

## DEPARTMENT OF SURVEY ENGINEERING

The objective of the department is aimed at providing theoretical principles and practical techniques on surveying and mapping necessary for various engineering and development projects. Courses offering in the department both at undergraduate and graduate levels cover broad fields of surveying, photogrammetry and remote sensing, cartography, geodesy, and spatial information technology.

The department currently have three curriculums:

1. The bachelor degree in survey engineering
2. The master of engineering program in survey engineering
3. The doctor of philosophy program in geomatic engineering

The bachelor degree curriculum which is four years is designed such that the student will have basic knowledge in engineering in general and a more intensive knowledge of survey engineering in particular. The curriculum is blended with theories and practices. Students will have experiences on various surveying instruments and computer programming. Confidence and competence to solve practical problems in the domain of survey engineering is strengthened through field practices and on the job training. A more insight to the subject is possible, upon the department's approval, through senior project, special study, and seminars on topics of the student's interest. It is expected that the program would enable the students to

1. understand the structures and requirements of surveying and mapping;
2. apply the theories and techniques to general surveying tasks effectively, efficiently, and economically;
3. analyse the instrumental mechanics for evaluating the accuracy and precision attained;
4. follow new technology and development in the field of surveying and mapping and spatial information technology.

The master of engineering in survey engineering program (revised curriculum 1994) is a two-year program designed to respond social needs which keep changing according to technological advances. The program objectives are

1. To allow more flexible curriculum structure in order to be more responsive to social needs and;
2. To produce graduates highly capable in both theory and practice;
3. To study and research in fields related to survey engineering and mapping, in order to improve the quality of the graduates.

The program of master of science in spatial information in engineering is a two-year program

commenced in academic year 1999. The curriculum is designed to respond social needs of people highly capable in spatial information technology or geographic information system. The program objectives are:

1. To produce graduates who have a deep understanding of spatial information technology for engineering enterprises in both business and public sector;
2. To generate new body of knowledge in spatial information system for the research and development of the department and the university.

Ph.D. in survey engineering is a three-years program for full-time candidates with the possibility of two years extensions. Candidates undertake a research program which is supervised normally through a supervisory panel with one principle supervisor. The program objectives are:

1. To generate new body of knowledge in the specific field of survey engineering through a research work;
2. To produce graduates.

### HEAD :

Chalermchon Satirapod, Ph.D. (New South Wales)

### PROFESSORS:

Chalermchon Satirapod, Ph.D. (New South Wales)

### ASSOCIATE PROFESSORS :

Banjerd Phalakarn, Doctorat (Denis Diderot)  
Itthi Trisirisatayawong, Ph.D. (Melbourne)  
Chanin Tinnachote, D.Eng. (AIT)  
Phisan Santitamnont, Dr.-Ing. (Leibniz Hannover)  
Vichai Yieengveerachon, M.Eng. (Chula)

### ASSISTANT PROFESSORS :

Sanphet Chunithipaisarn, Ph.D. (Newcastle upon Tyne)  
Colonel Kanok Weerawong Ph.D. (Purdue)  
Somchai Kriengkraiwasin M.Eng. (Chula)

### LECTURERS :

Octavian Andrei, Ph.D. (TUI, Romania)  
Chaichoke Vaiphasa, Ph.D. (ITC)  
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**SURVEY ENGINEERING CURRICULUM  
FIRST YEAR CURRICULUM  
COMMON TO ALL ENGINEERING STUDENTS**

<b>COURSE</b>	<b>SUBJECT</b>	<b>CREDITS</b>	<b>COURSE</b>	<b>SUBJECT</b>	<b>CREDITS</b>
<b>THIRD SEMESTER</b>			<b>SUMMER SEMESTER</b>		
2301207	CALCULUS III	3	2100301	ENGINEERING PRACTICE	2
2103205	DESCRIPTIVE DRAWING	3			
2103213	ENGINEERING MECHANICS I	3			
2104253	ENGINEERING STATISTICS I	3			
2108234	NUMERICAL ANALYSIS IN GEOMATICS	3			
xxxxxxx	GENERAL EDUCATION I	<u>3</u>			
		<b>18</b>			
<b>FOURTH SEMESTER</b>			<b>SEVENTH SEMESTER</b>		
			2108415	GEODETTIC SUREYING	3
			xxxxxxx	APPROVE ELECTIVES I	3
			xxxxxxx	APPROVE ELECTIVES II	3
			xxxxxxx	GENERAL EDUCATION III	3
			xxxxxxx	FREE ELECTIVES I	<u>3</u>
					<b>15</b>
			<b>EIGHTH SEMESTER</b>		
2101344	FUNDAMENTAL OF CIVIL ENGINEERING	3			
2106251	GENERAL GEOLOGY	3			
2108202	SURVEYING ENGINEERING	3	2108413	FIELD PRACTICE ON PRECISE SURVEYING	1
2108311	GLOBAL GEODESY	3			
5500208	COMMUNICATION AND PRESENTATION SKILLS	3	2108414	FIELD PRACTICE ON DIGITAL MAPPING	1
xxxxxxx	GENERAL EDUCATION II	<u>3</u>	2108499	SURVEY ENGINEERING	3
		<b>18</b>	OR		
			2100499	SENIOR PROJECT	
			xxxxxxx	APPROVE ELECTIVES III	3
			xxxxxxx	APPROVE ELECTIVES IV	3
			xxxxxxx	GENERAL EDUCATION IV	3
			xxxxxxx	FREE ELECTIVES II	<u>3</u>
					<b>17</b>
			<b>TOTAL CREDITS FOR GRADUTATION = 144</b>		
<b>FIFTH SEMESTER</b>					
2108301	SURVEYING WITH CONSTRUCTION APPLICATIONS	3			
2108371	PHOTOGRAMMETRY AND REMOTE SENSING SYSTEM	3			
2108342	MATHEMATICAL CARTOGARPHY	3			
2108325	GEOGRAPHIC INFORMATION SYSTEM AND APPLICATIONS	3			
2108332	ADJUSTMENT COMPUTATION	3			
2100311	ENGINEERING ESSENTIALS	<u>3</u>			
		<b>18</b>			
<b>SIXTH SEMESTER</b>					
2112343	HYDROLOGY FOR SURVEYING ENGINEERS	3			
2108372	ADVANCED REMOTE SENSING	3			
2108373	ADVANCED PHOTOGRAMMETRY	3			
2108306	FIELD PRACTICE ON TOPOGRAPHIC SURVEYING	1			
2108307	FIELD PRACTICE ON ROUTE SURVEYING	1			
2108412	SATELLITE SURVEYING	3			
2108326	GEOSPATIAL INFORMATION ANALYSIS AND VISUALIZATION	3			
5500308	TECHNICAL WRITING FOR ENGINEERING	<u>3</u>			
		<b>20</b>			

**NAME OF THE DEGREE**

: Master of Engineering  
: M.Eng.

**PROFESSORS :**

Chalermchon Satirapod, Ph.D. (New South Wales)

**ASSOCIATE PROFESSORS :**

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Teetat Charoenkalunyuta, Ph.D. (Chula)  
Garavig Tanaksaranond, Ph.D. (London)

**ADMISSION**

An applicant must hold a Bachelor's Degree in Survey Engineering or a Bachelor's Degree in other fields of study as approved by the Department. The applicant must also meet the requirements of the Graduate School.

**DEGREE REQUIREMENTS**

Students are required to fulfill the following specific requirements

- A. *A minimum of 24 credits of courses which consists of*
1. 18 credits of the required courses.
  2. At least 6 credits of elective course approved by the department.

B. *An acceptable thesis of 12 credits*

A student who fulfilled the requirements of the program with a cumulative grade point average not less than 3.00 with a period of study not less than 4 regular semesters and not more than 8 regular semesters will be awarded the Degree of Master of Engineering.

**COURSE REQUIREMENTS****1) Required Courses (18 credits)**

2108511	Numerical Techniques in Geomatics	3(2-3-7)
2108512	Adjustment Computation in Geomatics	3(2-3-7)
2108532	Satellite Surveying and Modern Techniques	3(2-3-7)
2108557	Spatial Data Structure and Models	3(3-0-9)
2108592	Seminar in Geoinformatic Technology	3(3-0-9)
2108627	Geoimage Processing	3(2-3-7)

**2) Elective Courses (21 credits)**

2108502	Fundamentals of Positioning and Mapping	3(2-3-7)
2108513	Geodesy and Geodetic Methods	3(3-0-9)
2108556	Online Spatial Information Technoloties	3(2-3-7)
2108558	Spatial Data Handling and Analysis	3(2-3-7)
2108601	Advanced Adjustment Computation	3(2-3-7)
2108628	Radar Remote Sensing	3(2-3-7)
2108629	Advanced Geoimage Processing	3(2-3-7)
2108632	Advanced GNSS Surveying	3(2-3-7)

**3) Thesis**

2108811	Thesis	12 credits
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**NAME OF THE DEGREE**

: Doctor of Philosophy  
: Ph.D.

**PROFESSORS :**

Chalermchon Satirapod, Ph.D. (New South Wales)

**ASSOCIATE PROFESSORS :**

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Garavig Tanaksaranond, Ph.D. (London)

**SPECIAL LECTURERS :**

Dr.Chaowalit Silpathong, Ph.D. (Toulouse III)  
Dr.Chris Rizos, Professor, Ph.D. (UNSW)  
Dr.Clive Frasser, Professor, Ph.D. (Wash)  
Dr.Shunji Murai, Professor, D.Eng. (Univ. of Tokyo)  
Dr.Wicha Jiwalai, Ph.D. (Ohio State U.)  
Dr.Sukit Viseshsin, D.Eng. (Univ.of Tokyo)  
Dr.Suvit Vibulsresth, D.Eng. (Univ. of Tokyo)

**COURSES DESCRIPTIONS IN SURVEY ENGINEERING (B.ENG.)****2108202 Surveying Engineering 3(2-3-4)**

Concepts of surveying and mapping; theory of measurements and errors; basic survey measurements:- distance and angle measurements, theodolite and total station, traversing and computation, vertical distance measurements:- leveling; reciprocal leveling and trigonometric leveling, contours, topographic mapping procedure:- control and topographic surveying; map accuracy; specification, profile and cross section, areas and volumes.

**2108205 Fundamental of Geomatics 3(3-0-6)**

Roles of geospatial information in society; overview of geospatial data capturing, processing, and utilizing procedures; representing the Earth digitally; modeling reality into spatial database, geospatial data model:

concept of coordinate system; mapping the Earth; Earth figure and its impact on position; map scale and accuracy of geospatial data; surveying and mapping techniques for geospatial data acquisition; applications of geospatial information technology.

**2108234 Numerical Analysis in Geomatics 3(2-3-4)**

*Condition : Prerequisite 2108233*

Numerical Techniques for Solving Set of Linear Equations; Algorithmic Solutions to Non-Linear System; Interpolation and Curve Fitting; 2-D and 3-D Coordinate Transformations; Purposes and Necessity of Coordinate Transformation, Affine Transformation, Polynomial and Rational Polynomial Transformation, Introduction to Spherical Trigonometry, Solving Direct Problem and Inverse Problem.

**2108298 Surveying 3(2-3-4)**

Introduction to surveying work; basic field works, leveling; principles and applications of theodolites and total stations; distance and direction measurements; errors in surveying, acceptable errors, data correction, triangulation; precise determination of azimuth; precise traverse; plane coordinate system, precise leveling; topographic survey; map plotting.

**2108301 Surveying with Construction Applications 3(2-3-4)**

*Condition : Prerequisite 2108202*

Alignment, grade and equipment for construction surveys, route location and design; horizontal curve; spiral curve; vertical curve; earth work, tunnel surveying, hydrographic surveying, survey project planning and management.

**2108306 Field Practice on Topographic Surveying 1(field practice)**

*Condition : Prerequisite 2108202or 2108298*

Field practices at surveying camp to complete fair drawing of planimetric and topographic maps of given areas; third order levelling and traverse; topographic detailing.

**2108307 Field Practice on Route Surveying 1(field practice)**

*Condition : Prerequisite 2108301*

Planning, scheduling, and carrying out a complete strip topographic map for feasibility study of route location; design and staking-out; earthwork computation.

**2108311 Global Geodesy 3(3-0-6)**

*Condition : Prerequisite 2108234*

Figure of the earth, geodetic datums, gravity field of the earth, reference coordinate systems, astro-geodetic method, computation on the ellipsoid, gravimetric method, satellite method.

**2108325 Geographic Information System and Applications 3(2-3-4)**

*Condition : Prerequisite 2108201*

Definition, basic principles and components of Geographic Information System (GIS); geospatial data

models : vector, raster, and surface(3D) data models; different types of data sources and data input techniques; basic geospatial data management and query; basic geospatial data analysis and manipulation; spatial analysis of discrete entities in space; spatial analysis using continuous fields; applications of Geo-Information Systems in various fields; introduction to web GIS and location-based services; quality and metadata of geospatial data; geospatial data standards.

**2108326 Geospatial Information Analysis and Visualization 3(2-3-4)**  
*Condition : Prerequisite 2108325*

Geospatial data analysis functions; spatial interpolation and surface modeling; exploratory spatial data analysis; process modeling and simulation; cartographic fundamentals; principles of graphic design; scientific visualization; animation and virtual worlds; cognitive basis of visualization; cartographic communication; cartographic symbolization and map design; map annotation and name placement; geo-spatial data generalization; web cartography.

**2108332 Adjustment Computation 3(2-3-6)**  
*Condition : Prerequisite 2108233, 2108234*

Statistical concepts; principle of propagation ; least squares adjustment methods; post adjustment analysis.

**2108342 Mathematical Cartography 3(2-3-6)**  
*Condition : Prerequisite 2108311*

Rectangular and Polar Coordinate Systems, Horizontal Datum, Geodetic Coordinate System; General Transformation Formulae, The First Gaussian Fundamental Quantities on Sphere and Plane, Differential Parallelograms; Theory of Map Projection, Computation of Distortions on Map Plane, Properties of Map Projections; Analysis of Map Projections, Scale Factor, Principal Direction, Tissot's Indicatrix, Analytical Construction of Map Projections; Conformal Projections and National Plane Coordinate System, The Importance of Conformal Projections, UTM and UPS Coordinate System, Reduction of Survey Measurements onto Plane, Georeferencing Spatial Data to National Plane Coordinate System; Reprojection and Transformation of Geo-spatial Data.

**2108371 Photogrammetry and Remote Sensing System 3(2-3-6)**  
*Condition : Prerequisite 2108202*

Concepts and basic principles of remote sensing, electromagnetic energy, sources and radiation principles, energy interaction with atmosphere and earth surface features, sensors and digital image characteristics, multispectral-thermal-hyperspectral sensing, radar imagery, Earth observation satellite, an ideal remote sensing system, characteristics of real remote sensing systems, elements of photographic systems, history of aerial photography, basic principles of photogrammetry, geometry of aerial photographs, monoscopic measurement, stereoscopic of photogrammetry, mapping with photogrammetry.

**2108372 Advanced Remote Sensing 3(2-3-6)**  
*Condition : Prerequisite 2108371*

Digital imagery, vector and raster data, Image rectification and restoration, image enhancement, contrast manipulation, multi-image manipulation, Image classification, fourier analysis for image processing, hyperspectral image analysis, radar image analysis, feature extraction, pattern recognition, colour systems, colour image processing.

**2108373 Advanced Photogrammetry 3(2-3-6)**  
*Condition : Prerequisite 2108302*

Imaging air-borne and high-resolution sensor systems, geometry on single image frame, information from stereo images, aerial triangulation, sensor modeling and its orientation, mapping and other data products from photogrammetry, applications of photogrammetric products.

**2108374 Close-range Photogrammetry 3(3-0-6)**

Introduction to close-range photogrammetry, calibration of cameras, geometric and non geometric factors of projects, accuracy and reliability, 3D models, visualization. applications of close-range photogrammetry in civil engineering, industry, architecture, archeology.

**2108408 Computer Aided Surveying and Design 3(2-3-4)**  
*Condition : Prerequisite 2108202*

Survey automation system:- field code system, triangulated irregular network, earth work; road design and civil works.

**2108411 High Precision Surveying 2(1-3-2)**  
*Condition : Prerequisite 2108311 ,2108332*

High precision Instruments:- calibration and testing, target, benchmark; Horizontal measurement methods, vertical measurement methods, 3D measurement methods, computation technique, modern surveying technology.

**2108412 Satellite Surveying 3(2-3-6)**  
*Condition : Prerequisite 2108311*

Concept of satellite positioning, global positioning systems, NAVSTAR GPS concept, errors in GPS measurements, observables in GPS, survey planning, field methods, data processing, practical applications.

**2108413 Field Practice on Precise Surveying 1(field practice)**  
*Condition : Prerequisite 2108411, 2108412*

Field practice on geodetic horizontal and vertical controls surveying, computation, photo control surveying.

**2108414 Field Practice on Digital Mapping 1(field practice)**  
*Condition : Prerequisite 2108325, 2108371*

Rectification of Satellite and Aerial Images; Various Techniques for Detail Survey and Field Data Acquisition; Map Updating; GIS Database Construction.

**2108415 Geodetic Surveying 3(2-3-4)**  
*Condition : Prerequisite 2108201, 2108301 and 2108311*

Introduction to physical geodesy, Height systems, Height from GNSS (GPS), High precision instruments:- calibration and testing, target, benchmark and geodetic control point; Datum transformation, Horizontal measurement methods, Vertical measurement methods, 3D measurement methods, computation technique on UTM.

**2108421 Modern Integrated Surveying Technology 3(2-3-4)**  
*Condition : Senior Standing*

Concepts of integrating modern surveying technologies to speed up survey: robotic theodolite, laser ranging, laser scanner, GNSS receiver, inertial surveying system, digital camera and video.

**2108436 Spatial Database 3(2-3-6)**  
*Condition : Prerequisite 2108326*

Introduction to Spatial Database; spatial concept and data model; spatial query language; simple feature for SQL; spatial storage and indexing; query processing and optimization; introduction to spatial data mining; trends in DBMS.

**2108450 Advanced GIS Techniques 3(2-3-6)**  
*Condition : Prerequisite 2108326*

Overview of GIS and spatial data base management system; review of spatial data models; GIS data management functions; data analysis modeling and functions; output presentation functions; data applications in natural resources and environmental management; applications in disaster management; applications in socio-economic and business problems; GIS development processes; GIS development in Thailand; standard and data quality; trends of future GIS technology.

**2108455 GIS Application Development 3(2-3-6)**  
*Condition : Prerequisite 2108326*

Types of GIS application; GIS application environment; software development technologies; VBA; Python; .NET; Web application development; opensource tools and software; Software customization.

**2108457 Seminar in Survey Engineering 1(1-0-2)**  
*Condition : Senior Standing*

Presentation and discussion on topics of interest in survey engineering.

**2108495 Advanced Topics in Survey Engineering I 3(3-0-6)**  
*Condition : Senior Standing or Consent of Faculty*

Topics of current interest and new developments in various fields of survey engineering.

**2108496 Advanced Topics in Survey Engineering II 3(3-0-6)**  
*Condition : Senior Standing or Consent of Faculty*

Topics of current interest and new developments in various fields of survey engineering.

**2108497 Special Problems in Survey Engineering I 3(2-3-7)**  
*Condition : Senior Standing or Consent of Faculty*

Study or investigation of special problems in survey engineering.

**2108498 Special Problems in Survey Engineering II 3(2-3-7)**  
*Condition : Senior Standing or Consent of Faculty*

Study or investigation of special problems in survey engineering.

**2108499 Survey Engineering Project 3(0-6-3)**  
*Condition : Senior Standing or Consent of Faculty*

Practice interesting project or problem in various fields of survey engineering.

#### COURSES DESCRIPTIONS IN SURVEY ENGINEERING (M.ENG., PH.D.)

**2108502 Fundamentals of Positioning and Mapping 3 (2-3-7)**

Figure of earth, geodetic datum, earth coordinate reference frame, map projection, general techniques of positioning, 2-D and 3-D coordinate transformation, measurement sampling and interpolation, position determination by modern ground-based instruments, mapping from digital satellite/aerial imagery.

**2108511 Numerical Techniques in Geomatics 3 (2-3-7)**

Overview of matrix and linear systems, solutions of non-linear systems, overdetermined system, functional and stochastic model, measurement error and error propagation, statistical analysis of observation and parameters.

**2108512 Adjustment Computation in Geomatics 3 (2-3-7)**

Review of statistical concepts and linear algebra; principle of covariance propagation; non-linearity, linearization and iteration procedure; math models for least-squares adjustment computation; unified least-squares adjustment; statistical analysis of adjustment results; reliability of networks; data snooping and blunder detection.

**2108513 Geodesy and Geodetic Methods 3(3-0-9)**

Earth's gravity field; geoid, reference ellipsoid and geodetic datum; geodetic survey, astronomic observations; direction, distance and calculation on the ellipsoid; geodetic height and elevation; satellite orbit, positioning.

**2108516 Engineering Geodesy 3 (2-3-7)**

*Condition : Senior Standing*

The course build on student active participation by integration of theory and practice. The main objective is to demonstrate how four different geomatic technologies (Global Navigation Satellite System, Total Station, Digital Levelling and Terrestrial Laser Scanning) may be integrated to resemble the technical measurement design and precise positioning production in engineering projects. The course does not teach details of any of the above-mentioned technologies but rather how to use them in an integrated approach.

**2108532 Satellite Surveying and Modern Techniques 3 (2-3-7)**

Satellite datum, coordinate systems, concept of satellite positioning, global positioning system, observable in GPS, errors in GPS measurements, survey planning, field procedures, data processing, principle of inertial navigation system (INS), practical applications of GPS, principles of electronics, electronic surveying systems and basic components, geometry of electronic surveying, instrumentation and modern surveying technology.

**2108533 Remote Sensing of Environment 3(3-0-6)**

*Condition : Senior Standing*

Remote Sensing of Environment brings the student through recent publication on theory, science, applications and technology of remote sensing of earth resources and environment.

**2108534 Microwave Remote Sensing 3(3-0-6)**

*Condition : Senior Standing*

Fundamental of microwave, microwave and human health, microwave in remote sensing, SLAR, SAR, InSAR, Lidar, basic SAR data processing, basic Lidar processing, SAR and Lidar applications and case studies.

**2108536 Spatial Database 3(3-0-6)**

*Condition : Senior Standing*

Introduction to Spatial Database; spatial concept and data model; spatial query language; simple feature for SQL; spatial storage and spattial indexing; query processing and optimization; introduction to spatial data mining; trends in DBMS.

**2108556 Online Spatial Information Technology 3 (2-3-7)**

*Condition : Senior Standing*

Introduction to GIS, and internet GIS, fundamental of computer networking, client/server computing, technology evolution of web GIS, DHTML, standards for distributed geospatial services (ISO & OGC), XML, GML and SVG, mobile GIS, case studies and web GIS applications.

**2108557 Spatial Data Structure and Models 3 (3-0-9)**

Conceptual model of space: entities & fields; vector data model, raster data model; data organization in raster: chain, block, run length, quadrees, binary; data organization in vector: point, line, network, polygon, topology; comparisons of vector and raster data; database

structure; file and data access; hierarchical structure; network structure, relational structure, object-oriented structure; introduction to geo-spatial relational database system, graph theory; optimal path.

**2108558 Spatial Data Handling and Analysis 3 (2-3-7)**

Data capture technique, coordinate systems, data quality; intersections of lines and curves, calculation of length and area, coordinate adjustment, geometric searching; range searching; proximity searching; buffering; rubber sheeting, edge matching, image warping, conflation, feature editing; feature alignment; generalization; densification; topology reconstruction; surface modeling; viewsheds; intervisibility; contouring; linear referencing, mapping accuracy standard and determination method.

**2108559 Geospatial Database and OpenGIS 3 (2-3-7)**

Introduction to relational database management system (RDBMS), Data Model: Entity Relationship Model, Normalization of Database Tables, Introduction to Structured Query Language(SQL), Data Types, SQL Commands, Function and Operation, OGC/ISO Simple Feature (SF), OGC SF Object and Structure, Spatial Database and Table, Simple Feature Access using SQL/SF and SQL for Multimedia (SQL/MM), attribute and spatial querying, OpenGIS Functions, Procedural Language / Structure Query Language (PL/SQL), database optimization and spatial indexing, interface to geospatial RDBMS via web-based applications, Roles of geo-spatial RDBMS in information services and Open Geospatial Information System

**2108560 Advanced Map Design and Prototyping 3(2-3-7)**

*Condition : Senior Standing*

Introduction to various types of maps focusing on user-centered design, including generating new ideas, system analysis, user requirement analysis, prototyping, evaluation and improving; interaction design principle; the effects of interactive functions to map design principle; map prototyping methods, including drawing and using software.

**2108592 Seminar in Geoinformatic Technology 3(3-0-9)**

Case studies in geoinformation technology, special lectures on advanced/emerging geoinformation technology, experimental design, research topic development.

**2108601 Advanced Adjustment Computation 3 (2-3-7)**

Sequential least-squares adjustment; Helmert-Wolf blocking; generalized inverse matrices; Kalman filter for geomatics; approximation, interpolation and prediction; least-squares collocation.

**2108627 Geomage Processing 3 (2-3-7)**

Concepts of digital image: air borne, space borne; electromagnetic wave; optical and microwave sensor; digital image processing; classification; image coordinate and photo coordinate; sensor orientation;

Stereo-photogrammetry; photogrammetric triangulation; orthorectification, mosaic, photo map production.

**2108628 Radar Remote Sensing 3 (2-3-7)**

Characteristics of Microwave, Microwave Interaction with Atmosphere and Target, Radar Equation and Radar Cross Section, Principles of Imaging Radar, Measureable Phase/Amplitude/Polarization in Radar Imagery, Geometric and Radiometric Properties of Radar Imagery, Synthetic Aperture Radar, Airborne/Spaceborne SAR Systems, Interferometric SAR, Processing Stages in Interferogram Generation, Differential Interferometric SAR, InSAR/DInSAR as Measurement Tools, Geodetic and Geophysical Applications of InSAR/DInSAR, Polarimetric SAR, Classification/Analysis of Polarimetric SAR, Landuse/Landcover Mapping Applications using Polarimetric SAR.

**2108629 Advanced Geoimage Processing and Applications 3 (2-3-7)**

Digital photogrammetry, digital photogrammetric workstation and workflow, digital sensor types: line, area/frame and TDI/staggered CCD, sensor models and sensor orientation, airborne digital camera systems, mapping from space, Digital Elevation Model (DEM), light detection and ranging (Lidar), high-resolution satellite imageries, high-resolution satellite imageries processing, relief displacement, orthorectification, geo-image compression, tile and pyramid image structure, oblique photogrammetry and 3-D geoinformation system, orthophoto service and mash-up mapping, tile-caching management service, acquisition of panorama view and information service.

**2108632 Advanced GNSS Surveying 3 (2-3-7)**

GPS system, coordinate and reference systems, GPS observations and equations, GPS error mitigation techniques, computation of GPS satellite positions, principles of least-squares estimation, mathematical models for GPS positioning, standard format of GPS data, GPS data processing by least-squares method, interpretation of baseline results, GPS network adjustment, quality control for GPS surveying, GPS heighting, trends and applications in GNSS technology.

**2108502 Fundamentals of Positioning and Mapping 3 (2-3-7)**

Figure of earth, geodetic datum, earth coordinate reference frame, map projection, general techniques of positioning, 2-D and 3-D coordinate transformation, measurement sampling and interpolation, position determination by modern ground-based instruments, mapping from digital satellite/aerial imagery.

**2108511 Geodetic Astronomy 3(2-3-7)**

Precise determination of time, astronomic latitude, longitude and azimuth.

**2108512 Physical Geodesy 3(3-0-9)**

The gravity and its potential; the disturbing potential and its representation; Applications and current methods.

**2108513 Geodesy and Geodetic Methods 3 (3-0-9)**

Earth's gravity field; geoid, reference ellipsoid and geodetic datum; geodetic survey, astronomic observations; direction, distance and calculation on the ellipsoid; geodetic height and elevation; satellite orbit, positioning.

**2108514 Mathematical Projections in Geodesy 3(3-0-9)**

Use of analytic functions; representation of the ellipsoid on a sphere; geometry of the projected geodesic; mercator, transverse mercator, bolique mercator, conformal conic projections.

**2108515 Introduction to Advance Geodetic Surveying 3(3-0-9)**

Geometry of reference ellipsoid; triangulations and trilaterations, Traverses and levelling for major geodetic control; position determination of points by geometric, gravimetric and astronomical methods.

**2108521 Aerial Triangulation 3(1-6-5)**

Ground control points; aeropolygon aerial triangulation, graphical and numerical strip adjustment and independent model aerial triangulation.

**2108522 Analytical Photogrammetry 3(2-3-7)**

Comparator, measurement of plate coordinates; transformation of plate coordinates and corrections; relative and absolute orientations; computation of ground coordinates from plate coordinates.

**2108523 Terrestrial and Close-Range Photogrammetry 2(1-3-4)**

Introduction ; terrestrial and closed-range cameras and their orientations; geometry of photographs ; control surveys ; graphical and analytical determination of horizontal and vertical positions of point; parallax equations; space coordinates of point by direction cosines.

**2108532 Satellite Surveying and Modern Techniques 3 (2-3-7)**

Satellite datum, coordinate systems, concept of satellite positioning, Global Positioning System (GPS), observable in GPS, errors in GPS measurements, survey planning, field procedures, data processing, principles of inertial navigation system (INS), practical applications of GPS, principles of electronics, electronic surveying systems and basic components, geometry of electronic surveying, instrumentation and modern surveying technology.

**2108551 Spatial Data Structures and Algorithms 2(2-0-6)**

n-depth examination of geographic information system components; representation of spatial data; storage and retrieval techniques; algorithms for spatial data manipulation and analysis ; aster/vector conversion algorithms; advanced spatial data models; user interface; knowledge-based system.



**2108552 GIS Design and Evaluation 2(2-0-6)**  
 Nature of design ; feasibility studies & requirements analysis ; software engineering techniques; detailed system design; program design & implementation; design of spatial database; system selection.

**2108556 Online Spatial Information Technology 3(2-3-7)**  
*Prerequisite : 2108352 or 2108453 or 2108460*

Introduction to GIS; introduction to Internet GIS; fundamental of computer networking, client/server computing, technology evolutions of web GIS; standards for distributed geospatial services (ISO & OGC), GML and SVG, Mobile GIS; case studies and web GIS applications.

**2108557 Spatial Data Structure and Models 2(3-0-9)**  
 Conceptual models of space: entities and fields; vector data model, raster data model; data organization in raster: chain, block, run length, quadtrees, binary; data organization in vector: point, line, network, polygon, topology; comparisons of vector and raster data; database structure; file and data access; hierarchical structure; network structure, relational structure, object-oriented structure; graph theory; optimal path.

**2108558 Spatial Data Handling and Analysis 2(2-3-7)**  
 Data capture techniques, coordinate systems, data quality; intersections of lines and curves, calculation of length and area, coordinate adjustment, geometric searching; range searching; proximity searching; buffering; rubber sheeting, edge matching, image warping, conflation, feature editing; feature alignment; generalization; densification; topology reconstruction; surface modeling; viewsheds; intervisibility; contouring.

**2108559 Geospatial Database and OpenGIS 3 (2-3-7)**  
 Introduction to relational database management system (RDBMS), data model: Entity Relationship model, normalization of database tables, Structured Query Language (SQL), data types, SQL commands, function and operation, OGC/ISO Simple Feature (SF), OGC SF object and structure, spatial database and table, Simple Feature Access using SQL/SF and SQL for multimedia (SQL/MM), attribute and spatial querying, OpenGIS functions, Procedural Language / Structure Query Language (PL/SQL), database optimization and spatial indexing, interface to geospatial RDBMS via web-based applications, roles of geospatial RDBMS in information services and open geospatial information system

**2108592 Seminar in Geoinformatic Technology 2(2-3-7)**  
 Advanced and emerging geoinformation technology; case studies; experimental design, research topic development.

**2108601 Advanced Adjustment Computation 3(3-0-9)**  
*Prerequisite :2108331 or Consent of Faculty*  
 Generalized minimum variance solution for hybrid measuring systems, constraints, statistical tests, empirical fitting of polynomials, correlations, inner adjustment, multivariate statistical analysis, advanced least squares, generalized matrices in adjustment.

**2108604 System Engineering and Management for Survey Engineer 3(3-0-9)**  
 A study of methodologies and processes of system engineering. A discipline concerned with the planning, organization and management of programs for designing and operating systems. Application of systems engineering to surveying projects.

**2108606 Development Planning Survey 3(3-0-9)**  
 Function of surveyor in a multidisciplinary investigations for development planning; the concepts and working methods in related disciplines, their possibilities and limitations; interdisciplinary execution of surveys and for the presentation of collected data.

**2108621 Analog Photogrammetry 3(2-3-7)**  
 Theory of orientation, method and accuracy; review of various plotting instruments; testing of instrument; rectification and orthophotography.

**2108622 Metric Photography 2(1-3-4)**  
 Properties, design and calibration of various photogrammetric cameras; physical characteristics and quality control of photography; navigation and auxiliary devices; image evaluation.

**2108623 Photogrammetry in Practice 3(3-0-9)**  
*Prerequisite : 2108621 and 2108625*  
 Photogrammetric planning; digital terrain model; applications to various fields, e.g. cadastral survey, highway planning and design, damsite study, architecture, museum and monument preservations, biostereometric and medicine, etc.

**2108624 Advanced Analytical Photogrammetry 3(2-3-7)**  
 Systematic errors, system calibration and self-calibration, analytical strip and block triangulation with and without auxiliary data, constraints, structure and solution of the normal matrix. Reseau photography and specialized comparator techniques.

**2108625 Remote Sensing I 3(3-0-9)**  
 A study on theory, instrumentation, and techniques employed in remote sensing.

**2108626 Remote Sensing II 3(2-3-7)**  
*Prerequisite : 2108625 and Consent of Faculty*  
 Applications and interpretation of remote sensing data, in general and in particular. An indepth study of an application chosen by individual participant.

**2108627 Geoimage Processing 3 (2-3-7)**  
 Concepts of digital image: air borne, space borne; electromagnetic wave; optical and microwave sensor; digital image processing; classification; image coordinate and photo coordinate; sensor orientation; stereo-photogrammetry; photogrammetric triangulation; orthorectification.

**2108628 Radar Remote Sensing 3 (2-3-7)**  
 Characteristics of microwave, microwave interaction with atmosphere and target, radar equation and radar cross section, principles of imaging radar, measurable phase/amplitude/polarization in radar imagery, geometric and radiometric properties of radar imagery, synthetic aperture radar, airborne/spaceborne SAR systems, interferometric SAR, processing stages in interferogram generation, differential interferometric SAR, InSAR/DInSAR as measurement tools, geodetic and geophysical applications of InSAR/DInSAR, polarimetric SAR, classification/analysis of polarimetric SAR, landuse/landcover mapping applications using polarimetric SAR.

**2108629 Advanced Geoimage Processing 3(2-3-7)**  
 Special problems to be carried out under staff direction. Digital photogrammetry, digital photogrammetric workstation and workflow, digital sensor types: line, area/frame and TDI/staggered CCD, sensor models and sensor orientation, airborne digital camera systems, mapping from space, digital elevation model (DEM), light detection and ranging (Lidar), high-resolution satellites imageries, high-resolution satellite imageries processing, relief displacement, orthorectification, geo-image compression, tile and pyramid image structure, oblique photogrammetry and 3-D geoinformation system, orthophoto service and mash-up mapping, tile-caching management service, acquisition of panorama view, data collection and information service.

**2108632 Advanced GNSS Surveying 3(2-3-7)**  
 GPS system, coordinate and reference systems, GPS observations and equations, GPS error mitigation techniques, computation of GPS satellite positions, principles of least-squares estimation, mathematical models for GPS positioning, standard format of GPS data, GPS data processing by least-squares method, interpretation of baseline results, GPS network adjustment, quality control for GPS surveying, GPS heighting, trends and applications of GNSS technology.

**2108691 Special Studies 3(2-3-7)**  
 Special problems to be carried out under staff direction.

**2108790 Seminar in Geomatic Engineering I 3(0-9-3)**  
 Review of and discussion on special topics related to problems and progress in Geomatic engineering.

**2108791 Seminar in Geomatic Engineering II 3(0-9-3)**  
*Condition : PRER 2108790*

Discussion on special topics related to progress in Geomatic engineering; analysis of related data, conclusion, data presentation and report of findings.

**2108792 Seminar in Geomatic Engineering III 3(0-9-3)**  
*Prerequisite : 2108791*

Discussion on special topics related to progress in Geomatic engineering concerning research projects; analysis of related data, conclusion, data presentation and report of findings.

**2108811 Thesis 12 credits**

**2108828 Dissertation 48(0-0-0)**  
*(S/U)(1/2548)*

**2108894 Doctoral Dissertation Seminar 0(0-0-0)**  
*(S/U)(1/2548)*

**COURSE DESCRIPTIONS IN SPATIAL INFORMATION SYSTEM (M.SC.)**

**2108501 Fundamentals of Surveying and Mapping 3(2-3-7)**  
 Shape of earth; reference ellipsoids; positioning on earth surface; map projections; scale and distortion; 2-D and 3-D coordinate transformation; model of measurements; error and error propagation; Mapping and map updating techniques.

**2108502 Fundamentals of Positioning and Mapping 3 (2-3-7)**  
 Figure of earth, geodetic datum, earth coordinate reference frame, map projection, general techniques of positioning, 2-D and 3-D coordinate transformation, measurement sampling and interpolation, position determination by modern ground-based instruments, mapping from digital satellite/aerial imagery.

**2108511 Numerical Techniques in Geomatics 3 (2-3-7)**  
 Overview of matrix and linear systems, solutions of non-linear systems, overdetermined system, functional and stochastic model, measurement error and error propagation, statistical analysis of observation and parameters.

**2108512 Adjustment Computation in Geomatics 3 (2-3-7)**  
 Review of statistical concepts and linear algebra; principle of covariance propagation; non-linearity, linearization and iteration procedure; math models for least-squares adjustment computation; unified least-squares adjustment; statistical analysis of adjustment results; reliability of networks; data snooping and blunder detection.

**2108513 Geodesy and Geodetic Methods 3 (3-0-9)**  
 Earth's gravity field; geoid, reference ellipsoid and geodetic datum; geodetic survey, astronomic observations; direction, distance and calculation on the ellipsoid; geodetic height and elevation; satellite orbit, positioning.

**2108524 Analysis of Aerial and Satellite Imageries** 3(2-3-7)  
 Operations on image, point operations, local operations, geometric operations; image segmentation by clustering, thresholding, spectral classification, spatial classification, edge detection; iterative segmentation by probabilistic relaxation, fuzzy relaxation.

**2108531 GPS Satellite Surveying** 3(2-3-7)  
*Condition : PRER 2108501 or C.F.*  
 Fundamental of satellite orbit motion; global positioning system; GPS observables and errors; surveying method; data processing; applications in Thailand.

**2108541 Computer Assisted Cartography** 3(2-3-7)  
*Condition : PRER 2108501 or C.F.*  
 Development, production and application of computer-assisted mapmaking ; survey of computer cartography terms , concepts and equipment; conceptual and development aspects of computer-produced maps; digitizing; coordinate data structures; spatial databases; computer map design; turnkey cartographic systems; computer map production.

**2108553 Spatial Data Model** 3(3-0-9)  
 Vector data model, vector data organization, spaghetti model, topological models; raster data model, representation of raster data, runs, binary trees, blocks, quadtrees, borders; comparisons of vector and raster data model; conversion between raster and vector data.

**2108554 Spatial Data Handling** 3(2-3-7)  
 Data capture techniques; coordinate systems; intersections of lines and curves; calculation of length and area; coordinate adjustment; rubber sheeting; edge matching; image warping; conflation; feature editing; feature alignment; generalization; densification; topology reconstruction; surface modeling; viewsheds; intervisibility; contouring.

**2108532 Satellite Surveying and Modern Techniques** 3 (2-3-7)  
 Satellite datum, coordinate systems, concept of satellite positioning, global positioning system, observable in GPS, errors in GPS measurements, survey planning, field procedures, data processing, principle of inertial navigation system (INS), practical applications of GPS, principles of electronics, electronic surveying systems and basic components, geometry of electronic surveying, instrumentation and modern surveying technology.

**2108556 Online Spatial Information Technology** 3 (2-3-7)  
 Introduction to GIS, Introduction to Internet GIS, Fundamental of Computer Networking, Client/Server Computing, Technology Evolutions of Web GIS, DHTML, Standards for Distributed Geospatial Services (ISO & OGC), XML, GML and SVG, Mobile GIS, Case Studies and WebGIS Applications.

**2108557 Spatial Data Structure and Models** 3(3-0-9)  
 Conceptual model of space: entities & fields; vector data model, raster data model; data organization in raster: chain, block, run length, quadtrees, binary; data organization in vector: point, line, network, polygon, topology; comparisons of vector and raster data; database structure; file and data access; hierarchical structure; network structure, relational structure, object-oriented structure; introduction to geo-spatial relational database system, graph theory; optimal path.

**2108558 Spatial Data Handling and Analysis** 3(2-3-7)  
 Data capture technique, coordinate systems, data quality; intersections of lines and curves, calculation of length and area, coordinate adjustment, geometric searching; range searching; proximity searching; buffering; rubber sheeting, edge matching, image warping, conflation, feature editing; feature alignment; generalization; densification; topology reconstruction; surface modeling; viewsheds; intervisibility; contouring; linear referencing, mapping accuracy standard and determination method.

**2108559 Geospatial Database and OpenGIS** 3(2-3-7)  
 Introduction to relational database management system (RDBMS), Data Model: Entity Relationship Model, Normalization of Database Tables, Introduction to Structured Query Language(SQL), Data Types, SQL Commands, Function and Operation, OGC/ISO Simple Feature (SF), OGC SF Object and Structure, Spatial Database and Table, Simple Feature Access using SQL/SF and SQL for Multimedia (SQL/MM), attribute and spatial querying, OpenGIS Functions, Procedural Language / Structure Query Language (PL/SQL), database optimization and spatial indexing, interface to geospatial RDBMS via web-based applications, Roles of geo-spatial RDBMS in information services and Open Geospatial Information System

**2108592 Seminar in Geoinformatic Technology** 3(3-0-9)  
 Case studies in geoinformation technology, special lectures on advanced/emerging geoinformation technology, experimental design, research topic development.

**2108601 Advanced Adjustment Computation** 3(2-3-7)  
 Sequential least-squares adjustment; Helmert-Wolf blocking; generalized inverse matrices; Kalman filter for geomatics; approximation, interpolation and prediction; least-squares collocation.

**2108627 Geoimage Processing** 3(2-3-7)  
 Concepts of digital image: air borne, space borne; electromagnetic wave; optical and microwave sensor; digital image processing; classification; image coordinate and photo coordinate; sensor orientation; Stereo-photogrammetry; photogrammetric triangulation; orthorectification, mosaic, photo map production.

- 2108628 Radar Remote Sensing 3(2-3-7)**  
 Characteristics of Microwave, Microwave Interaction with Atmosphere and Target, Radar Equation and Radar Cross Section, Principles of Imaging Radar, Measurable Phase/Amplitude/Polarization in Radar Imagery, Geometric and Radiometric Properties of Radar Imagery, Synthetic Aperture Radar, Airborne/Spaceborne SAR Systems, Interferometric SAR, Processing Stages in Interferogram Generation, Differential Interferometric SAR, InSAR/DInSAR as Measurement Tools, Geodetic and Geophysical Applications of InSAR/DInSAR, Polarimetric SAR, Classification/Analysis of Polarimetric SAR, Landuse/Landcover Mapping Applications using Polarimetric SAR.
- 2108629 Advanced Geomage Processing and Applications 3 (2-3-7)**  
 Digital photogrammetry, digital photogrammetric workstation and workflow, digital sensor types: line, area/frame and TDI/staggered CCD, sensor models and sensor orientation, airborne digital camera systems, mapping from space, Digital Elevation Model (DEM), light detection and ranging (Lidar), high-resolution satellite imageries, high-resolution satellite imageries processing, relief displacement, orthorectification, geo-image compression, tile and pyramid image structure, oblique photogrammetry and 3-D geoinformation system, orthophoto service and mash-up mapping, tile-caching management service, acquisition of panorama view and information service
- 2108632 Advanced GNSS Surveying 3 (2-3-7)**  
 GPS system, coordinate and reference systems, GPS observations and equations, GPS error mitigation techniques, computation of GPS satellite positions, principles of least-squares estimation, mathematical models for GPS positioning, standard format of GPS data, GPS data processing by least-squares method, interpretation of baseline results, GPS network adjustment, quality control for GPS surveying, GPS heighting, trends and applications in GNSS technology.
- 2108555 Spatial Analysis 3(3-0-9)**  
 Data quality; measures of dispersion; measures of arrangements; geometric searching; range searching; proximity searching; buffer generation; polygon overlays; spanning trees and graph traversal; shortest part routing.
- 2108591 Seminar in AM/FM/GIS 3(3-0-9)**  
 Group discussion, special lectures on various topics, research paper, presentation of research paper, site visits.
- 2108623 Photogrammetry in Practice 3(3-0-9)**  
 Photogrammetric planning; digital terrain model; applications to various fields, e.g. cadastral survey, highway planning and design, damsite study, architecture, museum and monument preservations, biostereometric and medicine, etc.
- 2108625 Remote Sensing I 3(3-0-9)**  
 A study on theory, instrumentation, and techniques employed in remote sensing
- 2108626 Remote Sensing II 3(2-3-7)**  
*Condition : PRER 2108625 or C.F.*  
 Applications and interpretation of remote sensing data, in general and in particular. An indepth study of an application chosen by individual participant.
- 2108631 Advanced GPS Satellite Surveying 3(2-3-7)**  
*Condition : Prerequisite : 2108531*  
 GPS system; coordinate and reference systems, computation of GPS satellite position; GPS observations and equations; principles of least-squares estimation; mathematical models for GPS positioning; standard format of GPS data; GPS error mitigation techniques; GPS data processing by least-squares method; interpretation of baseline results; GPS network adjustment; quality control for GPS surveying; GPS heighting; trends and applications of GNSS technology.
- 2108651 Implementation of Spatial Information System 3(3-0-9)**  
*Condition : Prerequisite 2108501 and 2108553 or C.F.*  
 Components of a spatial information system; roles of spatial information system; development cycle of spatial information system; characteristics of GIS software; applications of spatial information system; investment issues; data warehousing; data standard; copyright issues; trend and future of spatial technology.
- 2108671 Geoinformation Technologies for Infrastructure Development 3(3-0-9)**  
 Overview of geoinformation technologies for infrastructure planning construction, monitoring and maintenance; coordinate system and map projection; GPS and GNSS, mapping by remote sensing and photogrammetry techniques; GIS technologies for infrastructure project planning and management; emerging geoinformation technologies for infrastructure development.
- 2108691 Special Studies 3(2-3-7)**  
 Special problems to be carried out under staff direction.
- 2108790 Seminar in Geomatic Engineering I 3(0-9-3)**  
 Review of and discussion on special topics related to problems and progress in Geomatic engineering.
- 2108791 Seminar in Geomatic Engineering II 3(0-9-3)**  
 Discussion on special topics related to progress in Geomatic engineering; analysis of related data, conclusion, data presentation and report of findings.
- 2108792 Seminar in Geomatic Engineering III 3(0-9-3)**
- 2108828 Dissertation 48 Credits**

2108894	Doctoral Dissertation Seminar	
2108897	Qualifying Exam	S/U
2108811	Thesis	12 Credits