Higher Surveying
Civil Engineering

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Course Intro: : Conventional survey techniques are all about measuring 2D or 3D coordinates of a point for mapping of a surface. Though accurate, these techniques are time consuming for topographic mapping. With development of various hard and soft technologies in last two decades, advanced mapping techniques have evolved. It gives a paradigm shift as conventional surveys are superseded by advanced surveying techniques, which are not only accurate and flexible but require minimum time to acquire large amount of 3D data. Therefore, these techniques have been extensively used in many areas of engineering by students, researchers, and industries. On the other hand, the fundamental concepts of most of the advanced surveying techniques are not clear to all users. This course on Higher Surveying discusses about the modern techniques of advanced surveying, their fundamental concepts, data acquisition, data processing, and applications.

Pre Requisites: : A course on â€œBasic Surveyingâ€• is pre-requisite
Core/Elective: : Core
UG/PG: : Both
Industry Support : All companies involved in advanced practices of Survey Engineering value this course.

Reference : Elements of Photogrammetry with Application in GIS, by Paul R Wolf, Bon A DeWitt, and Benjamin E Wilkinson, 4th ed, McGraw-Hill Education, 2014. Introduction to Modern Photogrammetry, by E M Mekhail, 1st ed, Wiley, 2001. Adjustment Computations: Spatial Data Analysis, by Charles D Ghilani, 5th ed, Wiley, 2010. GPS for Land Surveyors, by J V Sickle, 4th ed, CRC Press, 2015. Bathymetry: Concepts and Applications, by J Harper (Editor), Callisto Reference, 2015. Hydrography, by C D de Jong, G Lachapelle, S Skone, and I A Elema, 2nd ed, DUP Blue Print, 2003. Hydrographic Surveying - Methods, Tables and Forms of Notes, by S H Lea, and J Gloag, Forgotten Books, 2017. Elements of Hydrographic Surveying, by G W Logan, Forgotten Books, 2017. The Surveying Handbook, by E C Brinker and R Minnick (editors), CBS Publishers and Distributors Pvt Ltd, 2nd ed, 1995. Electronic Surveying in Practice, by S H Laurila, John Wiley & Sons, 1983. Engineering Surveying Technology, by T J M Kennie and G Petrie (editors), Blackie and Sons Ltd, 1990. Map Projections - A Reference Manual, by L M Bugayevskiy and J P Snyder, Taylor & Francis Ltd, 2000. GPS Satellite Surveying, by A Leick, John Wiley & Sons, 3rd ed, 2004. Topographic Laser Ranging and Scanning â€“ Principles and Processing, by J Shan and C K Toth (editors), CRC Press, 2009. Introduction to Microwave Remote Sensing, by I H Woodhouse, CRC Press, 2006. Radar Interferometry â€“ Data Interpretation and Error Analysis, by R F Hanssen, Springer Netherlands, 2001.

About Instructor: Dr Ajay Dashora is a faculty member in Earth Science Group of Dept of Civil Engineering, Indian Institute of Technology Guwahati. He completed his Masters and PhD degrees in Geoinformatics discipline from Indian Institute of Technology Kanpur. While pursuing his academics, he worked extensively on modern surveying techniques, like GPS, Photogrammetry, and LiDAR for topographic mapping. For research and teaching of modern surveying techniques for mapping at IIT Guwahati, he has been conducting various field related activities that require modern surveying technologies. His main interests are to develop low cost 3D mapping methods.

COURSE PLAN

SL.NO	Week	Module Name
1	1	1.What is Higher Surveying? Need and pre-requisites for Higher Surveying, Connection of Basic Surveying with Higher Surveying, detailed course content, books, notes, and other sources (1 lecture); 2.Fundamental requirements of higher surveying: platform requirements, type of surveys, type of sensors, scanning mechanisms, scale and resolution of survey, planning of survey, data acquisition and data management (1 lecture); 3.Coordinate systems in mapping for Earth surface (1 lecture).
2	2	1.Coordinate and datum transformations for 3D coordinates on Earth surface (2 lecture); 2.Introduction to Adjustments Computations
3	3	1.Methods of Adjustments Computations 2.Accuracy assessment of parameters using Adjustments Computations
4	4	Positioning and direction survey for navigation. Introduction to Photogrammetric survey
5	5	Physical models of photogrammetry â€“ Collinearity and coplanarity equations.Space resection, space intersection, and aerial triangulation for photogrammetry . Bundle adjustment, camera calibration, relative and absolute orientation, direct georeferencing
6	6	Mathematical models of photogrammetry â€“ Affine, Conformal, Rational functional model (RFM), and direct linear transformations. Close range and terrestrial photogrammetry for mapping
7	7	1.Introduction to LiDAR survey and fundamental concepts 2. Flight planning for airborne LiDAR data acquisition
8	8	1.Geolocation process 2.Error propagation and accuracy assessment for LiDAR 3. LiDAR data processing for DTM, DSM, BEM, and DEM generation

9	9	1.LiDAR data processing for DTM, DSM, BEM, and DEM generation 2. Introduction to Sounding and Bathymetry survey and fundamental concepts
10	10	1.Data acquisition planning and execution for Sounding surveys 2.Introduction to Radar interferometry survey and fundamental concepts 3. Mapping with RADAR technique
11	11	1.Mapping with RADAR technique 2. Compatibility of various Higher Surveying techniques 3. Applications of Higher Surveying techniques for Archeological Surveys
12	12	1.Applications of Higher Surveying techniques for Cadastral survey and building detection and extraction 2. Applications of Higher Surveying techniques for forestry 3. Applications of Higher Surveying techniques for measurements of surface deformation and plate tectonic movement 4. Applications of Higher Surveying techniques for 3D mapping and virtual model development. 5.Applications of Higher Surveying techniques for Geomorphological features mapping