KINGDOM OF SAUDI ARABIA
Technical and Vocational Training Corporation
General Directorate of Curricula

المملكة العربية السعودية
المؤسسة العامة للتدريب التقني والمهني
الإدارة العامة للمناهج

نسخة أولية

الخطط التدريبية للكليات التقنية
Training Plans for Technical Colleges

Curriculum for Department of Surveying and Geomatics Engineering

الخطة التدريبية في قسم هندسة المساحة والجيوماتيكا

Major — **تخصص**

Surveying — **المساحة**

A Bachelor's Degree

Semesters
1439H - 2017

Index

Program Description

This program of Geometrics Surveying is designed so as to meet the training needs of the local labor market, following professional International standards set for Surveying Engineering Technology.

Training in this program includes general skills in English, physics, statistical methods, mathematics and professional ethics, methods of human communication, interaction skills, project management, Quality management and leadership.

It also includes training on computer programing as well as specialized skills in the field of Geometrics, such as: Geodesy, theory of errors and adjustment, map projections and making, advance topics in GIS, spatial databases, mine surveying, hydrographic surveying, and surveying applications by computer software, remote sensing and digital photogrammetry.

In this training program the trainees spend (1616) training hours in college.

The graduates of this program will be given a bachelor degree in “Surveying”. Graduates of this program must demonstrate:

1- The ability to analyze, design, and implement surveying projects, GIS data, and remote sensing applications .

2- The ability to apply project management techniques to surveying projects.

3- The ability to utilize statistics/probability, transforms methods, discrete mathematics, or applied differential equations in handling with surveying process.

The Theoretical and Practical Tests and Graduation Projects Determine Learning Outcomes and Trainee Levels for each program.

The training courses contain a theoretical part and a practical part. The practical part is tested as a practical test and the theoretical part is a theoretical test with different evaluation methods

The Bachelor Degree Graduate gets the seventh level in the Saudi Arabian Qualifications Framework (SAQF).

Admission Requirements: The applicant must have a diploma in Surveying.

Study Plan

Sixth Semester								
No.	Course Code	Course Name	Pre. req	No. of Units				
				CRH	L	P	T	CTH
1	MATH 301	Mathematics (1)		3	2	2	0	4
2	PHYS 301	Physics		3	2	2	0	4
3	ENGL 301	English Language (1)		3	3	0	1	4
4	ICMT 402	Computer Programming		3	2	2	0	4
5	SSRV 311	Geodesy		3	2	2	0	4
Total				15	11	8	1	20

CRH:Credit Hours **L**:Lecture **P**:Practical **T**:Tutorial **CTH**:Contact Hours

Seventh Semester								
No.	Course Code	Course Name	Pre. req	No. of Units				
				CRH	L	P	T	CTH
1	STAT 303	Statistics and Probability		3	3	0	1	4
2	MATH 302	Mathematics (2)	MATH301	3	2	2	0	4
3	ENGL302	English Language (2)	ENGL301	3	3	0	1	4
4	SSRV 352	Digital Image Processing		3	2	2	0	4
5	SSRV 321	Map Making & Projections		2	2	0	0	2
6	SSRV 432	Computer Survey Applications		2	0	4	0	4
Total				16	12	8	2	22

CRH:Credit Hours **L**:Lecture **P**:Practical **T**:Tutorial **CTH**:Contact Hours

Eighth Semester								
No.	Course Code	Course Name	Pre. req	No. of Units				
				CRH	L	P	T	CTH
1	SSRV 443	Spatial Databases		3	2	2	0	4
2	SSRV 472	Theory of Errors & Observation Adjustment	STAT303	2	2	0	2	4
3	SSRV 462	Indoor Positioning Technology		3	2	2	0	4
4	SSRV 433	Point Cloud Science		3	2	2	0	4
5	SSRV 361	Remote Sensing	SSRV 352	3	2	2	0	4
Total				14	10	8	2	20

CRH:Credit Hours **L**:Lecture **P**:Practical **T**:Tutorial **CTH**:Contact Hours

Ninth Semester									
No.	Course Code	Course Name	Pre. req	No. of Units				
				CRH	L	P	T	CTH
1	SSRV 341	Geographic Information Analysis	STAT 303	3	2	2	0	4
2	GNRL 402	Engineering Project Management		3	3	0	0	3
3	CCIV 461	Highway Engineering		3	2	2	0	4
4	SSRV 490	Project (1)		2	0	4	0	4
5	SSRV	Elective (1)		3	2	2	0	4
Total				14	9	10	0	19
CRH:Credit Hours **L**:Lecture **P**:Practical **T**:Tutorial **CTH**:Contact Hours								

Tenth Semester									
No.	Course Code	Course Name	Pre. req	No. of Units				
				CRH	L	P	T	CTH
1	SSRV 421	Distributed Geographic Information Systems		3	2	2	0	4
2	SSRV 451	Digital Photogrammetry	SSRV 352	3	2	2	0	4
3	SSRV 453	Hydrographic Surveying		3	2	2	0	4
4	SSRV492	Project(2)	SSRV 490	2	0	4	0	4
5	SSRV	Elective (2)		3	2	2	0	4
Total				14	8	12	0	20
CRH:Credit Hours **L**:Lecture **P**:Practical **T**:Tutorial **CTH**:Contact Hours								

Total Number of Semesters Credit Units	CRH	L	P	T	CTH
	73	50	46	5	101
Total of training Hours 16 * 101	1616				

Elective Courses

Elective courses(1)								
No.	Course Code	Course Name	Pre. req	No. of Units				
				CRH	L	P	T	CTH
1	**SSRV** 434	Web Technology		3	2	2	0	4
2	**SSRV** 481	Disaster Management		3	2	2	0	4
3	**SSRV** 454	Underground Surveying		3	2	2	0	4
CRH:Credit Hours **L**:Lecture **P**:Practical **T**:Tutorial **CTH**:Contact Hours								

Elective courses(2)								
No.	Course Code	Course Name	Pre. req	No. of Units				
				CRH	L	P	T	CTH
1	**SSRV** 482	Land Law and Registration		3	2	2	0	4
2	**SSRV** 455	Advanced Photogrammetry		3	2	2	0	4
3	**SSRV**422	Coordinate Transformations		3	2	2	0	4
CRH:Credit Hours **L**:Lecture **P**:Practical **T**:Tutorial **CTH**:Contact Hours								

Brief Description

Course Name	Geodesy	Course Code	SSRV 311	Credit Hours	3
Description	This course is designed in order to provide students with knowledge and skills of applying principles, instrumentation, data analysis methods, and visualization products associated with the science of geodesy which is concerned with the study of the shape and size of the earth in the geometric sense as well as with the form of the equipotential surfaces of the gravity potential.				

Course Name	Map Making & Projections	Course Code	SSRV 321	Credit Hours	2
Description	The Map Making course is designed since it is the art, science and engineering of map making, and it has been one of the fundamental components in the geospatial technology. This course provides in-depth discussions on the cartographic theories, principles and process of designing and making maps for visualizing spatial information. It will introduce how to practically make different kinds of maps by integrating theoretical understanding with mapping practice using latest version of ArcGIS software. All major thematic maps will be studied in the classroom and practiced in the computer lab. In addition, every student will be expected to do a mapping project as the final class project.				

Course Name	Geographic Information Analysis	Course Code	SSRV 341	Credit Hours	3
Description	This course covers techniques for the statistical analysis of spatial data. The course covers issues in characterizing spatial data, methods and problems in spatial data sampling, techniques for visualizing, exploring and modeling spatial data.				

Course Name	Hydrographic Surveying	Course Code	SSRV453	Credit Hours	3
Description	This course is designed in order to provide students with knowledge and skills of Hydrographic Surveying witch focus on measurement of the depth and bottom configuration of water bodies and the features which affect maritime navigation. At the end of the course, the students will be able to (1) gain adequate insight into theoretical aspects of hydrographic surveying (2) use the data to update nautical charts and develop hydrographic models; increasingly, the hydrographic data is used for multiple purposes, through the Integrated Ocean and Coast Mapping program.				

Course Name	Spatial Databases	Course Code	SSRV 443	Credit Hours	3
Description	This course covers basic concepts of a Spatial Database, including understanding what schemas and views are. Topics will cover also spatial data modeling, query language indexes and access methods.				

Course Name	Remote Sensing	Course Code	SSRV 361	Credit Hours	3
Description	The course aims to cover the fundamental physical and technical concepts and applications of remote sensing for the Environment. The course will have a lecture/labs format with emphasis on interpretation of satellite data.				

Course Name	Digital Photogrammetry	Course Code	SSRV 451	Credit Hours	3
Description	This Course is the second part of photogrammetry topics. This course aims at providing trainee with essential and basic skills to deal with digital aerial photographs, and digital photogrammetry systems for drawing digital survey maps form digital aerial stereographs, and forming digital terrain models (DTMs). In this course, trainee practices and operates digital photogrammetry computer software and will use it to perform different photogrammetry operations which includes; inner orientation, relative orientation, absolute orientation, aerial triangulation, establish digital survey maps, and form digital terrain models.				

Course Name	Computer Survey Applications	Course Code	SSRV 432	Credit Hours	2
Description	This course aims at providing trainee chance to practice and gain more skills through performing some projects using computer programs to draw cadastral and contour maps and print them with different scales. Also use computer programs to construct longitudinal and cross section from contour map and extract the cut and fill volumes. Also use computer programs to level piece of compute quantities considering designed level is horizontal and with certain slope.				

Course Name	Highway Engineering	Course Code	SSRV 461	Credit Hours	3
Description	The course is presented in two strands. The first strand is concerned with the fundamentals of highway and pavement engineering. It introduces the design process of roads and intersections, including horizontal and vertical alignment design, cross-sections and earthworks. The second half of this strand deals with pavement design and evaluation. Topics include pavement composition, pavement materials, asphalt mix design, the pavement thickness design, and defects in Flexible pavements and failures in rigid pavements. The second strand is presents briefly bridges classification and construction methods.				

Course Name	Theory of Errors & Observation Adjustment	Course Code	CSRV 472	Credit Hours	2
Description	This course is designed for the purpose of examining the nature of measurements, statistical analysis of random errors in measurements, propagation of errors, survey standards and design specifications, development of coordinate geometry and trigonometric solutions of plane surveying problems, analysis of errors and mistakes in indirect measurement.				

Course Name	Distributed Geographic Information Systems	Course Code	SSRV 421	Credit Hours	3
Description	This course will describe new services, which become widely distributed through world today such as Distributed GIS, Web Mapping, and Location Based Services.				

Course Name	Digital Photogrammetry	Course Code	SSRV 451	Credit Hours	3
Description	The course will be designed to address remote digital image acquisition systems, format of digital data, image processing for radiometric and geometric corrections, geo-referencing and registration, image enhancement techniques (including PCT and FT), image classification techniques, data merging and accuracy assessment.				

Course Name	Indoor Positioning Technology	Course Code	SSRV462	Credit Hours	3
Description	Indoor Positioning Technologies can be used to locate people or objects inside buildings, typically via a mobile device such as a smart phone or tablet. . It helps people in finding their targets. With indoor positioning, we are able to guide our visitors exactly to the item they are looking for				

Course Name	Point Cloud Science	Course Code	SSRV433	Credit Hours	3
Description	This advanced course will familiarize students with the various data collection technologies used in the generation of 3D point cloud data, and their associated sources of error. This course is aimed at collectors and users of 3D point cloud data so that informed decisions can be made regarding the appropriateness of the various data collection and processing options, and deliverables, and so that the issues around data management are appreciated.				

Course Name	Web Technology (Elective course-1)	Course Code	SSRV434	Credit Hours	3
Description	This course is designed to offer an overview of the modern Web technologies used for the Web development. The purpose of this course is to give students the basic understanding of how things work in the Web world from the technology point of view as well as to give the basic overview of the different technologies that can be used to develop Web-based Application.				

Course Name	Disaster Management (Elective course-1)	Course Code	SSRV481	Credit Hours	3
Description	This course is a unique program which will provide a balanced study of environmental hazards and disaster management, pre-event mitigation, disaster risk reduction and disaster relief, along with the development of technical and interpersonal skills. Topics of discussion include the knowledge of Principles and Concepts in Disasters, Management of Coastal and Hydrological Hazards, Management of Geological and Technological Hazards, Personal Preparedness for Disasters, Professional Development for Disasters.				

Course Name	Underground Surveying (Elective course-1)	Course Code	SSRV454	Credit Hours	3
Description	This course is designed in order to provide students with knowledge and skills of Underground Surveying which represent an important surveying activity and which is different from surveying in the sunlight. Students will be able to applying principles, instrumentation, data analysis methods, and visualization products associated with underground surveying. At the end of the course, the students will be able to gain adequate insight into theoretical aspects of underground surveying.				

Course Name	Advanced Photogrammetry (Elective course-2)	Course Code	SSRV455	Credit Hours	3
Description	This course will allow students carry out photo coordinates measurement and refinement, derive collinearity and coplanarity equations using collinearity and coplanarity conditions, respectively and apply these equations in forming analytical relative orientation, absolute orientation and aerial triangulation models and use of both terrestrial and unmanned aerial photographs to produce geometric survey data. Developing computer programs will be a task for some of these applications.				

Course Name	Land Law and Registration (Elective course-2)	Course Code	SSRV482	Credit Hours	3
Description	The course will give students broad background about various registration systems used worldwide with emphasis on that adopted in KSA, survey laws and legal principles related to transfer and endorsing real estate ownership in KSA using deeds and plans, professional ethics and role of surveyors.				

Course Name	Coordinate Transformations (Elective course-2)	Course Code	SSRV422	Credit Hours	3
Description	This course is designed to offer an overview of coordinate reference systems which are based on the definition of a datum, and which links the chosen coordinate system with the real world. Many datums are commonly used for referencing geospatial position. Students in the field of geospatial engineering must possess the knowledge, skills and competence in selecting, implementing and evaluating the transformation of coordinates between geodetic datums.				

Course Name	Project (1)	Course Code	SSRV 490	Credit Hours	
Description	This course is the first part of applied project. Trainee gets the chance to get knowledge about executable projects within capacity of trainee. In addition, Trainee reviews some maps and reports of already executed projects. Trainee should select a project in coordination with his supervisor. The selected project should meet some standards such as: allows trainee to apply what he already has of skills and experiences during his study. In addition, Trainee should be able to use available supplies such as computer labs, survey systems and software, modern instruments to collect data, process and adjust data, compute final coordinates and draw maps at required scale.				

Course Name	Project (2)	Course Code	SSRV 492	Credit Hours	
Description	This course is the second part of applied project. Trainee gets the chance to practice using most advanced systems to execute projects. In addition, Trainee applies his experiences in carrying out some engineering and surveying projects. Trainee should select a project in coordination with his supervisor. The selected project should meet some standards such as: allows trainee to apply what he already has of skills and experiences during his study. In addition Trainee should be able to use available supplies such as computer labs, survey systems and software, modern instruments to collect data, process and adjust data, compute final coordinates and draw maps at required scale, compute volumes of cut and fill from contour maps an longitudinal and cross sections, also use available software of Remote sensing, and geographic information systems, digital photogrammetry.				

Courses Detail Description

Department	Civil & Architectural Technology		**Major**	Surveying Technology					
Course Name	**Geodesy**		**Course Code**	SSRV 311					
Prerequisites			**Credit Hours** **CRH**	3		CTH	4		
				L	2	P	2	T	0

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description :

This course is designed in order to provide students with knowledge and skills of applying principles, instrumentation, data analysis methods, and visualization products associated with the science of geodesy which is concerned with the study of the shape and size of the earth in the geometric sense as well as with the form of the equipotential surfaces of the gravity potential.

Topics:

- Reductions And Computations For Plane Surveying Map Projections
- Geographic Coordinates And Reference Ellipsoids Height systems

- Geodetic Coordinate Systems
- Distances, Angles and Point Positioning
- Map Projections
- Gravity, Geopotential, and The Geoid
- Height Systems and Vertical Datum's
- Tides
- Earth and its Deformation in Time
- Adjustment Of Level Nets

Experiments: if applicable it will support the course topics.

References:

- Geodesy, Jürgen Müllerand Wolfgang Torge, 2012, de Gruyter Textbook
- Introduction to Geometrical and Physical Geodesy: Foundations of Geomatics, Thomas H, Meyer, 2012, Esri Press.

Details of Theoretical Contents		
No.	**Contents**	**Hours**
1	▪ **Introduction:** - Definition and brief history of geodesy - The three main areas of geodesy: Geometry, Rotation , Gravity - Physical geodesy and the need for gravity field modeling - Applications of geodesy in Earth science - Applications of geodesy in engineering	**2**
2	▪ **Reductions And Computations For Plane Surveying:** - Absolute versus Relative Positions - Plane Angles - Mathematical Tools - The Inverse Problem in the Plane - Reductions for Plane Surveying - The Direct Problem in the Plane	**3**
3	▪ **Geographic Coordinates And Reference Ellipsoids:** - The Need for Geodetic Surveying - Reference Ellipsoids - Earth rotation, precession, nutation, polar motion - Latitude and Longitude - Types of Latitudes	**3**
4	▪ **Geodetic Coordinate Systems:** - Earth-Centered, Earth-Fixed Geocentric Cartesian (XYZ) - Geodetic Longitude and Latitude, and Ellipsoid Height (LBH) - Local Horizontal Coordinate Systems - Reference Frames and Geodetic Datums - Transformation Formula between reference systems.	**3**

5	▪ **Distances, Angles and Point Positioning:** - Types of Distances - Distance Reductions - North and South - Spherical Trigonometry - Positioning on a Sphere - Grid Angles	**3**
6	▪ **Map Projections:** - Developable Surfaces - Map Projection Classification - Projection Parameters - Grid Coordinates - Map Projection Systems	**3**
7	▪ **Gravity, Geopotential, and The Geoid:** - Gravity vectors and gravity potential - The normal potential - The GRS80 and WGS84 - Gravity instrumentation and measurements - Terrestrial gravimetry: Spring and absolute gravity meters - Sea and airborne gravimetry - Satellite gravimetry	**3**
8	▪ **Height Systems and Vertical datum:** - Spirit leveling and the earth's gravity field - Height from geopotential numbers - Dynamic, normal and orthometric heights - Leveling and optimal combination of ellipsoidal, orthometric and geoidal heights - Vertical datums	**3**
9	▪ **Tides:** -Tidal Gravitational Attraction and potential - Ocean Tides and Body Tides	**3**
10	▪ **Earth and its Deformation in Time:** - Types of deformation - Tides - Tectonic deformations - Postglacial rebound - Geodetic observation of deformations	**3**
11	▪ **Adjustment Of Level Nets:** - Observation Equations - Unweighted Example - Reference Standard Deviation - Weighted Adjustment	**3**
Textbook:	▪ Introduction to Geometrical and Physical Geodesy: Foundations of Geomatics, Thomas H, Meyer, 2012, Esri Press.	

Details of Practical Contents

No.	Contents	Hours
1	▪ **Stable (Static) Gravimetry Measurement:** - Askania - Boliden - Gulf (hoyt)	8
2	▪ **Unstable (Astatic) Gravimetry Measurement:** - Thyssen - La Coste-Romberg - Worden	8
3	▪ **Height Systems and Vertical datum:** - Dynamic heights - Normal heights - Orthometric heights	8
4	▪ **Global Navigation Satellite System (GNSS)**	6
Textbook:	▪ Geodesy, Jürgen Müllerand Wolfgang Torge, 2012, de Gruyter Textbook	

Textbooks	▪ Introduction to Geometrical and Physical Geodesy: Foundations of Geomatics, Thomas H, Meyer, 2012, Esri Press.
	▪ Geodesy, Jürgen Müllerand Wolfgang Torge, 2012, de Gruyter Textbook

Department	Civil & Architectural Technology		**Major**	Surveying Technology					
Course Name	**Map Making & Projections**		**Course Code**	SSRV 321					
Prerequisites			**Credit Hours** **CRH**	**2**		CTH	2		
				L	**2**	P	**0**	T	**0**

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description :

The Map Making course is designed since it is the art, science and engineering of map making, and it has been one of the fundamental components in the geospatial technology. This course provides in-depth discussions on the cartographic theories, principles and process of designing and making maps for visualizing spatial information. It will introduce how to practically make different kinds of maps by integrating theoretical understanding with mapping practice using latest version of ArcGIS software. All major thematic maps will be studied in the classroom and practiced in the computer lab. In addition, every student will be expected to do a mapping project as the final class project.

Topics :

- Introduction to Thematic Mapping:
- Basic Geodesy, Coordinate Systems, and Scale:
- Map Projections:
- The Nature of Geographic Data and the Selection of Thematic Map Symbols:
- Descriptive statistics and Data Classification:
- Mapping Enumeration and Other Areally Aggregated Data: The Choropleth Map:
- The Dot Density Map:
- From Point to Point: The Proportional Symbol Map:
- Dynamic Representation: The Resign Of Flow Maps:
- The Map Design Process And The Elements Of Map Composition:
- Making The Map Readable: The Intelligent Use Of Type:
- Principles For Color Thematic Maps:
- Map Production Techniques:

Experiments: If applicable, it will support the course topics.

References :

- Map Use and Analysis. (Campbell 2012)
- Thematic Cartography and Geographic Visualization (Slocum et al. 2011)
- ArcGIS™ version 10 or 10.1 from ESRI, User's Guide

Details of Theoretical Contents		
No.	**Contents**	**Hours**
1	▪ **Introduction to Thematic Mapping:** - Map Definition - Definition of Cartography - Geographic Cartography - Kinds of Maps - Map Scale - Modern Views of Map Communication - Cartography and Geographic Information Systems - Cartographic Abstraction and Generalization - Selection - Classification - Simplification - Symbolization - Map Design -Definition of Map Design -Ethics in Cartography	**2**
2	▪ **Basic Geodesy, Coordinate Systems, and Scale:** - Basic Geodesy: The Size and Shape of the Earth - Coordinate Geometry for the Cartographer - The Geographic Grid - Principal Geometric Relationships of the Earth's Geographic Grid *-Linear* *-Angular* *-Azimuth* *- Area* *-Points*	**2**

	-*Circles on the Grid* - Scale Concept: Scale and Line Generation	
3	▪ **Map Projections:** -The map Projection Process -Developable Surfaces -Projection Parameters -Azimuthal projection -Cylindrical projection -Conic projection -Mathematical projection -Equal Area projection -Conformal Mapping -Equidistance Mapping -Minimum Error Projections -Deformation and its Distribution Over the Projection -Standard Lines and Points, Scale Factor -World Projections -Mathematical, Equivalent Projections -Minimum Error Projections -Cylindrical Projections -Projected Coordinate Systems -National (Saudi) Plane Coordinate System -Universal Transverse Mercator (UTM) System	**2**
4	▪ **The Nature of Geographic Data and the Selection of Thematic Map Symbols:** -The Nature of Data -Data Characteristics -Location -*Point Data* -*Line Data* -*Area Data* -Form -Qualitative/Quantitative Context -Spatial Context -Attribute Context -Time -Data Transformations -Scale -Form -Boundary Changes -Data Measurement -Nominal -Ordinal - Interval -Ratio -Data: Thematic Map Relationships -Map Symbols	**2**

	-Visual Variables -Size -Shape -Orientation -Texture -Saturation and Value -Cartographic Error -Source Error - Processing Error - Cartographic Design Error	
5	▪ **Descriptive statistics and Data Classification:** -Overview of a Data Sheet -Ratio, Proportion, Percent, and Rate -Descriptive Statistics -Data Classification -Selection of the Number of Classes -Data Classification Schemes -Natural Breaks -Nested Means -Mean and Standard Deviations -Equal Interval -Equal Frequency -Arithmetic and Geometric Intervals -User Defined	**2**
6	▪ **Mapping Enumeration and Other Areally Aggregated Data: The Choropleth Map:** -Selecting the Choropleth technique -Mapping Rationale -Appropriateness of Data -Preliminary Considerations in Choropleth Mapping -Geographic Phenomena -Map Scale -Number and Kinds of Enumeration Units -Data Processing -Data Classification Revisited -Classification Methods Compared -Data Truncation and Outliers - Different Maps from the Same Data -Unclassed Choropleth Maps -Legend Design Symbolization, and Base Map Design -Sources of Map-Reading Error and the Need for Accurate Design Response -Legend Design -Box Shape, Size, Orientation, and Range Placement	**3**

	-Continuous and Noncontiguous Class Ranges -Class Range Formatting, Legend Titles, and Other Legend – Information -Map Sequences and Animated Maps Considerations -Symbolization for Choropleth Maps - Black and White Mapping -Color Map Symbolization -Bipolar and Bivariate Symbolization -Adding Other Reference Features to the Map	
7	▪ **The Dot Density Map:** -Mapping Technique -Advantages and Disadvantages of Dot Density Mapping -Data Suitability -The Mapping Activity - Size of Enumeration Unit -Dot Value and Size -Dot Placement -Legend Design	**2**
8	▪ **From Point to Point: The Proportional Symbol Map:** -Conceptual Basis For Proportional Point Symbol Mapping -Selecting Method—Data Suitability - A Variety of Symbol Choices -Two-Dimensional Geometric Symbols -Three-Dimensional Geometric Symbols - Pictorial Symbols - Proportional Symbol Scaling -Absolute and Apparent Magnitude Scaling -Thematic Map Symbols -Absolute Scaling with Circles -Apparent Magnitude Scaling with Circles -The Square Symbol -Range Grading - Proportional Symbol Legend Design	**2**
	▪ **Mapping Geographic Surfaces:** -The Nature of Isarithmic And Three Dimensional Mapping -Isarithmic Categories and Terminology -The Basis of Isarithmic Construction -A Brief History of Isarithmic Mapping -Selecting the Isarithmic Method - Isarithmic Practices -Elements of Isarithmic Mapping -Concepts in Isarithm Placement	

9	- Locating Data Points -Concept of Interpolation -Automated Isarithmic Mapping -Gridding Methods of Interpolation -Evaluating Grid Error -The Selection of Isarithmic Intervals -Other Representations of Continuous Surfaces -Shaded Relief Maps -Wireframe and Surface Maps -Communicating Using Multiple Map Displays -Design Aspects For Isarithmic & Continuous Surface Maps - Isolines and Figure-Ground Relationship -Isoline Labels -Legend Design	**2**
10	▪ **The Cartogram: Value-by-Area Mapping:** -The Value y-Area Cartogram Defined - Two Basic Forms Emerge -Contiguous Cartograms -Noncontiguous Cartograms -Mapping Requirements -Data Limitations -Communicating With Cartograms -Recognizing Shapes -Estimating Areas -A Communication Model -Advantages and Disadvantages -Design Strategies Recap-Legends, Inset Maps, and Labeling -Bivariate Cartograms -Cartogram Construction - Manual Methods -Automated Solutions	**2**
11	▪ **Dynamic Representation: The Resign Of Flow Maps:** -The Purpose of Flow Mapping -Quantitative Flow Maps -Data Suitability - Directed and Undirected Flows -The Relevance of Flow Routes -Designing Flow Maps -Map Organization and Figure-Ground -Projection Selection -Essential Design Strategies -Line Scaling and Symbolization -Treatment of Symbols -Legend Design -Innovative Solutions	**2**

12	▪ **The Map Design Process And The Elements Of Map Composition:** -The Design Process -Design Evaluation -Creativity and Visualization -Graphic Ideation -Experimentation -Map Aesthetics -The Map's Design Elements - Design Levels On The Ma0 - Elements Of Map Composition -Purpose of Map Composition -Planar Organization of the Visual Elements -Balance -Focus of Attention -Internal Organization -Contrast and Design -Line Contrast -Texture Contrast -Value Contrast -Variation of Detail -Color Contrast -Vision Acuities -Visual Acuity -Resolution Acuity -The Special Case Of The Land-Water Contrast -Vignetting for Land-Water Differentiation -Designing Of The Page-Size Map	**3**
13	▪ **Making The Map Readable: The Intelligent Use Of Type:** -Function Of Map Lettering -The Elements of Type -Typeface Characteristics - Letterform Components -Typeface Style and Classification -The Personality of Type -The Legibility of Type -Cartographic Requirements -Type Font and Type Families -Type Size -Type Form -Type Width -Type Weight -Type Color -Letter, Word, and Line Spacing -Guidelines For Type Selection And Placement -The Use of Capital and Lowercase Letters -The Placement of Lettering -Point-Symbol Labeling	**2**

	-Linear Feature Labeling -Area Feature Labeling -Placement and Design of Titles and Legends -Scales and North Arrows -Source and Author Information	
14	▪ **Principles For Color Thematic Maps:** -Light And The Color Spectrum -Color Perception -Color Theories -The Desert Island Experiment -Components of Color -Color Models -Color Matching Systems -Subjective Reactions To Color -Color In Cartographic Design -The Functions of Color in Design -Design Strategies for the Use of Color -Developing Figure and Ground -The Use of Color Contrast -Developing Legibility -Color Conventions in Mapping -Color Harmony in Map Design	**2**
15	▪ **Map Production Techniques:** - Cartography And Digital Printing -Color Model -Desktop Printing -The Map Production Process	**2**
Textbook:	▪ Map Use and Analysis. (Campbell 2012) ▪ ArcGIS™ version 10 or 10.1 from ESRI, User's Guide	

Textbooks	▪ Map Use and Analysis. (Campbell 2012)
	▪ ArcGIS™ version 10 or 10.1 from ESRI, User's Guide

Department	Civil & Architectural Technology	Major	Surveying Technology
Course Name	Geographic Information Analysis	Course Code	CSRV 341
Prerequisites	STAT 303	Credit Hours CRH	3 (CTH 4) — L 2, P 2, T 0

CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours

Course description :

This course covers techniques for the statistical analysis of spatial data. The course covers issues in characterizing spatial data, methods and problems in spatial data sampling, techniques for visualizing, exploring and modeling spatial data.

Topics:

- Geographic Information Analysis and Spatial Data
- Fundamental Spatial Concepts
- Point Pattern Analysis
- Lines and Network
- Area Objects and Spatial Autocorrelation
- Describing and Analyzing Fields

Experiments: if applicable it will support the course topics.

References:

- Spatial Data Analysis for Geographic Information Science By Taher Buyong
- Geographic Information analysis (by David O'Sullivan and David J. Unwin).

Details of Theoretical Contents		
No.	**Contents**	**Hours**
1	▪ **Geographic Information Analysis and Spatial Data** - Introduction - Spatial data types - Scales for attribute description - GIS analysis, spatial data manipulation and spatial analysis	**5**
2	▪ **Fundamental Spatial Concepts:** - Euclidean space - Set – based geometry of space - Topology - Network spaces - Metric spaces - Endnote and fractal geometry	**7**
3	▪ **Point Pattern Analysis:** - Describing a point pattern - Density – based point pattern measures - Distance – based point pattern measures - Assessing point patterns statistically	**5**
4	▪ **Lines and Network:** - Representing and storing linear entities - Line length - Connection in line data - Statistical analysis of geographical line data	**5**

5	▪ **Area Objects and Spatial Autocorrelation:** - Types of area objects - Geometric properties of areas - Spatial autocorrelation - Other measures of spatial autocorrelation - Local indicators of spatial association	**5**
6	▪ **Describing and Analyzing Fields:** - Introduction - Modeling and storing field data - Spatial interpolation - Derived measures on surfaces	**5**
Textbook:	▪ Geographic Information analysis (by David O'Sullivan and David J. Unwin).	

Details of Practical Contents		
No.	**Contents**	**Hours**
1	▪ GIS applications	**5**
2	▪ Raster analysis	**5**
3	▪ Network analysis	**5**
4	▪ Univariate statistical analysis	**5**
5	▪ Bivariate statistical analysis	**5**
6	▪ Aerial analysis	**5**
Textbook:	▪ Spatial Data Analysis for Geographic Information Science By Taher Buyong	

Textbooks	▪ Geographic Information analysis (by David O'Sullivan and David J. Unwin).
	▪ Spatial Data Analysis for Geographic Information Science By Taher Buyong

Department	Civil & Architectural Technology	Major	Surveying Technology						
Course Name	Hydrographic Surveying	Course Code	SSRV453						
Prerequisites		Credit Hours CRH	3			CTH	4		
			L	2	P	2	T	0	

CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours

Course description :

This course is designed in order to provide students with knowledge and skills of Hydrographic Surveying witch focus on measurement of the depth and bottom configuration of water bodies and the features which affect maritime navigation. At the end of the course, the students will be able to (1) gain adequate insight into theoretical aspects of hydrographic surveying (2) use the data to update nautical charts and develop hydrographic models; increasingly, the hydrographic data is used for multiple purposes, through the Integrated Ocean and Coast Mapping program.

Topics:

- Concepts of Hydrographic Surveying
- Positioning methods and accuracy assessment
- Bathymetric survey systems
- Tidal theory
- Applications of hydrographic surveying

Experiments: if applicable it will support the course topics.

References:

- Robert van der Velden;etal Huibert-Jan Lekkerkerk (2006). Handbook of Offshore Surveying Volume 1. Amazon.
- C. D. de Jong , G. Lachapelle , I .A. Elema (Contributor), S. Skone , (2006). Hydrography. Amazon.
- American Society of Civil Engineers, (1998). Hydrographic Surveying. 328p.

Details of Theoretical Contents		
No.	**Contents**	**Hours**
1	▪ **Concepts of Hydrographic Surveying** - Purpose - Importance - International Hydrographic Organization	**6**
2	▪ **Positioning methods and accuracy assessment** - Decca System - Loran-C System - Omega System - Radar - Global Navigation Satellite System (GNSS)	**7**

3	▪ **Bathymetric survey systems** - Single-Beam Echo-Sounders - Multi-Beam Echo-Sounders - Side Scan Sonar	**7**
4	▪ **Tidal theory** - Gravitational forces - Semi-diurnal tide - Diurnal tide - Mixed tide - Tide gauges	**6**
5	▪ **Applications of hydrographic surveying** - Nautical charting - International standards applicable to nautical charting surveys - Port and coastal management	**6**
Textbook:	▪ C.D. de Jong, G. Lachapelle, S. Skone, I.A. Elema (2006). Hydrology, VSSD ISBN: 9040723591 ISBN13: 9789040723599 DDC: 551, 6th Edition.	

Details of Practical Contents		
No.	**Contents**	**Hours**
1	▪ Single-Beam Echo-Sounders	**6**
2	▪ Multi-Beam Echo-Sounders	**6**
3	▪ Side Scan Sonar	**6**
4	▪ Nautical charting	**12**
Textbook:	▪ Robert van der Velden;etal Huibert-Jan Lekkerkerk (2006). Handbook of Offshore Surveying Volume 1. Amazon. ▪ C.D. de Jong, G. Lachapelle, S. Skone, I.A. Elema (2006). Hydrology, VSSD ISBN: 9040723591 ISBN13: 9789040723599 DDC: 551, 6th Edition. ▪ Robert van der Velden;etal Huibert-Jan Lekkerkerk (2006). Handbook of Offshore Surveying Volume 1. Amazon.	

Department	Civil & Architectural Technology	Major	Surveying Technology						
Course Name	Spatial Databases	Course Code	SSRV 443						
Prerequisites		Credit Hours CRH	3		CTH	4			
			L	2	P	2	T	0	

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description :

This course covers basic concepts of a Spatial Database, including understanding what schemas and views are. Topics will cover also spatial data modeling, query language indexes and access methods.

Topics:

- Introduction to Databases
- Introduction to Spatial Database
- Spatial Operations
- Network
- Indexes
- Query

Experiments: If applicable, it will support the course topics.

References:

- Spatial Database Systems: Design, Implementation and Project Management edited by Albert K. W. Yeung, G. Brent Hall.
- Spatial Databases with application to GIS (by: Philippe Rigaux, Michel Scholl and Agnes Voisard).
- GIS a computing perspective (by: Michael Worboys and Matt Duckham).

Details of Theoretical Contents

No.	Contents	Hours
1	▪ **Introduction to Databases:** - Concept - Database features - Common types of database - Database management system - Types of database architectures: Hierarchical, Network, Relational, Object-oriented and Deductive. - Relational Model - SQL - Database analysis and design	7
2	▪ **Introduction to Spatial Database:** - System architecture - Vector spatial data - Spaghetti model - Topology model	5
3	▪ **Spatial Operations:** - Computing with spatial data - Algorithms - Geometric analysis operations - Relationship analysis - Geometry combination	5

4	▪ **Network:** - Features - Graphs - Representing graphs - Network operations	**5**
5	▪ **Indexes:** - General structure and access method - Spatial indexes - Spatial axes method - Raster structures - Point object structures - Linear objects - Collections of objects - Spherical data structures	**5**
6	▪ **Query:** - Query evaluation - Spatial join - Query optimization and execution	**5**
Textbook:	▪ Spatial Databases with application to GIS (by: Philippe Rigaux, Michel Scholl and Agnes Voisard).	

Details of Practical Contents		
No.	**Contents**	**Hours**
1	▪ SQL	**8**
2	▪ Spatial data	**8**
3	▪ Spatial analysis	**7**
4	▪ Network analysis	**7**
Textbook:	▪ GIS a computing perspective (by: Michael Worboys and Matt Duckham).	

Textbooks	▪ Spatial Databases with application to GIS (by: Philippe Rigaux, Michel Scholl and Agnes Voisard).
	▪ GIS a computing perspective (by: Michael Worboys and Matt Duckham).

Department	Civil & Architectural Technology		**Major**	Surveying Technology					
Course Name	**Remote Sensing**		**Course Code**	CSRV 361					
Prerequisites	SSRV 352		**Credit Hours** CRH	3			CTH		4
				L	2	P	2	T	0

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description :

The course aims to cover the fundamental physical and technical concepts and applications of remote sensing for the Environment. The course will have a lecture/labs format with emphasis on interpretation of satellite data.

Topics:

- Introduction to Remote Sensing
- Electromagnetic Radiation (EMR)
- Elements of Visual Image Interpretation
- Multispectral Remote Sensing Systems
- Thermal Remote Sensing
- Radar Remote Sensing
- Digital Image Processing – Part I: Basics
- Digital Image Processing – Part II: Image Classification
- In Situ Spectral Reflectance Measurement

Experiments: if applicable it will support the course topics.

References:

- Jensen, J.R. 2007. Remote Sensing of the Environment - an Earth Resource Perspective 2nd ed. Upper Saddle River, NJ, Prentice Hall.
- Jensen, J.R. 2000. Remote Sensing of the Environment - an Earth Resource Perspective 1st ed. Upper Saddle River, NJ, Prentice Hall.
- The Remote Sensing Core Curriculum - http://www.r-s-c-c.org/
- The Remote Sensing Tutorial - http://rst.gsfc.nasa.gov/

Details of Theoretical Contents		
No.	**Contents**	**Hours**
1	▪ **Introduction to Remote Sensing:** -What is Remote sensing? -Types of remote sensing -Basics of remote sensing -The remote sensing process -Image resolution -Brief history of remote sensing	**2**
2	▪ **Electromagnetic Radiation (EMR):** -EMR basics -Atmospheric interactions -Energy-terrain interactions	**4**
3	▪ **Elements of Visual Image Interpretation:** -Image analysis tasks -Elements of image interpretation -Pseudoscopic Illusion -Data fusion to improve image quality for visual analysis	**3**

4	▪ **Multispectral Remote Sensing Systems:** -Image acquisition -Digital image basics -Basic multispectral instrument types -Quantization -Spatial resolution	**6**
5	▪ **Thermal Remote Sensing:** -History of thermal remote sensing -Basics of thermal remote sensing -Thermal properties of terrain -Image geometry -Radiometric calibration	**5**
6	▪ **Radar Remote Sensing:** -Introduction to Radar -Radar geometry -Radar resolutions -Synthetic aperture radar (SAR) -Radar backscatter -Polarization	**3**
7	▪ **Digital Image Processing – Part I: Basics** -Visualizing multispectral images -Band math -Kauth-Thomas transformation	**3**
8	▪ **Digital Image Processing – Part II: Image Classification** -Classification methods -Supervised classification -Unsupervised classification -Thematic map accuracy	**3**
9	▪ **In Situ Spectral Reflectance Measurement:** -Measuring spectra in the field -Assumptions when collecting field spectra -Field procedures	**3**
Textbook:	▪ The Remote Sensing Core Curriculum - http://www.r-s-c-c.org/ ▪ The Remote Sensing Tutorial - http://rst.gsfc.nasa.gov/	

Details of Practical Contents		
No.	**Contents**	**Hours**
1	▪ **Introduction to ERDAS Imagine and the Basics of Digital Images:** - Understand Erdas imagine user-interface - Load and open images - Display the image in pan-chromatic, true color or false color. - Zoom and pan images - View and record the digital number (DN) values of image pixels. - View the reallocation information about the image and individual pixels.	**2**

	- Enhance image brightness and contrast - Display and use histograms to explore the image statistical properties.	
2	▪ **Gereferencing and Co-Registering an Image:** - Collect GCPs. - Use points of known coordinates. - Use previously dereferenced images.	**5**
3	▪ **Interpretation of Satellite Images:** - Identify features from space imageries or Google earth based on fundamental elements of image interpretation.	**2**
4	▪ **Visualizing and Analyzing Multispectral Images:** - Collect information about basic properties of major remote sensing systems using the internet - Explore several different types of remote sensing images to determine the most useful bands for discriminating certain type of features and to construct spectral signature curves for different types of geographic features; - Perform band rationing and finally - Visualize multi-spectral imagery using the RGB color model and HSV to RGB transformation technique for assisting visual interpretation.	**6**
5	▪ **Thermal Remote Sensing Data:** - Visually interpret a daytime Landsat thermal image - Calculate the absolute radiance based on the DN values of thermal image - Calculate the effective at-satellite temperature; - Smooth the temperature image using a low-pass filter - Visualize the temperature using pseudo color and 3D perspective views; and - Interpret and compare daytime and nighttime thermal images.	**5**
6	▪ **Interpreting Radar Images:** - Interpret a series of radar image chips - Visualize the SAR image - Create a 3D perspective view by draping the SAR image on top of a Digital Elevation Model	**3**
7	▪ **Image Classification:** - Perform supervised classification - Perform unsupervised classification	**4**
8	▪ **Field Spectroscopy:** - Collect spectral signatures in the VIS and NIR of common land cover materials. - Create a spectral library.	**3**
Textbook:	▪ The Remote Sensing Core Curriculum - http://www.r-s-c-c.org/ ▪ The Remote Sensing Tutorial - http://rst.gsfc.nasa.gov/ ▪ Jensen, J.R. 2007. Remote Sensing of the Environment - an Earth Resource Perspective 2nd ed. Upper Saddle River, NJ, Prentice Hall. ▪	

Department	Civil & Architectural Technology	Major	Surveying Technology						
Course Name	**Digital Photogrammetry**	Course Code	SSRV 451						
Prerequisites	SSRV 352	Credit Hours CRH	3		CTH	4			
			L	2	P	2	T	0	

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description :

This Course is the second part of photogrammetry topics. This course aims at providing trainee with essential and basic skills to deal with digital aerial photographs, and digital photogrammetry systems for drawing digital survey maps form digital aerial stereographs, and forming digital terrain models (DTMs).

In this course, trainee practices and operates digital photogrammetry computer software and will use it to perform different photogrammetry operations which includes; inner orientation, relative orientation, absolute orientation, aerial triangulation, establish digital survey maps, and form digital terrain models.

Topics:

- Introduction to Digital Photogrammetry
- Digital Photogrammetry System
- Ground Control for Aerial Photogrammetry
- Digital Photogrammetry Operations
- Aerotriangulation

Experiments: if applicable it will support the course topics.

References:

- Ackerman, F, "Automatic Aero triangulation". (1995)
- Heipke, C," Automation of interior, relative, and absolute orientation". (1997)
- Drewniok, C. & Rohr, K," Automatic exterior orientation of aerial images in urban environment". (1996)

Details of Theoretical Contents		
No.	**Contents**	**Hours**
1	▪ **Introduction to Digital Photogrammetry:** - Developing digital photogrammetry. - Digital photographs. - Digital aerial Camera.	**6**
2	▪ **Digital Photogrammetry System:** - Software. - Hardware.	**6**
3	▪ **Ground Control for Aerial Photogrammetry:** - Number and location of control points. - Artificial targets.	**4**
4	▪ **Digital Photogrammetry Operations:** - Inner orientation. - Relative orientation. - Absolute orientation.	**10**
5	▪ **Aerotriangulation:** - Strip formation and adjustment. - Simultaneous Bundle adjustment.	**8**
Textbook:	Kasser, M & Egels, W," Digital Photogrammetry". (2002)	

Details of Practical Contents		
No.	**Contents**	**Hours**
1	▪ **Know How to Operate Digital Photogrammetry Software:** - Program setup. - Tools of stereovision. - Program operating routines and their functions.	**5**
2	▪ **Digital Inner Orientation of Aerial Photograph:** - Prepare calibration data file. - Prepare digital photographs file of the project area. - Perform digital inner orientation of all photographs.	**5**
3	▪ **Digital Relative Orientation of Aerial Photograph:** - Start the program. - Make necessary digital measurements in overlapped areas of digital photographs. - Perform digital relative orientation to form stereo models, and evaluate results.	**5**
4	▪ **Digital Absolute Orientation of Aerial Model:** - Start the program. - Make necessary digital measurements of control points in digital models areas. - Perform digital absolute orientation to obtain adjusted models, and evaluate results.	**5**
5	▪ **Aerial Triangulation to Adjust Block of Models for Drawing Stage:** - Start the program. - Make necessary digital measurements of tie points in digital models and strips areas. - Perform digital aerial triangulation processing to obtain adjusted block of models, and evaluate results.	**5**
6	▪ **Draw Maps from Adjusted Stereo Models:** - Start the program. - Determine limits of drawing area. - Draw features and objects in the predefined drawing area. - Draw contour lines (form digital elevation model of the predefined drawing area). - Map revision, and drawing check. - Print map.	**5**
Textbook:	▪ Heipke, C," Automation of interior, relative, and absolute orientation". (1997)	

Textbooks	▪ Kasser, M & Egels, W," Digital Photogrammetry". (2002)
	▪ Heipke, C," Automation of interior, relative, and absolute orientation". (1997)

Department	Civil & Architectural Technology		**Major**	Surveying Technology							
Course Name	**Computer Survey Applications**		**Course Code**	SSRV 432							
Prerequisites			**Credit Hours** **CRH**	2			CTH		4		
				L	0	P	4	T	0		

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description :

This course aims at providing trainee chance to practice and gain more skills through performing some projects using computer programs to draw cadastral and contour maps and print them with different scales. Also use computer programs to construct longitudinal and cross section from contour map and extract the cut and fill volumes. Also use computer programs to level piece of land and compute quantities considering designed level is horizontal and with certain slope.

Topics:

- Draw and Print Complete Cadastral Map
- Draw and Print Complete Contour Map
- Earth Work from Digital Contour Map
- Longitudinal and Cross Sections

Experiments: if applicable it will support the course topics.

References :

- AutoDesk (2017). AutoCad user manual.
- Bentely (2017). Micro Station user manual.
- Available Survey Package user manual.

Details of Practical Contents		
No.	**Contents**	**Hours**
1	▪ **Draw and Print Complete Cadastral Map:** - Using Layers. - Add texts and legends. - Scale. - Plotting and printing.	**14**
2	▪ **Draw and Print Complete Contour Map:** - Using Layers. - Add texts and legends. - Scale - Plotting and printing.	**10**
3	▪ **Earth Work from Digital Contour Map: (case: leveling surface is horizontal).** - Average level. - Predefined level (cut case). - Predefined level (fill case).	**10**
4	▪ **Earth Work from Digital Contour Map: (case: leveling surface is not horizontal).** - Draw designed surface according to the given Slope. - Define height of cut or fill at designated points. - Compute resulted earth quantities.	**10**

5	▪ **Longitudinal and Cross Sections: (use digital contour map and available software)** - Draw longitudinal section. - Select and draw cross section (cut and fill). - Extract cut and fill quantities according to the designed level.	**18**
Textbook:	▪ AutoDesk (2017). AutoCad user manual. ▪ Bentely (2017). Micro Station user manual. ▪ Available Survey Package user manual.	

Textbooks	▪ AutoDesk (2017). AutoCad user manual.
	▪ Bentely (2017). Micro Station user manual.

Department	Civil & Architectural Technology		**Major**	Surveying Technology					
Course Name	**Highway Engineering**		**Course Code**	SSRV 461					
Prerequisites			**Credit Hours CRH**	3			CTH		4
				L	2	P	2	T	0

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description :

The course is presented in 2 strands. The first strand is concerned with the fundamentals of highway and pavement engineering. It introduces the design process of roads and intersections, including horizontal and vertical alignment design, cross-sections and earthworks. The second half of this strand deals with pavement design and evaluation. Topics include: pavement composition, pavement materials, asphalt mix design, the pavement thickness design, and defects in Flexible pavements and failures in Rigid pavements. The second strand is presents briefly bridges classification and construction methods.

Topics :

- History of Road Construction.
- Highway Development in Saudi Arabia.
- Highway Development Programmers at National Level in Saudi Arabia.
- The Highway planning process and principles of route location.
- Factors controlling Highway alignment.
- Engineering surveys for alignment
- Conventional methods and Modern methods (Remote sensing, GIS and GPS techniques)
- Geometric design of Highways.
- Highways drainage.
- Classification, Improvement and Stabilization of soil and Earthworks for Highways.
- Sources description properties and uses of bituminous binders.
- Asphalt mix design.
- Asphalt plants.
- Design and construction of different Pavement layers.
- Design of rigid Pavements.
- Pavement Management.
- Types of defects in Flexible Pavements.
- Types of Pavement, failures in Rigid Pavements.
- Pavement Evaluation.
- Introduction to Bridges including (briefly): Bridges classification, bridge types and Bridges construction methods.

Experiments: if applicable it will support the course topics.

References:

- Traffic and Highway Engineering, Fourth Edition, Nicholas J. Garber, Lester A. Hoel, University of Virginia. 2009, Cengage Learning, 1120 Birchmount Road, Toronto ON M1K 5G4 Canada.
- O'Flaherty, C.A. (ed) Highways: The Location, Design, Construction and Maintenance of Road Pavements. Butterworth Heinemann.
- Design of Highway Bridges, Authors: Richard Barker & Jay Puckett, Publisher: Wiley Interscience.

Details of Theoretical Contents		
No.	**Contents**	**Hours**
1	▪ **History of Road Construction:**	**2**

	- Highway Development in Saudi Arabia. - Highway Development Programmers at National Level in Saudi Arabia.	
2	▪ **The Highway planning process and principles of route location.**	**2**
3	▪ **Factors controlling Highway alignment.** - Engineering surveys for alignment - Conventional methods and Modern methods (Remote sensing, GIS and GPS techniques)	**3**
4	▪ **Geometric design of Highways.**	**4**
5	▪ **Highways drainage.**	**2**
6	▪ **Classification, Improvement and Stabilization of soil and Earthworks for Highways.**	**2**
7	▪ **Sources description properties and uses of bituminous binders.** - Asphalt mix design. - Asphalt plants.	**6**
8	▪ **Design and construction of different Pavement layers.**	**2**
9	▪ **Design of rigid Pavements.** - Pavement Management.	**2**
10	▪ **Types of defects in Flexible Pavements.** - Types of Pavement, failures in Rigid Pavements. - Pavement Evaluation.	**3**
11	▪ **Introduction to Bridges including (briefly):** - Bridges classification, bridge types and Bridges construction methods.	**2**
Textbook:	▪ Traffic and Highway Engineering, Fourth Edition, Nicholas J. Garber, Lester A. Hoel, University of Virginia. 2009, Cengage Learning, 1120 Birchmount Road, Toronto ON M1K 5G4 Canada.	

Details of Practical Contents		
No.	**Contents**	**Hours**
1	▪ Method for Effect of Heat and Air on a Moving Film of Asphalt	**2**
2	▪ Asphalt mix design according to Marshal Method.	**6**
3	▪ Quantitative Extraction of Bitumen From Bituminous Paving Mixtures.	**3**
4	▪ Rotational Viscosity.	**2**
5	▪ Pressure Aging Vessel.	**2**
6	▪ Dynamic Shear Remoter.	**2**
7	▪ Bending Beam Remoter.	**3**
8	▪ Direct Tension test.	**2**
9	▪ Gyratory Compaction test.	**2**
10	▪ Asphalt mix design by using E Pave Program (Super paves Method).	**6**
Textbook:	▪ O'Flaherty, C.A. (ed) Highways: The Location, Design, Construction and Maintenance of Road Pavements. Butterworth Heinemann.	

Textbooks	▪ Traffic and Highway Engineering, Fourth Edition, Nicholas J. Garber, Lester A. Hoel, University of Virginia. 2009, Cengage Learning, 1120 Birchmount Road, Toronto ON M1K 5G4 Canada.
	▪ O'Flaherty, C.A. (ed) Highways: The Location, Design, Construction and Maintenance of Road Pavements. Butterworth Heinemann.

Department	Civil & Architectural Technology	Major	Surveying Technology
Course Name	**Theory of Errors and Observations Adjustment**	Course Code	SSRV 473
Prerequisites	STAT 303	Credit Hours CRH	3 CTH 5 (L 3 P 0 T 2)

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description :

This course is designed for the purpose of examining the nature of measurements, statistical analysis of random errors in measurements, propagation of errors, survey standards and design specifications, development of coordinate geometry and trigonometric solutions of plane surveying problems, analysis of errors and mistakes in indirect measurement.

Topics:

- Fundamentals of Theory of Errors
- Measurements
- Observations and Their Analysis
- Random Error Theory
- Propagation Of Random Errors In Indirectly Measured Quantities
- Error Propagation In Angle and Distance Observations
- Error Propagation In Traverse Surveys
- Error Propagation In Elevation Determination
- Weights Of Observations
- Principles Of Least Squares
- Adjustment Of Level Nets
- Adjustment Of Horizontal Surveys- Triangulation
- Adjustment Of Horizontal Surveys - Traverses And Networks
- Adjustment Of GPS Networks
- Coordinate Transformations

Experiments: if applicable it will support the course topics.

References :

- Adjustment computations: spatial data analysis, charles d. Ghilani and paul wolf, 2010, john wiley & sons, inc.
- DeCastellarnau, A. and Saris, W. E. (2014). A simple procedure to correct for measurement errors in survey research. European Social Survey Education Net (ESS EduNet).
- Saris, W. E.; Revilla, M. (2015). "Correction for measurement errors in survey research: necessary and possible". *Social Indicators Research*. **127**: 1005–1020. :10.1007/s11205-015-1002.

Details of Theoretical Contents		
No.	**Contents**	**Hours**
1	▪ **Fundamentals of Theory of Errors:** - Standard Errors and Weights o Standard Errors o Weights and Unit-Weight Standard Error o Variance-Covariance Matrix and Cofactor Matrix - Error Propagation o Error Propagation in Linear Functions o Error Propagation in Non-Linear ▪ Functions	**4**

	▪ Propagation of Weights ▪ Propagation of Cofactor Matrices ▪ Point Errors - Statistical Analysis o Probability Distributions o Confidence Intervals and Error Tolerances o Hypothesis Tests o Variance Analysis o Regression Analysis o Uncertainty in Measurement o Optimal Estimation o Least Squares Method o Minimum Error Variance Estimation o Matrix Algebra and Numerical Methods o Numerical Solutions of Linear Equation Systems	
2	▪ **Measurements:** - Direct and Indirect Measurements - Measurement Error Sources - Definitions - Precision versus Accuracy - Redundant Measurements in Surveying and Their Adjustment - Advantages of Least Squares Adjustment	**2**
3	▪ **Observations and Their Analysis:** - Sample versus Population - Range and Median - Graphical Representation of Data - Numerical Methods of Describing Data	**2**
4	▪ **Random Error Theory:** - Theory of Probability - Properties of the Normal Distribution Curve - Standard Normal Distribution Function - Probability of the Standard Error o 50% Probable Error o 95% Probable Error o Other Percent Probable Errors o Uses for Percent Errors Practical Examples	**3**
5	▪ **Propagation Of Random Errors In Indirectly Measured Quantities:** - Basic Error Propagation Equation - Frequently Encountered Specific Functions - Standard Deviation of a Sum - Standard Deviation in a Series - Standard Deviation of the Mean	**2**
	▪ **Error Propagation In Angle and Distance Observations:** - Error Sources in Horizontal Angles - Reading Errors - Angles Observed by the Repetition Method - Angles Observed by the Directional Method - Estimated Pointing and Reading Errors with Total Stations	

6	- Target Centering Errors - Instrument Centering Errors - Effects of Leveling Errors in Angle Observations - Numerical Example of Combined Error - Propagation in a Single Horizontal Angle - Use of Estimated Errors to Check Angular - Misclosure in a Traverse - Errors in Astronomical Observations for an Azimuth - Errors in Electronic Distance Observations - Use of Computational Software	**4**
7	▪ **Error Propagation In Traverse Surveys:** - Derivation of Estimated Error in Latitude and Departure - Derivation of Estimated Standard Errors in Course Azimuths - Computing and Analyzing Polygon Traverse Misclosure Errors - Computing and Analyzing Link Traverse Misclosure Errors	**2**
8	▪ **Error Propagation In Elevation Determination:** - Systematic Errors in Differential Leveling - Collimation Error - Earth Curvature and Refraction - Combined Effects of Systematic Errors on Elevation Differences - Instrument Leveling Errors - Rod Plumbing Error - Estimated Errors in Differential Leveling - Error Propagation in Trigonometric Leveling	**3**
9	▪ **Weights Of Observations:** - Weighted Mean - Relation between Weights and Standard Errors - Statistics of Weighted Observations - Standard Deviation - Standard Error of Weight and Standard Error of the Weighted Mean - Weights in Angle Observations - Weights in Differential Leveling	**3**
10	▪ **Principles Of Least Squares:** - Fundamental Principle of Least Squares - Fundamental Principle of Weighted Least Squares - Observation Equations - Formulation of the Normal Equations - Using Matrices to Form the Normal Equations - Least Squares Solution of Nonlinear Systems - Least Squares Fit of Points to a Line or Curve - Fitting Data to a Straight Line - Fitting Data to a Parabola - Calibration of an EDM Instrument - Least Squares Adjustment Using Conditional Equations - Observation Equations	**6**
11	▪ **Adjustment Of Level Nets:** - Observation Equations - Unweighted Example - Reference Standard Deviation	**3**

	- Weighted Adjustment	
12	▪ **Adjustment Of Horizontal Surveys- Triangulation:** - Azimuth Observation Equation - Linearization of the Azimuth Observation Equation - Angle Observation Equation - Adjustment of Intersections - Adjustment of Resections - Adjustment of Triangulated Quadrilaterals	**4**
13	▪ **Adjustment Of Horizontal Surveys - Traverses And Networks:** - Observation Equations - Redundant Equations - Minimum Amount of Control - Adjustment of Networks	**3**
14	▪ **Adjustment Of GPS Networks:** - GPS Observations - GPS Errors and the Need for Adjustment - Reference Coordinate Systems for GPS - Converting between the Terrestrial and Geodetic - Coordinate Systems - Application of Least Squares in Processing GPS Data - Network Preadjustment Data Analysis - Analysis of Fixed Baseline Measurements - Analysis of Repeat Baseline Measurements - Least Squares Adjustment of GPS Networks	**4**
15	▪ **Coordinate Transformations:** - Two-Dimensional Conformal Coordinate Transformation Equation Development - Two-Dimensional Affine Coordinate Transformation - Two-Dimensional Projective Coordinate Transformation - Three-Dimensional Conformal Coordinate Transformation	**3**
Textbook:	▪ Adjustment computations: spatial data analysis, charles d. Ghilani and paul wolf, 2010, john wiley & sons, inc. ▪ John Robert Taylor (1999). An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements. University Science Books. p. 94, 4.1. ISBN 0-935702-75-X.	

Textbooks	▪ Adjustment computations: spatial data analysis, charles d. Ghilani and paul wolf, 2010, john wiley & sons, inc.
	▪ John Robert Taylor (1999). An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements. University Science Books. p. 94, 4.1. ISBN 0-935702-75-X.

Department	Civil & Architectural Technology	Major	Surveying Technology
Course Name	**Distributed Geographic Information Systems**	Course Code	SSRV 421
Prerequisites		Credit Hours CRH	3 CTH 4 (L 2 P 2 T 0)

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description :

This course will describe new services which become widely distributed through world today such as Distributed GIS, Web Mapping ,Location Based Services.

Topics:

- Distributed GIS : Concepts , Applications
- Web Mapping : Introduction , Web mapping supporting technologies , Web mapping services , Web mapping applications
- Location Based Services: Introduction , Applications , Architectures

Experiments: if applicable it will support the course topics.

References:

- Zhong-RenPeng, Ming-Hsiang Tsou (2003) Internet GIS: Distributed Geographic Information Services for the Internet. ISBN: 978-0-471-35923-4.
- Web GIS: Principles and Applications (by: Pinde Fu and Jiulin Sun).

Details of Theoretical Contents		
No.	**Contents**	**Hours**
1	▪ **Distributed GIS:** - Concepts - Applications	**6**
2	▪ **Web Mapping:** - Introduction - Web mapping supporting technologies - Web mapping services - Web mapping applications	**12**
3	▪ **Location Based Services:** - Introduction - Applications - Architectures - Standards - Interfaces - Privacy	**14**
Textbook:	▪ Zhong-RenPeng, Ming-Hsiang Tsou (2003) Internet GIS: Distributed Geographic Information Services for the Internet. ISBN: 978-0-471-35923-4.	

Details of Practical Contents		
No.	**Contents**	**Hours**

1	▪ **Web Mapping:** - Introduction - Setting up a WM service - Element of a map - Layout and labeling	**15**
2	▪ **LBS:** - Introduction - Development location aware agents - Build a simple agent - Build a simple location based service - Making agents move and detect each other - Privatize the location information	**15**
Textbook :	▪ Web GIS: Principles and Applications (by: Pinde Fu and Jiulin Sun).	

Textbooks	▪ Zhong-RenPeng, Ming-Hsiang Tsou (2003) Internet GIS: Distributed Geographic Information Services for the Internet. ISBN: 978-0-471-35923-4.
	▪ Web GIS: Principles and Applications (by: Pinde Fu and Jiulin Sun).

Department	Civil & Architectural Technology	Major	Surveying Technology
Course Name	Digital Image Processing	Course Code	SSRV451
Prerequisites		Credit Hours CRH	3 CTH 4 (L 2 P 2 T 0)

CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours

Course description :

The course will be designed to address remote digital image acquisition systems, format of digital data, image processing for radiometric and geometric corrections, geo-referencing and registration, image enhancement techniques (including PCT and FT), image classification techniques, data merging and accuracy assessment.

Topics:

- Digital image and acquisition equipment
- Pre-processing of digital images
- Image Enhancement
- Image classification
- Radar Image Processing

Experiments: if applicable it will support the course topics.

References:

- Ralph Bernstein, Digital image processing for remote sensing. *IEEE Press.*
- Richards, J. A. & J. Xiuping, "Remote Sensing Digital Image Analysis", 4th edn.2006, Springer-Verlag Berlin Heidelberg.

Details of Theoretical Contents		
No.	**Contents**	**Hours**
1	▪ **Digital Image Acquisition and Data Formats** - Linear and Array Charged-coupled device (CCD) - Band sequential Format (BSQ) - Band Interleaved by line format - Band Interleaved by pixel format - Run length Encoding format -	6
2	▪ **Initial Statistics Extraction** - Image Histogram - Univariate descriptive image statistics - Multivariate image statistics	4
3	▪ **Pre-processing** - Geometric corrections - Radiometric corrections - Geo-referencing Techniques	4

4	▪ **Image Enhancement** - Image Histogram and statistics - Contrast enhancement - Image Band ratios - Spatial Filtering techniques - Transformations and Principal components Analysis	**8**
5	▪ **Image classification** - Supervised classification - Un supervised classification - Fuzzy classification - Accuracy assessment - Image merging -	**6**
6	▪ **SAR Radar Imagery** - Speckle noise - Backscatter radar intensity - Multispectral SAR imagery	**4**
Textbook:	▪ John R. Jensen, 2007. Introductory Digital Image Processing: A Remote Sensing Perspective. Prentice Hall. ▪ Thomas Lillesand, R. W. Keifer and J. Chipman, 2015. Remote Sensing and Image Interpretation, 7th Edition. Wiley.	

Details of Practical Contents		
No.	**Contents**	**Hours**
1	▪ Geo Referencing and Image Enhancement using ERDAS software	**16**
2	▪ Image Classification using ERDAS software	**14**
Textbook:	▪ John R. Jensen, 2007. Introductory Digital Image Processing: A Remote Sensing Perspective. Prentice Hall.	

Textbooks	▪ Thomas Lillesand, R. W. Keifer and J. Chipman, 2015. Remote Sensing and Image Interpretation, 7th Edition. Wiley.
	▪ John R. Jensen, 2007. Introductory Digital Image Processing: A Remote Sensing Perspective. Prentice Hall.

Department	Civil & Architectural Technology		**Major**	Surveying Technology					
Course Name	**Indoor Positioning Technologies**		**Course Code**	SSRV 462					
Prerequisites			**Credit Hours CRH**	3			CTH		4
				L	2	P	2	T	0

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description :

Indoor Positioning Technologies can be used to locate people or objects inside buildings, typically via a mobile device such as a smart phone or tablet. It helps people in finding their targets. With indoor positioning, we are able to guide our visitors exactly to the item they are looking for.

Topics:

- Introduction
- Communications Technologies
- Radio Frequency Positioning
- Non-radio Indoor Positioning Systems
- Some Real-World Indoor Location Systems
- The Business of Location

Experiments: if applicable it will support the course topics.

References:

- Roberto Michel, (2016) Information Management: Wearables come in for a refit, Modern Materials Handling, Retrieved Dec 28, 2016.
- Indoor Location Technologies, 2013, Subrata Goswami

Details of Theoretical Contents		
No.	**Contents**	**Hours**
1	▪ **Introduction** - Concept - Relation to GNSS - Applications	**4**
2	▪ **Communications Technologies** - Coding - Modulation - Spreading - Orthogonal Frequency Division Multiplexing - Multiple Access - Multiple Input Multiple Output - Electromagnetic Radiation Propagation - The Multipath Effect - The Large-Scale Fading Effect - The Small-Scale Fading or Multipath Effect - Multipath Mitigation Techniques	**6**
3	▪ **Radio Frequency Positioning** - Time of Flight - Time of Arrival - Measuring Time of Arrival	**6**

	- Time of Arrival Measurement Through Spread Spectrum - Time of Arrival Measurement Through UWB-IR - Sources of Errors in Time of Flight Methods - Time Difference of Arrival - Round Trip Travel Time - Angle of Arrival - Angle Measurement - Signal Strength - Other Methods	
4	▪ **Non-radio Indoor Positioning Systems** - Sonic and Ultrasonic Waves - Sonic Communication - Sonic Positioning. - Inertial Navigation. - Simultaneous Locationing and Mapping - Augmented Reality	**6**
5	▪ **Some Real-World Indoor Location Systems** - Aeroscout - Zebra - Sonitor - Awarepoint - ISO/IEC 24730 - 802.11v - 802.15.4A/F	**6**
6	▪ **The Business of Location** - The GPS Market - The Location-Based Services Market - The Indoor Location Market	**4**
Textbook:	▪ Indoor Location Technologies, 2013, Subrata Goswami	

Details of Practical Contents		
No.	**Contents**	**Hours**
1	▪ Way-Finding	**4**
2	▪ Public Venues	**4**
3	▪ Healthcare	**4**
4	▪ Geo-Fencing	**4**
5	▪ Proximity Marketing	**4**
6	▪ Multi-Dot	**4**
7	▪ Retail	**4**

Textbook:	▪ Roberto Michel, (2016) Information Management: Wearables come in for a refit, Modern Materials Handling, Retrieved Dec 28, 2016.

Textbooks	▪ Roberto Michel, (2016) Information Management: Wearables come in for a refit, Modern Materials Handling, Retrieved Dec 28, 2016.
	▪ Indoor Location Technologies, 2013, Subrata Goswami

Department	Civil & Architectural Technology	Major	Surveying Technology
Course Name	Point Cloud Science	Course Code	SSRV433
Prerequisites		Credit Hours CRH	3 CTH 4 (L 2 P 2 T 0)

CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours

Course description :

This advanced course will familiarize students with the various data collection technologies used in the generation of 3D point cloud data, and their associated sources of error. This course is aimed at collectors and users of 3D point cloud data so that informed decisions can be made regarding the appropriateness of the various data collection and processing options, and deliverables, and so that the issues around data management are appreciated.

Topics :

- Point Cloud Characteristics
- Point Cloud Acquisition
- Sources of errors
- Pre-processing
- Processing
- Deliverables
- Management
- Applications

Experiments: if applicable it will support the course topics.

References :

- McInerney D., Kempeneers P. (2015) 3D Point Cloud Data Processing. In: Open Source Geospatial Tools. Earth Systems Data and Models. Springer, Cham
- X. L. Hou., Z. W. Liao., S. X. Hu. (2011) Skeletonization of Low-Quality Characters Based on Point Cloud Model. pp 633-643

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	▪ **Point Cloud Characteristics:** a. Accuracy, b. XYZI, c. Other sensors.	**4**
2	▪ **Point Cloud Acquisition:** a. Measurement science: - Time-of-flight, - Amplitude modulated phase, - Frequency modulated phase comparison, - Full waveform measurement, - Image matching. b. Technologies: - TLS, - ALS, - Image matching,	**6**

	- Interferometric scanners, - Industrial scanners, - Hand scanners, - CMM touch probes, - Medical scanners.	
3	▪ **Sources of error:** a. Instrumental, b. Environmental.	**4**
4	▪ **Pre-processing:** a. Cleaning, b. Segmentation, c. Registration, d. Adjustment, e. Geo-referencing.	**4**
5	▪ **Processing:** a. Decimation, b. Classification, c. Modeling, d. Sectioning, e. Rendering, f. Integration with other sensors.	**4**
6	▪ **Deliverables:** a. Point cloud, b. 2D/3D vector drawings, c. Sections, d. Meshed models, e. Textured models, f. CAD primitive models.	**4**
7	▪ **Management:** a. Reprocessing data, b. Formatting, c. Archiving, d. Metadata.	**4**
8	▪ **Applications: Case studies.**	**2**
Textbook:	▪ Open Source Geospatial Tools (2015). Earth Systems Data and Models. Springer, Cham (by McInerney, Daniel, Kempeneers, Pieter).	

Detailed of Practical Contents		
No.	**Contents**	**Hours**
1	▪ Pre-processing	**6**
2	▪ Processing	**6**
3	▪ Deliverables	**6**
4	▪ Management	**6**
5	▪ Applications: Case studies.	**6**
Textbook:	▪ Open Source Geospatial Tools (2015). Earth Systems Data and Models. Springer, Cham (by McInerney, Daniel, Kempeneers, Pieter).	

Textbooks	▪ McInerney D., Kempeneers P. (2015) 3D Point Cloud Data Processing. In: Open Source Geospatial Tools. Earth Systems Data and Models. Springer, Cham.
	▪ Open Source Geospatial Tools (2015). Earth Systems Data and Models. Springer, Cham (by McInerney, Daniel, Kempeneers, Pieter).

Department	Civil & Architectural Technology	Major	Surveying Technology						
Course Name	**Web Technologies (Elective Course-1)**	Course Code	SSRV 4XX						
Prerequisites		Credit Hours CRH	3		CTH	4			
			L	2	P	2	T	0	

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description :

This course is designed to offer an overview of the modern Web technologies used for the Web development. The purpose of this course is to give students the basic understanding of how things work in the Web world from the technology point of view as well as to give the basic overview of the different technologies that can be used to develop Web-based Applications.

Topics:

- Basic design and implementation of websites
- Discussion of different navigation and organizational strategies
- Client-side technologies including HTML5, CSS, JavaScript, JSON, and JQuery
- Server-side technologies emphasizing implementations in PhP
- XML & Web Services
- Web Design
- Web Security

Experiments: if applicable it will support the course topics.

References:

- Web Programming Step by Step (2012) 668 pages, by J. Miller, V. Kirst, Marty Stepp.
- PHP and MySQL for Dynamic Web Sites: Visual QuickPro Guide, (2005) (ISBN 0-321-33657-7) by Larry Ullman .
- Internet and World Wide Web How to Program (2012) ISBN-13: 978-0132151009; ISBN-10: 0132151006 by H. M. Deitel, P. J. Deitel, and A. B. Goldberg .
- http://www.w3.org/
- Practical Web Technologies, by P.K. Yuen and V. Lau (2003) ISBN-13: 978-0201750768 ISBN-10: 0201750767.
- Web Services: Principles and Technology (2008) by Michael P. Papazoglou.

Details of Theoretical Contents		
No.	**Contents**	**Hours**
1	▪ **Introduction to internet concepts and WWW** - HTML - CSS	**4**
2	▪ **JavaScript** - JSON	**4**
3	▪ **JQuery** - AJAX	**4**

4	▪ **PHP** ▪ **MySQL**	**4**
5	▪ **XML**	**4**
6	▪ **Web Services**	**4**
7	▪ **Cookies and Sessions**	**4**
8	▪ **Web Security**	**2**
9	▪ **Web Design** ▪ **User-centered design** - Page layout - Accessibility	**2**
Textbook:	▪ Web Programming Step by Step (2012) 668 pages, by J. Miller, V. Kirst, Marty Stepp.	

Details of Practical Contents		
No.	**Contents**	**Hours**
1	▪ **Basic HTML** - Page Structure - Elements - Lists - Tables - Meta Data - W3C validator	**2**
2	▪ **CSS** - CSS syntax - Properties - Style inheritance - Classes	**2**
3	▪ **JavaScript** - Client-side scripting - Event-Driven programming - DOM - JavaScript Syntax - Program Logic	**2**
4	▪ **JSON** - JavaScript Object Literals - JSON Data Format - Processing JSON Data	**2**

5	▪ **JQuery** - Syntax - Selectors - Events	**3**
6	▪ **AJAX** - Using XMLHTTPREQUEST - Synchronous Requests - Checking for Ajax Errors - Asynchronous Requests	**3**
7	▪ **PHP** - PHP basic syntax - Embedded PHP - Functions - Arrays - For each loop - Classes and Objects	**3**
8	▪ **MySQL** - Database basics - Connecting to MySQL - Select statement - Querying a Database in PHP	**3**
9	▪ **XML** - What is XML? - XML Document Structure, Schemas, and DTDs - Processing XML Data	**3**
10	▪ **Web Services** - WSDL - SOAP - RDF	**3**
11	▪ **Cookies and Sessions** - Cookies in JavaScript - Cookies in PHP - Sessions in PHP	**2**
12	▪ **Web Security** - XSS attack - Regular expressions - SQL Injection - Session Hijacking	**2**
Textbook:	▪ Web Programming Step by Step (2012) 668 pages, by J. Miller, V. Kirst, Marty Stepp.	

Textbooks	▪ Internet and World Wide Web How to Program (2012) ISBN-13: 978-0132151009; ISBN-10: 0132151006 by H. M. Deitel, P. J. Deitel, and A. B. Goldberg .
	▪ Web Programming Step by Step (2012) 668 pages, by J. Miller, V. Kirst, Marty Stepp.

Department	Civil & Architectural Technology	Major	Surveying Technology						
Course Name	**Disaster Management (Elective Course-1)**	Course Code	SSRV4XX						
Prerequisites		Credit Hours CRH	3		CTH	4			
			L	2	P	2	T	0	

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description :

This course is a unique program which will provide a balanced study of environmental hazards and disaster management, pre-event mitigation, disaster risk reduction and disaster relief, along with the development of technical and interpersonal skills. Topics of discussion include the knowledge of Principles and Concepts in Disasters, Management of Coastal and Hydrological Hazards, Management of Geological and Technological Hazards, Personal Preparedness for Disasters, Professional Development for Disasters.

Topics:

- Hazards and Disasters
- Disaster Preparedness and Planning
- Disaster Rehabilitation
- Disaster Risk Assessment
- Case Studies of Crises and Disasters

Experiments: if applicable it will support the course topics.

References:

- Vishvas Publications (2017). Disaster Management Project Book,Class-IX,As Per Latest Syllabus Issued By Cbse-2017-18. ISBN-10: 8175372699. ISBN-13: 978-8175372696. Amazon.
- Brassard, Caroline, Giles, David W., Howitt, Arnold M. (2015). Natural Disaster Management in the Asia-Pacific. Springer. ISBN 978-4-431-55157-7.
- Jack Pinkowski 2008). Disaster Management Handbook. ISBN 9781420058628 - CAT# AU5862. CRC Press. 624p.

Details of Theoretical Contents		
No.	**Contents**	**Hours**
1	▪ **Hazards and Disasters** - Principles and Concepts in Disasters - Classification of Disasters - Levels of Disaster - Effect of Disasters - Causal Factors of Disasters - Hazard - Vulnerability - Risk	**10**

2	▪ **Disaster Preparedness and Planning** - Main Objectives - Dealing with Major Disasters - Strategies for Disaster - Preparedness and Planning - Disaster Preparedness - Disaster Planning, Principles of Disaster Planning - Myths in Disaster Planning - Involvement of Disaster Plan Users	**11**
3	▪ **Disaster Rehabilitation** - Issues in Rehabilitation - Hindrances for Normalization - Rehabilitation Approaches - The Ad Hoc Approach - The Single Sector Approach - The Integrated Recovery Approach - Opportunity for Change after a Disaster, - Rehabilitation: From Shelter To Housing - Materials Distribution For Rehabilitation	**11**
Textbook:	▪ Brassard, Caroline, Giles, David W., Howitt, Arnold M. (2015). Natural Disaster Management in the Asia-Pacific. Springer. ISBN 978-4-431-55157-7.	

Details of Practical Contents		
No.	**Contents**	**Hours**
1	▪ **Disaster Risk Assessment** - Risk Mapping - Vulnerability Analysis - Risk Identification - Factors Influencing Disaster Risk - Assessing Risk in a Context of Uncertainty - Understanding Disaster Risk Assessment - Phases in Risk Assessment - Limitations of Risk Assessment - Integrating Disaster Risk - Assessment in the Project Development Cycle - Disaster Risk Assessment, Steps - Involved in a Disaster Risk Assessment - Sourcing Additional Information, - Disaster Risk Assessment Methods	**18**

	- Disaster Risk Management - Disaster Aid - Disaster Insurance	
2	▪ **Case Studies of Crises and Disasters** - Flood risk management. - Management of Coastal and Hydrological Hazards - Management of Geological and Technological Hazards	**12**
Textbook:	▪ Vishvas Publications (2017). Disaster Management Project Book,Class-IX,As Per Latest Syllabus Issued By Cbse-2017-18. ISBN-10: 8175372699. ISBN-13: 978-8175372696. Amazon.	

Textbooks	▪ Brassard, Caroline, Giles, David W., Howitt, Arnold M. (2015). Natural Disaster Management in the Asia-Pacific. Springer. ISBN 978-4-431-55157-7.
	▪ Vishvas Publications (2017). Disaster Management Project Book,Class-IX,As Per Latest Syllabus Issued By Cbse-2017-18. ISBN-10: 8175372699. ISBN-13: 978-8175372696. Amazon.

Department	Civil & Architectural Technology	Major	Surveying Technology
Course Name	**Underground Surveying (Elective Course-1)**	Course Code	SSRV4XX
Prerequisites		Credit Hours CRH	2 CTH 2

L	2	P	0	T	0

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description :

This course is designed in order to provide students with knowledge and skills of Underground Surveying which represent an important surveying activity and which is different from surveying in the sunlight. Students will be able to applying principles, instrumentation, data analysis methods, and visualization products associated with underground surveying. At the end of the course, the students will be able to gain adequate insight into theoretical aspects of underground surveying.

Topics:

- Concepts of Underground Surveying
- Activities of Underground surveying
- Underground Practices: Station
- Uses of the Mine Maps
- Making the Mine Map

Experiments: if applicable it will support the course topics.

References:

- Loyal Wingate Trumbull (2015). A Manual of Underground Surveying. ISBN 10: 1296722120 ISBN 13: 9781296722128. Publisher: Andesite Press.
- Ghatak (1996). Mine Surveying - Vol. I, II, III, , 5th edition, Coal Field Publishers.

Details of Theoretical Contents		
No.	**Contents**	**Hours**
1	▪ **Concepts of Underground Surveying** - Utility - differences with surveying in the sunlight - Typical Duties of Mining Surveyor	**6**
2	▪ **Activities of Underground surveying** - Mines and Tunnels Design and measurement - Representation of underground mining on mine plans - Mining process management	**6**
3	▪ **Underground Practices: Station** - Kinds - Marking - Numbering - Setting up transit - Sighting in dark	**7**

4	▪ **Uses of the Mine Maps** - Laws regarding mine maps - Uses of the topographical map - Geological maps and sections - Old working - Assay maps	**7**
5	▪ **Making the Mine Map** - Paper - Scale - Platting of Angles - Protractor - Tangents - Chords - Coordinates	**6**
Textbook:	▪ Loyal Wingate Trumbull (2015). A Manual of Underground Surveying. ISBN 10: 1296722120 ISBN 13: 9781296722128. Publisher: Andesite Press. ▪ Ghatak (1996). Mine Surveying - Vol. I, II, III, , 5th edition, Coal Field Publishers.	

Details of Practical Contents		
No.	**Contents**	**Hours**
1	▪ **Uses of the Mine Maps** - Laws regarding mine maps - Uses of the topographical map - Geological maps and sections - Old working - Assay maps	**15**
2	▪ **Making the Mine Map** - Paper - Scale - Platting of Angles - Protractor - Tangents - Chords - Coordinates	**15**
Textbook:	▪ Brassard, Caroline, Giles, David W., Howitt, Arnold M. (2015). Natural Disaster Management in the Asia-Pacific. Springer. ISBN 978-4-431-55157-7.	

Textbooks	▪ Ghatak (1996). Mine Surveying - Vol. I, II, III, , 5th edition, Coal Field Publishers.
	▪ Loyal Wingate Trumbull (2015). A Manual of Underground Surveying. ISBN 10: 1296722120 ISBN 13: 9781296722128. Publisher: Andesite Press.

Department	Civil & Architectural Technology	Major	Surveying Technology
Course Name	Coordinate Transformations (Elective Course-2)	Course Code	SSRV4XX
Prerequisites		Credit Hours CRH	3 CTH 4

L	2	P	2	T	0

CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours

Course description :

This course is designed to offer an overview of coordinate reference systems which are based on the definition of a datum, and which links the chosen coordinate system with the real world. Many datums are commonly used for referencing geospatial position. Students in the field of geospatial engineering must possess the knowledge, skills and competence in selecting, implementing and evaluating the transformation of coordinates between geodetic datums.

Topics:

- Overview of reference systems
- Computations in Cartesian coordinate systems
- Coordinate Transformations

Experiments: if applicable it will support the course topics.

References:

- Jim Crume (2013). Coordinate Transformation: Step by Step Guide (Surveying Mathematics Made Simple) (Volume 9).
- International Standard (2007). Iso 19111:Geographic Information Spatial Referencing by coordinates.
- https://ec.europa.eu/jrc/en/publications-list

Details of Theoretical Contents		
No.	**Contents**	**Hours**
1	▪ **Overview of reference systems** - Coordinate reference systems - Terrestrial reference systems	**6**
2	▪ **Computations in Cartesian coordinate systems** - Computations in 2D Cartesian coordinate system - Computations in 3D Cartesian coordinate system	**6**
3	▪ **Coordinate Transformations** - 2D linear conformal transformations (four parameter) - 2D linear affine transformations (six parameters) - 2D linear perspective transformations (eight parameters) - 3D linear conformal transformations (seven parameter Helmert) - Least Squares computational models for coordinate transformations - Transformations between geodetic reference systems	**20**

	- Transformations between map grids	
Textbook:	▪ Jim Crume (2013). Coordinate Transformation: Step by Step Guide (Surveying Mathematics Made Simple) (Volume 9).	

Details of Practical Contents		
No.	**Contents**	**Hours**
1	▪ Computations in 2D Cartesian coordinate system	**3**
2	▪ Computations in 3D Cartesian coordinate system	**3**
3	▪ 2D linear conformal transformations (four parameter)	**3**
4	▪ 2D linear affine transformations (six parameters)	**3**
5	▪ 2D linear perspective transformations (eight parameters)	**3**
6	▪ 3D linear conformal transformations (seven parameter Helmert)	**3**
7	▪ Least Squares computational models for coordinate transformations	**4**
8	▪ Transformations between geodetic reference systems	**4**
9	▪ Transformations between map grids	**4**
Textbook:	▪ Jim Crume (2013). Coordinate Transformation: Step by Step Guide (Surveying Mathematics Made Simple) (Volume 9).	

Textbooks	▪ International Standard (2007). Iso 19111:Geographic Information Spatial Referencing by coordinates.
	▪ Jim Crume (2013). Coordinate Transformation: Step by Step Guide (Surveying Mathematics Made Simple) (Volume 9).

Department	Civil & Architectural Technology	Major	Surveying Technology						
Course Name	**Advanced Photogrammetry (Elective Course-2)**	Course Code	SSRV4XX						
Prerequisites		Credit Hours CRH	3		CTH	4			
			L	2	P	2	T	0	

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description :

This course will allow students carry out photo coordinates measurement and refinement, derive collinearity and coplanarity equations using collinearity and coplanarity conditions, respectively and apply these equations in forming analytical relative orientation, absolute orientation and aerial triangulation models and use of both terrestrial and unmanned aerial photographs to produce geometric survey data. Developing computer programs will be a task for some of these applications.

Topics:

- Image coordinates measurements and refinement
- Derivation and linearization of collinearity and coplanarity equations
- Applications of collinearity and coplanarity equations in photogrammetric mathematical models
- Close range or terrestrial photogrammetry
- Radaragrammetry and LIDAR Mapping
- Unmanned Aerial Vehicle Phtogrammetry

Experiments: if applicable it will support the course topics.

References:

- Wolf, P., B.A. Dewitt and B. E. Wilkinson, 2014. Elements of Photogrammetry with Applications in GIS. 4th edition. Mc Grew Hill, NY, USA.
- Thomas Luhman, Stuart Robson, Stephen Kyle and Ian Harley, 2011. Close Range Photogrammetry: Principles, Techniques and Applications. Whittles Publishing.

ISBN-13: 978-1849950572

- Colomina, I. and P.Molina, 2014. "Unmanned aerial systems for photogrammetry and remote sensing: A review." ISPRS Journal of Photogrammetry and Remote Sensing. Volume 92, June 2014, Pages 79-97. https://doi.org/10.1016/j.isprsjprs.2014.02.013
- Grandshaw, S. I., 2010. Close Range Photogrammetry: Principles, Methods And Applications.
- Ebadi, H., 2006. Advanced Analytical Aerial Triangulation. KN Toosi University of Technology.
- Toutin, T., and Gray, L., 2000, State-of-the-art of elevation extraction from satellite SAR data. ISPRS Journal of Photogrammetry & Remote Sensing, 55: 13-33

Details of Theoretical Contents		
No.	**Contents**	**Hours**
1	▪ **Image Coordinates Measurement and Refinement** - Image and space coordinate Systems - Measurement of photo coordinates (Comparators) - Refinement of Image Coordinates - Two dimensional Conformal, Affine and Projective image coordinate transformations	**6**

2	▪ **Collinearity Condition and Equations** - Collinearity condition and derivation of collinearity equations - Linearization of Collinearity equations - Applications of collinearity equations: Space Resection, analytical relative orientation and analytical aerial triangulation	**6**
3	▪ **Coplanarity Condition and Equations** - Coplanarity condition and derivation of coplanarity equations - Linearization of coplanarity equations - Analytical relative orientation model from coplanarity equation	**4**
4	▪ **Close Range Photogrammetry (CRP)** - Close range cameras and calibration - Computation of camera axis angle of inclination, horizontal and vertical angles and location of camera exposure station. - Three dimensional positioning by intersection from two or more overlapping terrestrial photos - Applications of CRP: Medical applications, recording complex structures, measurement of surface roughness.	**6**
5	▪ **Radaragrammetry and LIDAR Mapping** - Concept and advantages of Radaragrammetry - Production of DEM from Radaragrammetry - Principles of LIDAR and IFSAR - Generation of DEM from Lidar and IFSAR	**4**
6	▪ **Unmanned Air Vehicle (UAV) Photogrammetry** - Concept and development of UAV photogrammetry - UAV photogrammetry in cadastral applications - UAV photogrammetry for mapping and 3D modelling - Point cloud generation from UAV imagery - Three-dimensional building reconstruction using images obtained by UAV.	**6**
Textbook:	▪ Wolf, P., B.A. Dewitt and B. E. Wilkinson, 2014. Elements of Photogrammetry with Applications in GIS. 4th edition. Mc Grew Hill, NY, USA.	

Detailed of Practical Contents		
No.	**Contents**	**Hours**
1	▪ Measurement of Photo coordinates	**6**
2	▪ Mapping from Close Range Cameras	**8**
3	▪ UAV Mapping	**8**
4	▪ Radar and Lidar DEM production	**8**
Textbook	▪ Wolf, P., B.A. Dewitt and B. E. Wilkinson, 2014. Elements of Photogrammetry with Applications in GIS. 4th edition. Mc Grew Hill, NY, USA.	

Textbooks	▪ Thomas Luhman, Stuart Robson, Stephen Kyle and Ian Harley, 2011. Close Range Photogrammetry: Principles, Techniques and Applications. Whittles Publishing. ISBN-13: 978-1849950572
	▪ Wolf, P., B.A. Dewitt and B. E. Wilkinson, 2014. Elements of Photogrammetry with Applications in GIS. 4th edition. Mc Grew Hill, NY, USA.

Department	Civil & Architectural Technology	**Major**	Surveying Technology
Course Name	**Land Law and Registration (Elective Course-2)**	**Course Code**	SSRV4XX
Prerequisites		**Credit Hours CRH**	3 CTH 4 L 2 P 2 T 0

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description :

The course will give students broad background about various registration systems used worldwide with emphasis on that adopted in KSA, survey laws and legal principles related to transfer and endorsing real estate ownership in KSA using deeds and plans, professional ethics and role of surveyors.

Topics:

- Land law, records, tenures, leasehold and conveyancing
- Registration Systems
- Registration of deeds in KSA
- Boundaries and surveyor's role
- Valuation of Land

Experiments: if applicable it will support the course topics.

References:

- Gay, P., 2002. Fundamentals of Boundary Surveying: How Boundaries are Established. Professional Surveyors Publishing (2002).
- J. Mackenzie and M. Phillips, 2010. Textbook on Land Law. 13th edition. Oxford University Press.
- G. J. Donnelly, Fundamentals of Land Ownership, Land Boundaries and Surveying. International Committee on Surveying and Mapping

Details of Theoretical Contents		
No.	**Contents**	**Hours**
1	▪ **Land Law and Records** - Evolution and development of land law - The legal Aspects of Real Estates in KSA - Leasehold and Conveyance - The role of ethics and the surveyors duties	**8**
2	▪ **Registration Systems** - Land boundaries - Concept of registered and unregistered land - History of land registration systems - Registrations of deeds - Registration of title - English and Torren registration systems - Registration system in KSA	**8**
	▪ **Boundaries and surveyor's role**	

3	- Techniques and functions of cadastral surveying - Demarcation of Boundaries - Layouts and subdivision of parcels - Maps and plans for deed and title registration - Land consolidation and resettlement surveys - Boundaries at sea	**8**
4	▪ **Valuation of Land** - Land as a resource - Traditional methods of land valuation - Factors for Valuation of Land - Valuing land separately from developments on the land - The effect of planning regulations on land values - The need for regular valuations - Capital Values versus Rental values	**8**
Textbook:	▪ Gay, P., 2002. Fundamentals of Boundary Surveying: How Boundaries are Established. Professional Surveyors Publishing (2002).	

Details of Practical Contents		
No.	**Contents**	**Hours**
1	▪ Designing a Land Registration System	**12**
2	▪ Field Boundary Mapping using ground survey and aerial survey	**18**
Textbook:	▪ Gay, P., 2002. Fundamentals of Boundary Surveying: How Boundaries are Established. Professional Surveyors Publishing (2002).	

Textbooks	▪ J. Mackenzie and M. Phillips, 2010. Textbook on Land Law. 13th edition. Oxford University Press.
	▪ Gay, P., 2002. Fundamentals of Boundary Surveying: How Boundaries are Established. Professional Surveyors Publishing (2002).

Department	Civil & Architectural Technology			**Major**	Surveying Technology						
Course Name	**Project (1)**			**Course Code**	SSRV 491						
Prerequisites				**Credit Hours CRH**	**4**		CTH	4			
					L	**2**	P	**4**	T	**0**	

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description :

This course is the first part of applied project. Trainee gets the chance to get knowledge about executable projects within capacity of trainee. In addition, Trainee reviews some maps and reports of already executed projects.

Trainee should select a project in coordination with his supervisor. The selected project should meet some standards such as: allows trainee to apply what he already have of skills and experiences during his study. In addition, Trainee should be able to use available supplies such as computer labs, survey systems and software, modern instruments to collect data, process and adjust data, compute final coordinates and draw maps at required scale.

Experiments: If applicable, it will support the course topics.

References:

- Instrument manual, program manual, books and material used during training stage.

Details of Contents		
No.	**Contents**	**Hours**
1	**First Step:** - Preview already executed projects, and suggested projects. - Display some available projects. - Suggesting some idea for new projects. - Reviewing available survey software, hardware, and instruments. - Define the objectives of the project. - Final evaluation requirements regarding presentation of project out comes.	**90**
Textbook:	▪ Instrument manual, program manual, books and material used during training stage.	

Department	Civil & Architectural Technology	Major	Surveying Technology						
Course Name	Project (2)	Course Code	SSRV 492						
Prerequisites	CSRV 491	Credit Hours CRH	4		CTH	4			
			L	2	P	4	T	0	

CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours

Course description :

This course is the second part of applied project. Trainee gets the chance to practice using most advanced systems to execute projects. In addition, Trainee applies his experiences in carrying out some engineering and surveying projects.

Trainee should select a project in coordination with his supervisor. The selected project should meet some standards such as: allows trainee to apply what he already has of skills and experiences during his study.

Also Trainee should be able to use available supplies such as computer labs, survey systems and software, modern instruments to collect data, process and adjust data, compute final coordinates and draw maps at required scale, compute volumes of cut and fill from contour maps an longitudinal and cross sections, also use available software of Remote sensing, and geographic information systems, digital photogrammetry.

Experiments: If applicable, it will support the course topics.

References:

- Instrument manual, program manual, books and material used during training stage.

Details of Contents		
No.	**Contents**	**Hours**
1	**Second Step:** - Carry out project stages. - Set up project plan. - Evaluate and select required instruments and survey systems. - Fieldwork to collect data. - Office work to process data and compute file results. - Draw final map, and prepare final documents. - Present final product for evaluation.	**90**

Textbook:	▪ Instrument manual, program manual, books and material used during training stage.

Appendix Laboratory Equipment, Workshops and Laboratories

No.	Laboratory name / workshop	Capacity of training	Number of trainers	Training courses benefiting from the laboratory / workshop / lab
1	Geodesy Laboratory	30	15 per group	- Geodesy - Map Making and Projection - Point Cloud Science - Underground Surveying
2	GIS Laboratory	28	15 per group	- Geographic Information Analysis - Distributed Geographic Information Systems - Spatial Databases - Disaster Management
3	Remote sensing Laboratory	24	15 per group	- Remote Sensing - Digital Photogrammetry - Digital Image Processing - Advanced Photogrammetry
4	Survey Applications Laboratory	30	15 per group	- Computer Survey Applications - Coordinate Transformations - Theory of Errors & Observation Adjustment - Hydrographic surveying - Underground Surveying
5	Highway Engineering Laboratory	30	15 per group	- Highway Engineering
6	Computer Laboratory	30	15 per group	- Web Technology

List of Detailed Equipment for Each Laboratory, Workshop or Lab

List of Detailed Equipment for Each Laboratory, Workshop or Lab

Lab or Workshop's Name: Geodesy Laboratory		
No.	**Product's Name**	**Quantity**
1.	• Surveying Magnetic Locators	15
2.	• Surveyors Safety Vests	50
3.	• Field Books	100
4.	• Flagging and Survey Markers	100
5.	• Gammon Reels	15
6.	• Marking Paint	50
7.	• Hubs & Nails	100
8.	• Surveying Tripods	15
9.	• Surveying Bipods	15
10.	• Prism Poles	15
11.	• Prisms	15
12.	• Range Poles	15
13.	• GPS Equipment	5
14.	• Surveying Equipment Adapters	10
15.	• Clamps and Cradles	100
16.	• Robotics Poles	15
17.	• Robotics Accessories	15
18.	• Grade Rods	15
19.	• Cut & Fill Grade Rods	15
20.	• Direct Reading Optical Rods	15
21.	• Direct Reading Laser Rods	15
22.	• Tribrachs	15
23.	• Automatic Levels	15
24.	• Precise Levels	5
25.	• Electronic Levels	15

26.	• Total Stations	5
27.	• Elevating Tripods	15
28.	• Hand Levels	15
29.	• Measuring Tapes	20
30.	• Brush Axes	15
31.	• Plumb Bobs	15
32.	• Surveyors Hand Tools	15
33.	• Scanner Targets	15
34.	• Laser Scanner Accessories	15
35.	• Bags & Cases	15
36.	• Compasses	15
37.	• Surveyors Umbrellas	30
38.	• Surveying Equipment Batteries & Chargers	10
39.	• 3D Scanners	3

Lab or Workshop's Name: GIS Laboratory		
No.	**Product's Name**	**Quantity**
1.	• ArcGIS Desktop (Software)	For 15 users
2.	• Web GIS (Software)	For 15 users
3	• Data collectors	15

Lab or Workshop's Name: Remote sensing Laboratory		
No.	**Product's Name**	**Quantity**
1.	• ERDAS Imagine (Software)	For 15 users
2.	• LPS (Software)	For 15 users

Lab or Workshop's Name: Survey Applications Laboratory		
No.	**Product's Name**	**Quantity**
1.	• Software for least square adjustment & adjusting surveying observations	For 15 users
2.	• Mobile & mobile application for Indoor Positioning	15

References

Textbooks	**1.**	Geodesy, Jürgen Müllerand Wolfgang Torge, 2012, de Gruyter Textbook
	2.	Introduction to Geometrical and Physical Geodesy: Foundations of Geomatics, Thomas H, Meyer, 2012, Esri Press.
	3.	Map Use and Analysis. (Campbell 2012)
	4.	ArcGIS™ version 10 or 10.1 from ESRI, User's Guide
	5.	Spatial Data Analysis for Geographic Information Science By Taher Buyong
	6.	Geographic Information analysis (by David O'Sullivan and David J. Unwin).
	7.	Robert van der Velden;etal Huibert-Jan Lekkerkerk (2006). Handbook of Offshore Surveying Volume 1. Amazon.
	8.	C. D. de Jong , G. Lachapelle , I .A. Elema (Contributor), S. Skone , (2006). Hydrography. Amazon.
	9.	American Society of Civil Engineers, (1998). Hydrographic Surveying. 328p.
	10.	Spatial Database Systems: Design, Implementation and Project Management edited by Albert K. W. Yeung, G. Brent Hall.
	11.	Spatial Databases with application to GIS (by: Philippe Rigaux, Michel Scholl and Agnes Voisard).
	12.	GIS a computing perspective (by: Michael Worboys and Matt Duckham).
	13.	Jensen, J.R. 2007. Remote Sensing of the Environment - an Earth Resource Perspective 2nd ed. Upper Saddle River, NJ, Prentice Hall.
	14.	Jensen, J.R. 2000. Remote Sensing of the Environment - an Earth Resource Perspective 1st ed. Upper Saddle River, NJ, Prentice Hall.
	15.	Ackerman, F, "Automatic Aero triangulation". (1995)
	16.	Heipke, C," Automation of interior, relative, and absolute orientation". (1997)
	17.	Drewniok, C. & Rohr, K," Automatic exterior orientation of aerial images in urban environment". (1996)
	18.	AutoDesk (2017). AutoCad user manual.
	19.	Bentely (2017). Micro Station user manual.
	20.	Available Survey Package user manual.
	21.	Traffic and Highway Engineering, Fourth Edition, Nicholas J. Garber, Lester A. Hoel, University of Virginia. 2009, Cengage Learning, 1120 Birchmount Road, Toronto ON M1K 5G4 Canada.
	22.	O'Flaherty, C.A. (ed) Highways: The Location, Design, Construction and Maintenance of Road Pavements. Butterworth Heinemann.
	23.	Design of Highway Bridges, Authors: Richard Barker & Jay Puckett, Publisher: Wiley Interscience.
	24.	Adjustment computations: spatial data analysis, charles d. Ghilani and paul wolf, 2010, john wiley & sons, inc.
	25.	DeCastellarnau, A. and Saris, W. E. (2014). A simple procedure to correct for measurement errors in survey research. European Social Survey Education Net (ESS EduNet).
	26.	Saris, W. E.; Revilla, M. (2015). "Correction for measurement errors in survey research: necessary and possible". *Social Indicators Research*. **127**: 1005–1020. :10.1007/s11205-015-1002.

	27.	Zhong-RenPeng, Ming-Hsiang Tsou (2003) Internet GIS: Distributed Geographic Information Services for the Internet. ISBN: 978-0-471-35923-4.
	28.	Web GIS: Principles and Applications (by: Pinde Fu and Jiulin Sun).
	29.	Ralph Bernstein, Digital image processing for remote sensing. *IEEE Press.*
	30.	Richards, J. A. & J. Xiuping, "Remote Sensing Digital Image Analysis", 4th edn.2006, Springer-Verlag Berlin Heidelberg.
	31.	Roberto Michel, (2016) Information Management: Wearables come in for a refit, Modern Materials Handling, Retrieved Dec 28, 2016.
	32.	Indoor Location Technologies, 2013, Subrata Goswami
	33.	McInerney D., Kempeneers P. (2015) 3D Point Cloud Data Processing. In: Open Source Geospatial Tools. Earth Systems Data and Models. Springer, Cham
	34.	X. L. Hou., Z. W. Liao., S. X. Hu. (2011) Skeletonization of Low-Quality Characters Based on Point Cloud Model. pp 633-643
	35.	Web Programming Step by Step (2012) 668 pages, by J. Miller, V. Kirst, Marty Stepp.
	36.	PHP and MySQL for Dynamic Web Sites: Visual QuickPro Guide, (2005) (ISBN 0-321-33657-7) by Larry Ullman .
	37.	Internet and World Wide Web How to Program (2012) ISBN-13: 978-0132151009; ISBN-10: 0132151006 by H. M. Deitel, P. J. Deitel, and A. B. Goldberg .
	38.	Practical Web Technologies, by P.K. Yuen and V. Lau (2003) ISBN-13: 978-0201750768
	39.	Vishvas Publications (2017). Disaster Management Project Book,Class-IX,As Per Latest Syllabus Issued By Cbse-2017-18. ISBN-10: 8175372699. ISBN-13: 978-8175372696. Amazon.
	40.	rd, Caroline, Giles, David W., Howitt, Arnold M. (2015). Natural Disaster Management in the Asia-Pacific. Springer. ISBN 978-4-431-55157-7.
	41.	Jack Pinkowski 2008). Disaster Management Handbook. ISBN 9781420058628 - CAT# AU5862. CRC Press. 624p.
	42.	Loyal Wingate Trumbull (2015). A Manual of Underground Surveying. ISBN 10: 1296722120 ISBN 13: 9781296722128. Publisher: Andesite Press.
	43.	Ghatak (1996). Mine Surveying - Vol. I, II, III, , 5th edition, Coal Field Publishers.
	44.	Jim Crume (2013). Coordinate Transformation: Step by Step Guide (Surveying Mathematics Made Simple) (Volume 9).
	45.	International Standard (2007). Iso 19111:Geographic Information Spatial Referencing by coordinates.
	46.	Wolf, P., B.A. Dewitt and B. E. Wilkinson, 2014. Elements of Photogrammetry with Applications in GIS. 4th edition. Mc Grew Hill, NY, USA.
	47.	Thomas Luhman, Stuart Robson, Stephen Kyle and Ian Harley, 2011. Close Range Photogrammetry: Principles, Techniques and Applications. Whittles Publishing.
	48.	Colomina, I. and P.Molina, 2014. "Unmanned aerial systems for photogrammetry and remote sensing: A review." ISPRS Journal of Photogrammetry and Remote Sensing. Volume 92, June 2014, Pages 79-97. https://doi.org/10.1016/j.isprsjprs.2014.02.013

	49.	Grandshaw, S. I., 2010. Close Range Photogrammetry: Principles, Methods And Applications.
	50.	Ebadi, H., 2006. Advanced Analytical Aerial Triangulation. KN Toosi University of Technology.
	51.	Toutin, T., and Gray, L., 2000, State-of-the-art of elevation extraction from satellite SAR data. ISPRS Journal of Photogrammetry & Remote Sensing, 55: 13-33
	52.	Gay, P., 2002. Fundamentals of Boundary Surveying: How Boundaries are Established. Professional Surveyors Publishing (2002).
	53.	J. Mackenzie and M. Phillips, 2010. Textbook on Land Law. 13th edition. Oxford University Press.
	54.	G. J. Donnelly, Fundamentals of Land Ownership, Land Boundaries and Surveying. International Committee on Surveying and Mapping
	55.	O'Flaherty, C.A. (ed) Highways: The Location, Design, Construction and Maintenance of Road Pavements. Butterworth Heinemann.
	56.	Design of Highway Bridges, Authors: Richard Barker & Jay Puckett, Publisher: Wiley Interscience.
	57.	Adjustment computations: spatial data analysis, charles d. Ghilani and paul wolf, 2010, john wiley & sons, inc.
	58.	DeCastellarnau, A. and Saris, W. E. (2014). A simple procedure to correct for measurement errors in survey research. European Social Survey Education Net (ESS EduNet).
	59.	Saris, W. E.; Revilla, M. (2015). "Correction for measurement errors in survey research: necessary and possible". *Social Indicators Research*. **127**: 1005–1020. :10.1007/s11205-015-1002.
	60.	Zhong-RenPeng, Ming-Hsiang Tsou (2003) Internet GIS: Distributed Geographic Information Services for the Internet. ISBN: 978-0-471-35923-4.
	61.	Web GIS: Principles and Applications (by: Pinde Fu and Jiulin Sun).
	62.	Ralph Bernstein, Digital image processing for remote sensing. *IEEE Press.*
	63.	Richards, J. A. & J. Xiuping, "Remote Sensing Digital Image Analysis", 4th edn.2006, Springer-Verlag Berlin Heidelberg.
	64.	Roberto Michel, (2016) Information Management: Wearables come in for a refit, Modern Materials Handling, Retrieved Dec 28, 2016.
	65.	Indoor Location Technologies, 2013, Subrata Goswami
	66.	McInerney D., Kempeneers P. (2015) 3D Point Cloud Data Processing. In: Open Source Geospatial Tools. Earth Systems Data and Models. Springer, Cham
	67.	X. L. Hou., Z. W. Liao., S. X. Hu. (2011) Skeletonization of Low-Quality Characters Based on Point Cloud Model. pp 633-643
	68.	Web Programming Step by Step (2012) 668 pages, by J. Miller, V. Kirst, Marty Stepp.
	69.	PHP and MySQL for Dynamic Web Sites: Visual QuickPro Guide, (2005) (ISBN 0-321-33657-7) by Larry Ullman .
	70.	Internet and World Wide Web How to Program (2012) ISBN-13: 978-0132151009; ISBN-10: 0132151006 by H. M. Deitel, P. J. Deitel, and A. B. Goldberg .

	71.	Practical Web Technologies, by P.K. Yuen and V. Lau (2003) ISBN-13: 978-0201750768
	72.	Web Services: Principles and Technology (2008) by Michael P. Papazoglou.
	73.	Vishvas Publications (2017). Disaster Management Project Book,Class-IX,As Per Latest Syllabus Issued By Cbse-2017-18. ISBN-10: 8175372699. ISBN-13: 978-8175372696. Amazon.
	74.	Brassard, Caroline, Giles, David W., Howitt, Arnold M. (2015). Natural Disaster Management in the Asia-Pacific. Springer. ISBN 978-4-431-55157-7.
	75.	Jack Pinkowski 2008). Disaster Management Handbook. ISBN 9781420058628 - CAT# AU5862. CRC Press. 624p.
	76.	Loyal Wingate Trumbull (2015). A Manual of Underground Surveying. ISBN 10: 1296722120 ISBN 13: 9781296722128. Publisher: Andesite Press.
	77.	Ghatak (1996). Mine Surveying - Vol. I, II, III, , 5th edition, Coal Field Publishers.
	78.	Jim Crume (2013). Coordinate Transformation: Step by Step Guide (Surveying Mathematics Made Simple) (Volume 9).
	79.	International Standard (2007). Iso 19111:Geographic Information Spatial Referencing by coordinates.
	80.	Wolf, P., B.A. Dewitt and B. E. Wilkinson, 2014. Elements of Photogrammetry with Applications in GIS. 4th edition. Mc Grew Hill, NY, USA.
	81.	Thomas Luhman, Stuart Robson, Stephen Kyle and Ian Harley, 2011. Close Range Photogrammetry: Principles, Techniques and Applications. Whittles Publishing.
	82.	Colomina, I. and P.Molina, 2014. "Unmanned aerial systems for photogrammetry and remote sensing: A review." ISPRS Journal of Photogrammetry and Remote Sensing. Volume 92, June 2014, Pages 79-97. https://doi.org/10.1016/j.isprsjprs.2014.02.013
	83.	Grandshaw, S. I., 2010. Close Range Photogrammetry: Principles, Methods And Applications.