JADAVPUR UNIVERSITY
COMPUTER AIDED DESIGN CENTRE
Faculty Council of Engineering and Technology
Kolkata - 700 032

Certificate course on
Geospatial Technology

Geospatial Technology is a discipline that combines *Remote Sensing*, *Geographic Information System* (GIS) and *Global Navigation Satellite System* (GNSS). Remote sensing is basically the use of instruments or sensors to view the spectral and spatial relations of observable objects and materials at a distance. GNSS is the standard generic term for satellite navigation systems (such as GPS, GLONASS, etc.) that provide autonomous geospatial positioning information with global coverage. GIS is a computer-assisted information management system of geographically referenced data. The need for systems that monitor the changing land-use/land-cover, search and protect natural resources, and track interactions within the biosphere, atmosphere, hydrosphere, and geosphere has become a paramount concern to scientists, planners, managers, politicians, and the general citizens as well. The rapid progress and increased visibility of remote sensing, GNSS, and GIS since 1990s has been made possible by paradigm shift in the areas of computer technology, computer science, and software engineering, as well as airborne and space-borne earth observation technologies. As a result, a new field of study, namely *Geospatial Technology* or *Geoinformatics*, is now in its maturity.

This certificate course has been designed primarily for the research scholars, teachers, working persons, or others who want to learn Geospatial Technology in a very short duration. This course is very compact but provides comprehensive coverage. The course participants will be highly benefited if they follow regular classes.

The CAD Centre is the pioneer institute in the field of Geospatial Technology. It maintains a state-of-the-art infrastructure for its courses. The Centre has engaged highly experienced faculty members from academic sector as well as industry. Some of our faculty members are well known figures in the field of Geospatial Technology and have published huge number of books, monographs, and research articles internationally.

Course Duration : 6 months [3 days/week]

Class Duration : Theory classes: 2 hrs each; Practical classes: 3 hrs each

Eligibility : BE/BTech in Engineering or equivalent; BSc in any discipline; BA in Geography/Environmental Studies; 3-years Diploma in Engineering. All should have working ability with Windows, MS Word, and MS Excel.

Syllabus:

Topics	No. of Theory Classes	No. of Prac. Classes	Total No. of Classes
Introduction to Geoinformatics: Remote Sensing, GIS, GNSS, Geoinformatics and related terms, advantages/limitations of Geoinformatics, applications of geoinformatics.	1	-	1
Concept on remote sensing, platforms and sensor characteristics: Definition, data (in situ / remote sensing), passive optical remote sensing, remote sensing platforms, passive/active, orbits, swath, nadir, sensor resolutions.	1	-	1
Photographic and digital optical imaging: Introduction, types of photographic Camera, types of photos, vantage point, digital image, digital sensor, detector, image acquisition, PAN, multispectral, hyperspectral, digital camera.	1	-	1
Visual interpretation of photographic images: Interpretation elements, interpretation of optical images, interpretation keys, mapping geographic features, practical	1	1	2
Digital image processing (enhancement): DIP system, digital image (data format, metadata/header file), image display (RGB), image reduction/magnification, colour combinations, transect extraction.	1	-	1
*Visual interpretation of digital images (using **ERDAS Imagine**):* Opening an image, zoom, pan, band combination, image info, pixel inquiry, multilayer arrangement, image co-ordinates, header file, save as, etc.	1	1	2
Concepts on co-ordinate system: Map, scale, coordinate systems, sphere/spheroid, datums, projection, projection parameters.	1	-	1
DIP (pre-processing and enhancement): Georeferencing, RMS error, transformation and resampling, contrast enhancement, filtering.	2	-	2
Visual interpretation of digital images (using ERDAS Imagine): Image profile (choosing appropriate band/s), contrast enhancement.	1	1	2
Pre-processing (using ERDAS Imagine): *i)* Georeferencing (image to image, image to ground, image to map) *ii)* Mosaicking, AOI tools, subsetting (spatial and spectral), filtering.	2	2	4
Overview of GIS: Introduction to GIS, definition of GIS, Components of GIS, functions and advantages of GIS	1	-	1
Spatial data model and process of GIS: Dimensions of GIS data, Conceptual (field/object) and logical (raster/vector/object oriented), Data sources, data capture (raster/vector/attribute), Raster and vector data processing.	1	-	1
*GIS using **QGIS**:* *i)* QGIS Interface & plugins concepts, raster styling, Georeferencing image to image and image to ground, georeferencing using Google map. *ii)* Vector data creation, editing, and manipulation, attribute creation and data entering, import/export shapefile to kml. *iii)* Convert CSV/excel file to vector layer, coordinate extraction, join external excel file with vector layer, coordinate transformation etc.	6	6	12

*GIS using **ArcGIS**:* *iv)* Image Georeferencing (image to image, image to ground), metadata editing, define coordinate system. *v)* Geodatabase design, vector (generation/editing), add XY data, external data attachment, create relationship, query. *vi)* Topological relationships on vector data, georeferencing vector layers, ArcScan: automated R2V conversion.			
***GNSS** Technology:* Introduction, concept of GNSS technology, three segments of GNSS, timing and ranging, calculating location, errors, differential GNSS, applications.	1	-	1
Practical on GNSS: *i)* Using a GNSS receiver, GCP collection (field survey) *ii)* Field survey with GNSS receiver. *iii)* Downloading the data from GNSS receiver, georeferencing a map, R2V conversion, Mapping with GNSS survey data.	-	3	3
Geospatial analysis: attribute and spatial query, proximity analysis, geoprocessing, Thematic map, chart, layout etc.	1	-	1
GIS using QGIS and ArcGIS: *i)* Attribute & spatial query, area/perimeter/length extraction from features, field calculation/statistics etc. *ii)* Different types of Proximity and Geoprocessing analysis on vector layers *iii)* Thematic map, label, chart/graph and layout/map making etc.	4	4	8
DIP (transformation): image addition, image subtraction, image multiplication, index, PC transformation, FFT, fusion	1	-	1
Image transformation (using ERDAS Imagine): change detection, index/indices (iron oxide, NDVI), PC transformation, FFT, fusion	1	1	2
DIP (Classification): Information class, spectral class, supervised vs. unsupervised, decision rules for unsupervised classification, accuracy assessment	1	-	1
Image classification using ERDAS imagine: Unsupervised classification	1	1	2
DIP (Classification): Decision rules for supervised classification, post-classification filtering	1	-	1
Image classification using ERDAS Imagine: *i)* Supervised classification, accuracy assessment *ii)* Unsupervised classification of NDVI image, post-classification filtering, post-classification vectorisation *iii)* Layer stack, supervised classification using optical bands in addition to PC images and indexed image *iv)* Classification of change image, pseudo color image preparation, single class classification, import/export	4	4	8
Advanced geospatial analysis: Raster Interpolation, Raster Overlay analysis, 3D data preparation and analysis, network analysis, surface model and surface analysis	2	-	2
Advanced GIS using ArcGIS: *i)* Raster surface preparation using various interpolation methods such as IDW, spline and kriging *ii)* DEM creation using both raster and vector (TIN) approach, DEM surface analysis like slope, aspect, hillshade, viewshed and contour extraction	3	3	6

iii) 3D data creation, build 3D earth model, model GIS data on ArcGlobe, steepest path determination, line of sight and profile graph analysis *iv)* Suitable site analysis using raster distance, raster overlay, raster weighted overlay analysis techniques, network analysis like shortest path, closest facility and service area analysis *v)* Animation creation in ArcGIS			
Advanced geospatial analysis: Local and Focal operations, density analysis, hydrological analysis	1	-	1
Advanced GIS using ArcGIS: Raster algebra, raster density analysis and hydrological analysis	1	1	2
Review practical session	-	2	2
Total	42	30	72

Examination: One theory test of 100 marks and one practical test of 100 marks at the end of the course. Pass marks is 40. The candidate requires securing 40 marks individually in theory and practical test.