country. The objective of the program is to build knowledge and various levels of governance in collaboration with academia and user agencies. The three week Summer/ Winter School in Geospatial technology is being conducted at two levels– Level 1 and Level 2.The 21-day summer/winter school in Geospatial Science and Technology (Level 1) supported by the Natural Resource Data Management System of the Department of Science and Technology, Government of India focuses on developing knowledge and capacity building in geospatial technologies through the use of open source geospatial software.

Who can apply?

Faculty members, scientist, technologist, researchers from academia, national institutes of research, smart city cells, municipal corporations and other government departments, personnel from non government organizations who are registered on the DARPAN portal of DST, are eligible to apply. Only 2-3 seats at each centre are reserved for research scholars.

How to apply?

- Interested candidates should fill the online application form through the weblink available on http://dst-iget.in under Summer School in GST (2021-23)
- Selected candidates will be informed by mail.
- For any further queries write to dst-iget@bvieer.edu.in or call on +91-20-24375684 / 24362155.
- Address all queries regarding the program to the PI of this Winter School through email.

Important Information

Last date for registration : 30 September 2021
Dates of the program: 15 November to 09 December 2021
Mode of conduct: Online
No. of seats: 25-30
Registration Fees: Nil

Principal Investigator: Dr. K.C. Tiwari, Professor, Multidisciplinary Centre for Geoinformatics, Delhi Technological University, New Delhi
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Coordinators

1. Ms Shalini Gakhar, Senior Research Fellow (SRF) & PhD Research Scholar
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Grading and Certification

Participants will be assessed based on assignments completed during the course, a mini project are expected to complete, active participation during course, a mini project are expected to complete, active participation during the training program as well as attendance. An e-certificate will be awarded.

Note: Participants must ensure that they have a laptop and a strong internet connection. purposes.

Infrastructure and Facilities

- Well equipped GIS Laboratory

Program schedule for 21 Days Winter School in Geospatial Science and Technology (Level 1)
(15 November - 09 December 2021)

Day and Date	Morning Session (3 hours)	Lunch Break	Lab Session (3 hours)/ Field
	Week 1		
Day 1 15 Nov 2021	**Theory 1:** **Introduction to geospatial science and technology: What, why, how** • Introduction to the concept of geospatial science and technology • Introduction to UNGGIM / geospatial SDG indicators • Applications in diverse fields such as environmental sciences, ecology, social sciences, political sciences, physical and economic geography, biodiversity, livelihood, natural resource management, urban planning, watershed management, marine sciences, disaster management • Advances in geospatial technology: big data analytics, AI, drones, IoT This session will use case studies, videos to introduce the applications	**LUNCH**	**Lab 1:** **A.** Registration and Acquisition of free satellite data from Bhuvan, USGS, ESA, acquiring toposheets from SOI, ordering of IRS data **B.** Introduction to QGIS interface and functions
Day 2 16 Nov 2021	**Theory 1:** **Introduction to data types in geospatial sciences** • Spatial and non-spatial data types (aerial photos, remote sensing, toposheets, databases, drones, etc.) • Data sources (spatial and non-spatial) and secondary data acquisition • Assessing quality of data	**LUNCH**	**Lab 2:** Extracting data (Use IGET_GIS_004)
Day 3	**Theory 1:**	**LUNCH**	**Lab 3:**

17 Nov 2021	Basic geodesy • Spherical, ellipsoidal and geoidal earth, geographical co-ordinates, Co-ordinate systems: Plane co-ordinate system, Geographic co-ordinate system • Map projections: Scale factor and transformation, distortions resulting from map transformations, properties of map projections, classification of map projections, aspects of map projections, some commonly used projections (UTM, LCC), selection of a particular projection, geo-referencing, relationship between co-ordinate systems and map projections • Geodetic datum-concept and types		Working with projections using QGIS (use IGET_GIS_002) • Using existing projection Making a new projection Importing a projection
Day 4 18 Nov 2021	**Theory 1:** **Understanding data quality** • Elements of data quality • Sources and types of errors in geospatial data building • Importance of metadata Measures of accuracy	**LUNCH**	**Lab 4:** Georeferencing (Use IGET_GIS_003)
	Theory 2: **Digital Cartography** • Cartographic evolution • Map classification • Map elements • Principles of map design Exercise: Analysis of good and bad maps		**Lab 5:** Map preparation (Use IGET_GIS_006)
19 Nov 2021 Holiday) Guru Nanak Jayanti			
Day 5	**Theory 1:**	**LUNCH**	**Lab 6:**

20 Nov 2021	**Database** • Introduction to database and database management systems, importance of databases in GIS • Database structures • Database data models: Hierarchical model, network model, relational database model, object-oriented data model • Database creation, linking spatial and attribute data, GIS database applications • Challenges in database creation		Data exploration (Use IGET_GIS_007)/ Working with tables (use IGET_GIS_008)
21 Nov 2021 Holiday Sunday			
Week 2			
Day 6 22 Nov 2021	**Theory 1:** Spatial Analysis • Measurements • Queries • Buffering and neighbourhood functions • Map overlay • Spatial analysis • Multicriteria analysis Network Analysis	**LUNCH**	**Lab 7:** Working with queries (use IGET_GIS_009)
Day 7 23 Nov 2021	**Theory 1:** **Introduction to Global Navigation Satellite Systems (GNSS)** • Introduction, GNSS segments, GNSS satellite generations, current GNSS satellite constellation working principle • GNSS working principle, GNSS signal structure, types of GNSS receivers, pseudorange measurements, carrier phase measurements, cycle slips • GNSS errors and biases • Methods of GNSS observations GNSS applications	**LUNCH**	**Lab 8:** **Hands-on Session 10** Field exercise for collecting points using a hand-held system Importing location data into QGIS (Use IGET_GIS_011)

	Initiation of project topic selection		
Day 8 24 Nov 2021	**Theory 1:** **Introduction** • Definition and concept of remote sensing; Components of remote sensing, natural remote sensing, artificial remote sensing, passive and active remote sensing • Platforms of remote sensing-aircraft, satellites • Remote sensing data collection: The remote sensing process-statement of the problem, identification of in-situ and remote sensing data requirements. • Applications of remote sensing in various fields such as forestry, mining, watershed, urban planning, agriculture and advantages and limitations of remote sensing • Introduction to Earth Resource Satellites operating: LANDSAT Series, IRS series, Meteorological satellites, Ocean monitoring satellite	**LUNCH**	**Quiz 1:** Multiple Choice Questions based on previous studied topics.
Day 9 25 Nov 2021	**Physics of remote sensing** • Electro radiation models (Wave model of electromagnetic energy, the Particle Model- Radiation from atomic structures); • Energy-matter interactions in the atmosphere (Refraction, scattering and absorption, reflectance) • Atmospheric windows and types of remote sensing systems • Energy matter interactions with the terrain (hemispherical reflectance, absorptance and transmittance, spectral reflectance of vegetation, water body and soil spectral response patterns) • Radiant Flux Density (Irradiance and radiance exitance)	**LUNCH**	**Task 1:** • Make list of Optical Satellites and their application with respective country origin • Make list of Hyperspectral satellites (Airborne/ Sapce-borne) and their application with respective country origin • Make list of Microwave satellites and their application with respective country origin • Make list of Open source software of GIS and Image Processing.

Day 10 26 Nov 2021	**Elements of visual interpretation** Factors governing the interpretability, elements of image interpretation with examples Methods of search: Use of collateral information, convergence of evidence, the multi concept **Image Quality Assessment and Statistical Evaluation** • Significance of the histogram in digital image processing • Univariate descriptive image statistics: measures of central tendency, measure of dispersion, skewness Multivariate image statistics: covariance in multiple bands, correlation between multiple bands	**LUNCH**	**Lab 9:** Intro to SAGA (Use IGET_RS_001) Image interpretation (Use IGET_RS_002)
Day 11 27 Nov 2021	**Theory 1:** **Image rectification and restoration** • Radiometric correction: random bad pixels, line or column drop-outs, partial line or column dropouts, line start problems, n-line stripping • Atmospheric effects and correction • Geometric correction: Internal and external geometric error, types of geometric correction- image to map rectification, image to image registration, hybrid approach to image rectification/registration Intensity interpolation: nearest neighbour, bilinear interpolation	**LUNCH**	**Lab 10:** Understanding the image (histogram) (Use IGET_RS_003) Ex: Image registration (use IGET_RS_0004)
	Theory 2: **Introduction to image enhancements** • Contrast enhancements • Band rationing		**Lab 11 :** Working with images – subsetting and mosaicking (Use IGET_RS_005)

	• Spatial filtering • Principal Components Analysis Vegetation Indices (NDVI, SAVI, NBR, mNDWI)		Using enhancements (use IGET_RS_006)
28 November Holiday Sunday			
	Week 3		
Day 12 29 Nov 2021	**Image classification** • Introduction: Parametric and non-parametric method • Supervised classification: LULC classification levels, Stage involved in classification, Maximum Likelihood Classifier, neural networks, and random forests etc. • Unsupervised classification methods, K-means clustering and ISODATA • Hybrid classification and Knowledge based classification by incorporating ancillary data in the classification process • Validation of classification: Error matrix and Kappa statistics	**LUNCH**	**Lab 12:** Extracting information for satellite image using unsupervised classification (Use IGET_RS_007) **Lab 13:** Extracting information for satellite image using supervised classification (Use IGET_RS_008)
Day 13 30 Nov 2021	**Digital change detection** Steps required to perform change detection, change detection algorithms	**LUNCH**	**Lab 14:** Change detection with SAGA (use IGET_RS_011)
Day 14 1 Dec 2021	**Theory 1:** I**ntroduction to Google earth engine** Introduction, Code editor, Accessing EO datasets, Visualization and analysis of remote sensing images	**LUNCH**	
	Theory 2: **Understanding Terrain Data**		**Lab 15:** Terrain analysis (Use IGET_RS_010)

	Introduction to DEM, DTM, DSM Satellite images and applications		
Day 15 2 December 2021	Web GIS application • Technical basics: Web GIS basic architecture and components; Thin vs thick client architecture; Introduction to GML, geoRSS, XML, WKT (Well Known text) and preferred coordinate systems (GCS84) for web GIS apps; Use of APIs in creating web enabled GIS websites (open layers API and google map API) • Geospatial Web Services; From websites to web services; WMS, WFS and WCS; their roles in web GIS; Introduction to Interoperability and geospatial web service standards • Geospatial Mashups Introduction to NSDI, SDI	**LUNCH**	**Lab 16:** Using QGIS to create a web GIS; Understanding Geoserver
Day 16 3 Dec 2021	**Applications of geospatial technologies** • Applications on RS/GIS in planning (urban/rural) with specific case studies highlighting detailed methodology (advanced) • Applications of RS/GIS in natural resource management (forest, wildlife/agriculture/watershed) with specific case studies highlighting detailed methodology (advanced) • Applications of RS/GIS in climate studies with specific case studies highlighting detailed methodology (advanced) • Advances in RS/GIS Use of RS/GIS in SDGs, social sector, development of geospatial indicators • Introduction to the work of the UNGGIM	**LUNCH**	**Lab 17:** Exercise on Spatial Data Analysis (Use IGET_SA_001)
Day 17 to 21 4- 9 Dec 2021	**Project Work** Possible minor projects to be done by the participants. Institutions to give projects according to data available with them or using data that can be generated easily.	**LUNCH**	**Students will be divided into ten teams of three students each and assigned a project** **Daily Review**