University of Isfahan

Geomatics Engineering Undergraduate Program

Curriculum

Department of Geomatics Engineering

Faculty of Civil and Transportation Engineering

University of Isfahan

January 8, 2024

Definition and Goal

Geomatics engineering undergraduate program is one of the higher education programs that its goal is training skilled experts for surveying and Geomatics engineering projects.

Duration and Structure

The average duration of this program is 4 years. Every semester lasts 16 complete weeks of education. Each theoretical course takes 16 hours, each laboratory course might take 32 or 48 hours, and each workshop takes 48 hours each semester.

Credits

The total number of credits in this program is 140 that is described in Table 1. The titles of the aforementioned courses are as listed in Tables 2, 3 for general and basic courses and the following two table of contents for core and elective courses.

Table 1. Course credits of Geomatics engineering undergraduate program

No.	Type of courses	Credits
1	General courses	22
2	Basic courses	20
3	Core courses	42
4	Elective courses	22
Total		140

Table 2. General courses for Geomatics engineering undergraduate program

Course Title	Credits	Hours per week			Prerequisites/ Co-requisites
		Theoretical	Practical	Guided learning	
Islamic Thought 1	2	2	-	-	-
Islamic Thought 2	2	2	-	-	Islamic Thought 1
Islamic Ethics	2	2	-	-	-
Islamic Revolution	2	2	-	-	-
Islamic History	2	2	-	-	-
Quran Studies	2	2	-	-	-
Human Right in Islam	2	2	-	-	-
General Literature	3	3	-	-	-
General Foreign Language	3	3	-		

Course Title	Credits	Hours per week			Prerequisites/ Co-requisites
Physical Education 1	1	-	2	-	-
Physical Education 2	1	-	2	-	Physical Education 1
Total	22	20	4		

Table 3. Basic courses for Geomatics engineering undergraduate program

Course Title	Credits	Hours per week			Prerequisites/ Co-requisites
		Theoretical	Practical	Guided learning	
Calculus 1	3	3	-	1	-
Calculus 2	3	3	-	1	Calculus 1
Differential Equations	3	3	-	1	Calculus 2 (P/C)
Physics 1 (Mechanics & Heat)	3	3	-	1	Calculus 1 (P/C)
Computer Programming	3	3	-	-	Calculus 1
Numerical Methods	2	2	-	-	Calculus 1 Computer Programming (P/C)
Physics Lab 1	1	-	3	-	Physics 1 (P/C)
Statistics & Probability for Engineering	2	2	-	1	Calculus 1
Total	20	19	3		

The following table of contents shows the list of core and elective courses:

List of Core and Elective Courses

Core Courses

Remotely Sensed Image Processing

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Remotely Sensed Image processing, S5

Number of credits: 2

COURSE PREREQUISITES

Principles of Remote Sensing

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Mehdi Momeni

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone number: +983137935288

Homepage: https://eng.ui.ac.ir/~momeni

Email address: momeni@surv.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	1 h	-	1/3 h

COURSE OBJECTIVES

Be familiar with the principles of the image processing

Know the terms and workflow of the image processing in Remote sensing

Become experts in recognition of the branches and approaches of the image processing

REQUIRED STUDENT RESOURCES

Textbooks:

1. Richards, J. A., "Remote Sensing Digital Image Analysis: An Introduction", Springer, 2013.
2. Gieske A.S.M., Hecker C.A., Huurneman G.C., van der Horn J.A., Tempfli K., Grabmaier K.A., Janssen L.L.F., Feringa W.F., Bakker W.H., "Principles of remote sensing : an introductory textbook", ITC Educational Textbook Series 2, 2009.

References:

1. Rees W. G., "Physical Principles of Remote Sensing", 3rd Edition, University of Cambridge, 2012.

Emery W., Camps A., "Introduction to Satellite Remote Sensing, Atmosphere, Ocean, Cryosphere and Land Applications", Elsevier Science, 2017.

Thenkabail P.S., "Remotely Sensed Data Characterization, Classification, and Accuracies", 1st Edition, CRC Press, 2015.

Web links:--

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Introduction to principles, applications and necessities
2	Digital image formation and structure, the concept of Pixel
3	Color spaces (RGB, HIS, CMY)
4	Basic calculations in image processing (variance, median, mean, entropy, image information content etc.)
5	Basic image processing (histogram modification, contrast and brightness improvement, spatial and radiometric resolutions modification, satellite images' color composition)
6	Introduction to image formats (necessity, compression, general image formats, Remote Sensing image formats)
7	Image transformation (PCA, bands arithmetic, etc.)
8	Space domain filters (Introduction to correlation and convolution, mean, median, variance etc.)
9	Specific image filters (Introduction to morphologic filters, second order statistical filters)
10	Remote sensing image corrections (radiometric, atmospheric)

11	Introduction to image fusion (PCA, HIS, Brovey)

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	3 points
Comprehensive Assignment	4 points (at max)
Mid-Term Exam	5 points
Final Exam	8 points
Total Points	20 points

Analysis of Remotely Sensed Images

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Analysis of Remotely Sensed Images, S7

Number of credits: 2

COURSE PREREQUISITES

Remotely Sensed Image processing

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Mehdi Momeni

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone number: +983137935288

Homepage: https://eng.ui.ac.ir/~momeni

Email address: momeni@surv.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	1 h	-	1/3 h

COURSE OBJECTIVES

Be familiar with the principles of the Remote sensing image processing

Know the workflow of the Remote sensing analysis

Get some skills in Remote sensing applications

Required Student Resources

Textbooks:

1. Richards, J. A., "Remote Sensing Digital Image Analysis: An Introduction", Springer, 2013.

Jensen J. R., "Introductory Digital Image Processing: A Remote Sensing Perspective", Pearson Education, 2015.

References:

1. Rees W. G., "Physical Principles of Remote Sensing", 3rd Edition, University of Cambridge, 2012.
2. Emery W., Camps A., "Introduction to Satellite Remote Sensing, Atmosphere, Ocean, Cryosphere and Land Applications", Elsevier Science, 2017.
3. Mather P., Tso B., "Classification Methods for Remotely Sensed Data", 2nd Edition, CRC Press, 2009.
4. Thenkabail P.S.,"Remotely Sensed Data Characterization, Classification, and Accuracies", 1st Edition, CRC Press, 2015.

Student's field trip:

Visiting is necessary along with the approval of the specialized council of the department.

Course Schedule/Outline/Calendar of Events

Week	Topic
1	Introduction to principles and history of Remote sensing applications
2	Principles of satellite image interpretation
3	Visual interpretation of the satellite image
4	Supervised classification methods of the satellite image
5	Unsupervised classification methods of the satellite image
6	Introduction to knowledge-based classification
7	Image segmentation: simple methods
8	Pre-processing
9	Remote sensing accuracy assessment

Evaluation Procedures and Grading Criteria

Assignments 3 points

Comprehensive Assignment	4 points (at max)
Mid-Term Exam	5 points
Final Exam	8 points
Total Points	20 points

Analysis of Remotely Sensed Images Lab

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Analysis of Remotely Sensed Images Lab, S7

Number of credits: 1

COURSE PREREQUISITES

COURSE CO-REQUISITES

Analysis of Remotely Sensed Images

TEACHERS

The person in charge: Dr. Mehdi Momeni

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Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
-	-	2 h	1/3 h

COURSE OBJECTIVES

Know and use the workflow of the Remote sensing analysis

Get some operational skills in Remote sensing applications

REQUIRED STUDENT RESOURCES

Textbooks:

1. Richards, J. A., "Remote Sensing Digital Image Analysis: An Introduction", Springer, 2013.

Jensen J. R., "Introductory Digital Image Processing: A Remote Sensing Perspective", Pearson Education, 2015.

ENVI help (tutorial)

References:

1. Rees W. G., "Physical Principles of Remote Sensing", 3rd Edition, University of Cambridge, 2012.
2. Emery W., Camps A., "Introduction to Satellite Remote Sensing, Atmosphere, Ocean, Cryosphere and Land Applications", Elsevier Science, 2017.
3. Mather P., Tso B., "Classification Methods for Remotely Sensed Data", 2nd Edition, CRC Press, 2009.
4. Thenkabail P.S., "Remotely Sensed Data Characterization, Classification, and Accuracies", 1st Edition, CRC Press, 2015.

Student's field trip:

Visiting is necessary along with the approval of the specialized council of the department.

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Visual interpretation of the different satellite images
2	Vegetation cover extraction and change detection
3	Change Detection: 2 simple methods
4	knowledge-based classification: a simple method
5	Remote sensing accuracy assessment methods: comparison and reference data sources
6	Image segmentation: programming a simple method
7	Comparison of different information extraction methods
8	Pre-processing
9	Role of spatial resolution in information extraction

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	12 points
Comprehensive Assignment	4 points (at max)
Mid-Term Exam	- points
Final Exam	4 points
Total Points	20 points

Linear Algebra

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Linear Algebra, S3

Number of credits: 3

COURSE PREREQUISITES

General mathematics 1

COURSE CO-REQUISITES

TEACHERS:

The person in charge: Dr. Hamid Mehrabi

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

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Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	1 h	---	1/3 h

COURSE OBJECTIVES

The purpose of this course is to acquaint students with the concepts of linear algebra required in the field of surveying engineering. Based on this, matrix calculations, generalized inverses, eigenvectors and eigenvalues of a matrix and linear equations are taught.

REQUIRED STUDENT RESOURCES

References:

1. Dianst, S.A., Saber, E.S. (2009) Advanced Linear Algebra For Engineer With Matlab.
2. Strang, G. And K. Borre (1997) Linear Algebra, Geodesy, And Gps, Siam.
3. Stang, G. (2006) Linear Algebra And Its Applicatios, Thomson, Brooks/Cole.
4. Halmos, P.R, (1947) Finitc Dimensional Vector Spaces, Princton Univesity Press.
5. Hoffman, K. And R.A. Kunze (1971) Linear Algebra 2nd Ed, Prentice-Hall Of India Pvt, Limited.
6. Lipschutz, S. And M. Lipson (2008), Schaurn, s Outlinc Of Linear Algebra Fourth Edition, Megraw-Hill Education.

Web linkes:-

Student's field trip:

Visiting is not necessary.

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Vector spaces: Basic vectors, base and dimension, linear independence and dependence, linear transformation.
2	Matrices, matrix algebra, and matrix operators: Addition, multiplication, and division of matrices, rank of a matrix, row and column spaces of a matrix, determinant, calculation of inverse matrices.
3	Introduction to differential and integral calculus of matrices: Derivatives of a vector, chain rule for vectors, derivative of a scalar function of a matrix with respect to a matrix, derivative of a matrix with respect to a matrix, its elements, and vice versa.
4	normed vector spaces: Inner product spaces, orthogonality, normal and orthogonal sets, generalized Fourier series.
5	Eigenvalues and eigenvectors: Properties of eigenvalues and eigenvectors, triangularization theorem, spectral theorem, special matrices, singular value decomposition (SVD), matrix norm and condition number.
6	Solving systems of linear equations: Gaussian elimination, consistent systems, inconsistent systems.

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	2 points
Comprehensive Assignment	3 points (at max)
Mid-Term Exam	7 points
Final Exam	8 points
Total Points	20 points

Theory of Errors

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Theory of Errors, S3

Number of credits: 3

COURSE PREREQUISITES

Probability and Statistics of Engineering

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Hamid Mehrabi

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Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	1 h	---	1/3 h

COURSE OBJECTIVES

The purpose of this course is to acquaint students with the processing observations and mapping data and their statistical analysis.

REQUIRED STUDENT RESOURCES

References:

1. E. M. Mikhail and F. Ackermann, "Observations and Least Squares", IEP-A Dun-Donnelley Publisher, 1976.
2. A. Bjerhammar, "Theory of Errors and Generalized Matrix Inverses", Elsevier, 1973.
3. S. G. Rabinovich, "Measurement Errors and Uncertainties: Theory and Practice", 2nd Edition, AIP Press, 1999.
4. S. Rabinovich, "Measurement Errors and Uncertainties: Theory and Practice", 3rd Edition, Springer, 2005.
5. Soong, T. T, "Fundamentals of probability and statistics for engineers", John Wiley & Sons, 2004.
6. Wackerly, D., W. Mendenhall and R. L. Scheaffer, " Mathematical statistics with applications", Cengage , 2014.

Web linkes:

Student's field trip:

Visiting is not necessary.

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Introduction, basic definitions of statistics (parametric and non-parametric).
2	Random variable, population and statistical sample and parameters determining the statistical characteristics of a population or statistical sample (average parameters, Dispersion, and correlation).
3	Statistical principles and concepts including the definition of random variable (discrete and continuous), univariate and multivariate PDF and CDF functions, conditional distributions, special distribution functions in statistics, moment generating function, mathematical expectation, variance, covariance, correlation, and Statistical independence.
4	Exponential (Laplace and Gamma), Normal (Gaussian), Student, Fisher, and Tau distribution functions.
5	Second order moments matrix or covariance variance matrix of observations and Surveying unknowns.
6	Bivariate and multivariate normal distribution function.
7	Ellipses of Constant Probability and Confidence Level.
8	Confidence Intervals: Mean, Variance, and Ratio of Variances.

9	Estimation Theory: Estimation and Estimators, Evaluation Criteria, and Estimation Methods.
10	Statistical Tests: Concepts, Hypothesis Testing, and Test Power.
11	Observational Errors: Types of Errors, Co-factor Matrix, and Weight Matrix.
12	Principles and Laws of propagation in Errors (random and systematic), Distribution, Mean, and Variance Covariance matrix.

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	2 points
Comprehensive Assignment	3 points (at max)
Mid-Term Exam	7 points
Final Exam	8 points
Total Points	20 points

Adjustment Calculations and Statistical Tests

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Adjustment Calculations and Statistical Tests, S3

Number of credits: 3

COURSE PREREQUISITES

Theory of Errors, Linear Algebra, and Numerical Computations.

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Hamid Mehrabi

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Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	1 h	---	1/3 h

COURSE OBJECTIVES

The purpose of this course is to acquaint students with the process observations and various mapping data and test the results.

REQUIRED STUDENT RESOURCES

References:

1. P.J.G. Teunissen, “Probablity and Observation Theory”, Lecture notes, Delft University of Technology, 2006
2. E. M. Mikhail, "Observations and Least Squares", University Press of Amer, 1983.
3. P. Vanicek and A.Krakiwsky, "Geodesy The Concepts", North-Holland, 2015
4. D. E. Wells and E. J. Krakiwsky, "The Method of Least Squares", University of New Brunswick, Canada, 1976.
5. M. A. R. Cooper, "Control Surveys in Civil Engineering", Collins Professional and Technical Books, 1987.
6. P. Vanicek and D. E. Wells, "The Least Squares Approximation and Related Topics", University of New Brunswick, Canada, 1972.
7. P. R. Wolf and C. D. Ghilani, "Adjustment Computations: Statistics and Least Squares in Surveying and GIS", 3rd Edition, John Wiley, 1997.

Web linkes:-

Student's field trip:-

Visiting is not necessary.

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Introduction to Least Squares Estimation.
2	Recapitulation of concepts from Theory of Errors.
3	Review of Properties of Least Squares.
4	Observable Quantities and their Properties.
5	Classification of Mathematical Models: Models with unique solutions, Overdetermined models, Underdetermined models.
6	Least Squares by Combination model (general case), Parametric model (observation equations), and Condition model
7	Geometric interpretation of Parametric Equations and Condition Equations.
8	Constrained Least Squares.
9	Estimation of Nuisance Parameters.
10	Least Squares by Constraints between Unknowns
11	Least Squares by Weighted Unknown Parameters
12	Results Evaluation – Statistical Tests

13	Pre-Least Squares Tests: Inconsistent Observation Test, Observation Distribution Function Test, System Variance Test
14	Post-Least Squares Tests: Normality Test of Residuals, Inconsistent Residuals Test, Residual Chi-Square Test (Variance Factor Test)

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	2 points
Comprehensive Assignment	3 points (at max)
Mid-Term Exam	7 points
Final Exam	8 points
Total Points	20 points

Geodetic Surveying and Control Networks Analysis

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Geodetic Surveying and Control Networks Analysis, S3

Number of credits: 3

COURSE PREREQUISITES

Surveying 2, Adjustment Calculations and Statistical Tests.

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Hamid Mehrabi

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Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	1 h	---	1/3 h

COURSE OBJECTIVES

The purpose of this course is to acquaint students with the investigation and analysis of errors in various surveying measurements, calibration of measuring instruments, planning, design, and analysis of networks of planar and height control points.

REQUIRED STUDENT RESOURCES

References:

1. M. A. R. Cooper, "Control Surveys in Civil Engineering", Collins Professional and Technical Books, 1987.
2. E. W. Grafarend and F. Sanso, "Optimization and Design of Geodetic Networks", Springer-Verlag, 1985.
3. A. Johnson, "Plane and Geodetic Surveying: The Management of Control Networks", Spon Press, 2004.
4. S. Kuang, "Geodetic Network Analysis and Optimal Design", Sams Publications, 1996.
5. US. Army Corps of Engineers, “Geodetic and Control Surveying", University Press of the Pacific, 2004.
6. M. Berber, "Robustness analysis of geodetic networks", UNB Technical Report, 2006.

Web linkes:-

Student's field trip:-

Visiting is necessary along with the approval of the specialized council of the department.

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Analysis and Error Evaluation in Geodetic Measurements (including Angle, distance, and leveling Measurement)
2	Review of least squares adjustment: Constraints, degrees of freedom, and singularity.
3	Least squares by Inner constraints.
4	Similarity transformation S and its applications.
5	Quality control criteria and optimization of control networks.
6	Numerical precision functions, local network precision (ellipses and error curves), Criterion matrices.
7	Internal and External Reliability criteria.
8	Redundancy numbers.
9	Design Orders: - Zero-order design: Definition of the best coordinate system. - First-order design: Determination of best shape of the network.

	- Second-order design: Determination of the best of the weight's observations. - Third-order design: Improvement and expansion of existing network.
10	Post-adjustment processing in control networks.
11	Trial-and-error and analytical methods in geodetic network optimization.
12	Introduction to precise instrument methods in deformation analysis.

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	2 points
Comprehensive Assignment	3 points (at max)
Mid-Term Exam	7 points
Final Exam	8 points
Total Points	20 points

Surveying 1

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Surveying 1, S1

Number of credits: 2

COURSE PREREQUISITES

COURSE CO-REQUISITES

Calculus 1

TEACHERS

The person in charge: Dr. Seyed Bagher Fatemi

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Other instructors: -

WEEKLY HOURS

Guided learning	Laboratory	Problem Solving	Theory
1/3 h	-----	1 h	2 h

COURSE OBJECTIVES

The purpose of this course is to acquaint students with the principles and concepts of surveying and mapping

REQUIRED STUDENT RESOURCES

References:

1. Schofield, Wilfred, and Mark Breach. Engineering surveying. CRC Press, 2007.
2. A.Bannister and R.Baker, "Solving Problems in Surveying", 2nd Edition, Longman, 1996.
3. D. Wolf and C.Ghilani, "Elementary Surveying", 10th Edition, prentice- Hall, 2001.
4. Ghilani, Charles D., Paul R. Wolf, and Anthony Gidudu. Elementary surveying: An introduction to geomatics. Upper Saddle River: Pearson Prentice Hall, 2008.
5. Schofield, Wilfred. Engineering Surveying: Theory and examination problems for students. Elsevier, 2013.

Student's field trip:

Visiting is necessary along with the approval of the specialized council of the department.

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Topic	Week
Introduction: Definition of Surveying, Geomatics engineering, etc.	1
Concept of coordinate system, The north, Geographic Coordinate System	2
Fundamentals of ground surveying, basics of theory of errors,…	3
Distance measurement: Methods and applications	4
Surveying with simple methods and devices	5
Leveling: Principles, Methods, Devices, Applications	6
Angle measurement: Principles, Theodolites, Methods, Applications	7
Principles of Positioning	8

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	5 points
Comprehensive Assignment	2 points (at max)
Final Exam	13 points
Total Points	20 points

Surveying 1 (Hands-on)

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Surveying 1 (Hands-on), S1

Number of credits: 1

COURSE PREREQUISITES

COURSE CO-REQUISITES

Surveying 1

TEACHERS

The person in charge: Dr. Seyed Bagher Fatemi

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Email address: sb.fatemi@eng.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Guided learning	Laboratory	Problem Solving	Theory
-----	4 h	-----	-----

COURSE OBJECTIVES

References:

1. Schofield, Wilfred, and Mark Breach. Engineering surveying. CRC Press, 2007.
2. A.Bannister and R.Baker, "Solving Problems in Surveying", 2nd Edition, Longman, 1996.
3. D. Wolf and C.Ghilani, "Elementary Surveying", 10th Edition, prentice- Hall, 2001.
4. Ghilani, Charles D., Paul R. Wolf, and Anthony Gidudu. Elementary surveying: An

introduction to geomatics. Upper Saddle River: Pearson Prentice Hall, 2008.

5. Schofield, Wilfred. Engineering Surveying: Theory and examination problems for students. Elsevier, 2013.

Student's field trip:-

Visiting is necessary along with the approval of the specialized council of the department.

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Topic	Week
Introduction to field note-taking techniques (Concept of Scale and its Impact on Surveying), Field reconnaissance and project planning	1
Taping Distances and its Applications: (Aligning, Measurement on Sloping Ground, Angle Measurement with Tape)	2
Simple Surveying (Measurement, Calculations, and Map Drawing)	3
Hands-On Training in Using Level Instrument	4
Differential Leveling	5
The Leveling Loop (Adjusting Allowable Leveling Errors)	6
Profile Leveling (Measurement, Calculations, and Drawing of Profiles)	7
Determination of Collimation Leveling Error	8
Hands-On Training in Using Theodolite (Instrument Setup, Mechanical and Digital Angle Measurement)	9
Different Methods of Angle Observation (Coupled, Repetition, …)	10
Errors in Angle Measurement	11
Applications of Angle Measurement (Trigonometric Surveying, Tacheometric Surveying)	12

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	10 points
Comprehensive Assignment	0 points (at max)
Final Exam	10 points
Total Points	20 points

Surveying 2

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Surveying 2, S2

Number of credits: 2

COURSE PREREQUISITES

COURSE CO-REQUISITES

Calculus 1

TEACHERS

The person in charge: Dr. Seyed Bagher Fatemi

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Email address: sb.fatemi@eng.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Guided learning	Laboratory	Problem Solving	Theory
1/3 h	-----	1 h	2 h

COURSE OBJECTIVES

The purpose of this course is to acquaint students with the application of surveying and mapping

REQUIRED STUDENT RESOURCES

References:

1. Schofield, Wilfred, and Mark Breach. Engineering surveying. CRC Press, 2007.

2. A.Bannister and R.Baker, "Solving Problems in Surveying", 2nd Edition, Longman, 1996.
3. D. Wolf and C.Ghilani, "Elementary Surveying", 10th Edition, prentice- Hall, 2001.
4. Ghilani, Charles D., Paul R. Wolf, and Anthony Gidudu. Elementary surveying: An introduction to geomatics. Upper Saddle River: Pearson Prentice Hall, 2008.
5. Schofield, Wilfred. Engineering Surveying: Theory and examination problems for students. Elsevier, 2013.

Student's field trip:

Visiting is necessary along with the approval of the specialized council of the department.

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Topic	Week
Introduction: basic terms and concepts, an introduction to coordinate systems in mapping (two-dimensional and three-dimensional, geographic and planar, cartesian and polar)	1
The NORTH: Types of North, Direction, Direction, And Their Determination Methods, Orientation, Applications	2
An Introduction To Electronic Distance Measurement: Basic Concepts, Principles Of Electronic Distance Measurement, Distance Measurement Errors, Environmental Parameters, Systematic Errors,	3
Positioning Principles: Concepts, Applications And Methods	4
Travers, measurement control, Adjustment and identification of errors	5
Triangulation method, Solutions	6
Intersection and Rnnnnnnnn	7
An introduction to planar and topographic surveying, existing standards, procedures, surveying methods, different scales, radial surveying method, error checking	8
Taking details (tacheometry, total station, different methods of planar and height measurements, different scales, thematic mapping)	9
An introduction to non-construction mapping (cadastral and property surveys)	10
Basic principles of map generation	11
Principles of map set-up	12
Methods for area evaluation, Land division	13

Introduction of surveying software (Civil3D)	14

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	5 points
Final Exam	15 points
Total Points	20 points

Spatial Databases and Geospatial System Development

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Spatial Databases and Development of Geospatial Information Systems, S6

Number of credits: 2

COURSE PREREQUISITES

Geospatial information systems

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Farid Cheraghi

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone number: +983137935278

Homepage: https://cet.ui.ac.ir/~f.cheraghi

Email address: f.cheraghi@cet.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	yes	---	---

COURSE OBJECTIVES

Introduction of general database concepts and spatial databases in particular; design and implementation of spatial databases for management and sharing of spatial information; development of custom GIS application based on spatial databases

REQUIRED STUDENT RESOURCES

References:

1. Rigaux P., M. Scholl and A. Voisard, Spatial Databses With Applications to GIS, Morgan Kaufman Publisher, 2002

Web linkes:-

Student's field trip:-

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Databases definition, file-based vs database approach, DBMS environment elements, various centralized architectures: client-server and distributed
2	Design and implementation of database: modeling (conceptual, logical, and physical), unified modeling language (UML)
3	Database management: types of database managetment systems (DBMSs): Oracle, SQL Server, PostgreSQL, etc.
4	Relational data model: relational algebra, relationships and their cardinality (1:1, 1:n, n:n), conversion of conceptual model to relations, database completeness and its rules, database normalization (various dependencies and forms of normalization), SQL language
5	An introduction of OGC simple feature specifications: spatial data storage model and their metadata, SQL statements for spatial data backup
6	PostgreSQL database introduction and its PostGIS extension
7	Implementation of conceptual model to logical structure in PostgreSQL; tabe creation and data insertion
8	Various types of basic and spatial queries in PostgreSQL
9	Procedural vs object-oriented programming languages, object-orientation concepts and principles; definitions of class, object, propery, method and API concepts
10	Introduction of systematic thinking and algorithmic design, software engineering methods for a system development
11	Introduction of various spatial programming paradigm (commercial and free and open-source software)

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	2 points
Comprehensive Assignment	3 points (at max)
Mid-Term Exam	7 points
Final Exam	8 points
Total Points	20 points

Spatial Databases and Geospatial System Development Lab

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Lab of Spatial Databases and Geospatial System Developement, S6

Number of credits: 1

COURSE PREREQUISITES

COURSE CO-REQUISITES

Spatial Databases and Geospatial System Developement

TEACHERS

The person in charge: Dr. Farid Cheraghi

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

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Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
---	yes	2 h	---

COURSE OBJECTIVES

Hands-on experience with various spatial databases, running programming projects and developing GISs

REQUIRED STUDENT RESOURCES

References:

1. R. Hashemi Peikar, ArcObjects Programming in VBA, Naghoos Press, 1390
2. Brock R., 2003, Getting to Know ArcObjects, Esri Press.
3. Amirian P., 2013, Beginning ArcGIS for Desktop Development Using NET, John Wiley & Sons.
4. Obe R. O.and Hsu L. S.,2015, Beginning Databases with PostgreSQL: From Novice to Professional, Manning Publications; 2 edition.

Web linkes:-

Student's field trip:-

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Installation and setup of various spatial databases like Oracle, SQL Server and PostgreSQL and databaes extensions like PostGIS and ArcSDE
2	Table/Layer creation in databases
3	Data insertions in tables
4	Simple and spatial queries execution
5	Basic spatial analyses like routing using a database
6	Connection of general GIS software like QGIS/ArcGIS to a database for data retrieval, display and edition
7	Introduction of QGIS/ArcGIS development libraries like PyQGIS/ArcPy
8	Introduction of QGIS/ArcGIS development methods like customisation, extension creation, and standalone software creation based on their components
9	Run a QGIS/ArcGIS software customisation programming project
10	Run a project to create an extensions for QGIS/ArcGIS
11	Run a project to create a standalone GIS software based on QGIS/ArcGIS library components

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	5 points
Comprehensive Assignment	5 points (at max)
Mid-Term Exam	0 points
Final Exam	10 points
Total Points	20 points

Geospatial Information Systems

1. Basic Information

Place in curriculum, title and semester: core, Geospatial Information Systems, S4

Number of credits: 2

2. Course prerequisites

Cartography fundamentals

3. Course co-requisites

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4. Teachers

The person in charge: Dr. Farid Cheraghi

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Other instructors: ---

5. Weekly hours

Theory	Problem Solving	Laboratory	Guided learning
2 h	yes	---	---

6. Course Objectives

Introduce spatial data modeling concepts, spatial queries, spatial data management and geographical information system (GIS) and their applications for solving practical problems

Required Student Resources

References:

1. Paul A. Longley, Mike Goodchild, David J. Maguire, David W. Rhind, 2016, Geographic

Information Systems and Science, Wiley.

Web linkes: ---

Student's field trip: ---

7. COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Spatial information history, CAD and GIS differences, explanation of Cartography and its central role in GIS
2	Applications of GIS, GIS definition as a system, Taxonomy and semantics of GIS
3	Organizational role of GIS, GIS responsibilities as a spatial information provider, spatial information management, analysis and processing of spatial information, preparation of outputs
4	Common data models in GIS like vector and raster models, basic data for each model, methods for provision of data for each model, sources of spatial and attribute data
5	Data preparation steps including: identification and removal of various types of errors in spatial and attribute data, attribute data preparation and link to spatial data through unique ID, data format and model conversion, definition of coordinate reference systems, their projections and conversions
6	Data structure and storage method in spaghetti and topology vector data models and raster with/without compression, introduction of topologic relations (point set and RCC methods), topologic conversions and structure, lossy compression methods like Fourier transform, lossless compression methods like RLE, Quad Tree, etc.
7	Data preparation in vector model
8	Data preparation in raster model like various interpolation methods: Bilinear, Bicubic, cubic convolution, Spline, Kriging
9	Introduction to DBMS and their models, data modeling methods introduction, object-oriented modeling, normalization, basics of access control to data
10	Basic vector analysis methods like various spatial and attribute queries, statistical classification methods, spatial autocorrelation and Moran's I statistics, spatial clustering, geometrical analysis like buffer, intersection and point in polygon, Voronoi diagram, routing algorithms like Dijkstra and A*

11	Various basic raster analysis like local, neighborhood, regional and global raster operations; surface analysis like slope, aspect, Hillshade, Viewshed, cut and fill, Euclidean distance and aspect, weighed distance and aspect
12	Design and implementation of applications by chaining basic analysis and data
13	Design and implementation of a few applications like site location and routing
14	Basics of digital color ramps and thematic mapping

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	2 points
Comprehensive Assignment	3 points (at max)
Mid-Term Exam	7 points
Final Exam	8 points
Total Points	20 points

Geospatial Information Systems Lab

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Lab of Geospatial Information Systems, S4

Number of credits: 1

COURSE PREREQUISITES

COURSE CO-REQUISITES

Geospatial Information Systems

TEACHERS

The person in charge: Dr. Farid Cheraghi

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Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
---	---	3 h	---

COURSE OBJECTIVES

Mastering spatial data prepration in a GIS, executing various (spatial) queries and performing spatial analyses

REQUIRED STUDENT RESOURCES

References:

1. Scott Crosier, Bob Booth, Andy Mitchell, 2010, Getting Started with ArcGIS, ESRI Press.
2. QGIS documentation team, 2023, QGIS Training Manual

Web linkes:-

Student's field trip:-

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Introduction to various GIS software
2	Introduction to QGIS/ArcGIS modules and running a pratical exercise lab with each
3	Introduction to the modules' capabilities and different types of attribute, spatial and mixed queries
4	An explanation fo layers, map canvas, and the method of adding layers to map
5	Create vector layers in various formats like Geopackage, Spatialite, Shapefile, etc.; Vector layer digitization in both GIS and AutoCAD; Performing data prepration steps like identification of attribute and topologial errors; coordinate reference system and map projection definition
6	Attribute data entry including: adding a field to a layer's attribute table; import data from Excel to QGIS/ArcMap and attribute join of two tables
7	Raster layer creation including various spatial interpolation methods, especially DEM generation
8	Various basic vector analyses methods including extract، proximity، overlay، spatial statistics class of methods and network analysis; raster analyses methods including distance، slope، aspect، hill shade، viewshed، visibility، reclassification and map algebra.
9	Exercising various GIS applications like routing, site selection, center line extraction, etc.

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	5 points
Comprehensive Assignment	5 points (at max)

Mid-Term Exam	0 points
Final Exam	10 points
Total Points	20 points

Principles of Triangulation in Photogrammetry

Basic Information

Place in Curriculum, title and semester: Core, Principles of Triangulation in Photogrammetry, S6

Number of credits: 3

Course prerequisites

Analytical Photogrammetry

Course co-requisites

Teachers

The person in charge: Dr. Hossein Bagheri

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone number: +983137935299

Homepage: https://cet.ui.ac.ir/~h.bagheri

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Other instructors: -

Weekly hours

Guided learning	Laboratory	Problem Solving	Theory
1/3 h	---	1h	3h

Course Objectives

The purpose of this course is to acquaint students with the concept of triangulation in aerial and satellite images

Required Student Resources

References:

1. P. Wolf, B. DeWitt, B. Wilkinson, “Elements of Photogrammetry with Application in GIS”, Fourth Edition, 4th Edition, McGraw-Hill Education, 2014.
2. F.H. Moffitt, "Photogrammetry”, 3rd Edition, Harper & Row, 1980.
3. K. Kraus, "Photogrammetry", Vol.1, Duemmler, Bonn, 1992.
4. J.C. McGlone, "Manual of Photogrammetry”, 5th Edition, ASPRS, 2004.
5. W. Linder, "Digital Photogrammetry: Theory and Applications", Springer-Verlag, 2003.

Student's field trip:---

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Topic	Week
Introduction	1
Comparison of aerial triangulation methods	2
Full description of the independent method	3
Full description of the bundle method	4
Aerial triangulation problems and how to solve them	5
Aerial triangulation based on auxiliary GPS / IMU data and geodetic observations	6
Linear array geometry and rational equations	7
Affine geometry and relative orientation of high spatial resolution images	8
Modeling systematic errors with shift and Affine parameters and how to deal with them	9
Satellite image triangulation using rational equations	10

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	2 points
Comprehensive Assignment	3 points
Mid-Term Exam	7 points
Final Exam	8 points
Total Points	20 points

Principles of Triangulation in Photogrammetry Lab

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Principles of Triangulation in Photogrammetry Lab, S6

Number of credits: 1

COURSE PREREQUISITES

Analytical Photogrammetry, Analytical Photogrammetry (Lab)

COURSE CO-REQUISITES

Principles of Triangulation in Photogrammetry

TEACHERS

The person in charge: Dr. Hossein Bagheri

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

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Other instructors: -

WEEKLY HOURS

Guided learning	Laboratory	Problem Solving	Theory
---	1h	---	---

COURSE OBJECTIVES

The purpose of this course is to acquaint students with the production line of topographic maps by photogrammetric method, as well as to perform semi-automated processing in the production line, including aerial triangulation and production of digital elevation model and orthophoto-mosaic.

REQUIRED STUDENT RESOURCES

References:

1. P. Wolf, B. DeWitt, B. Wilkinson, “Elements of Photogrammetry with Application in GIS”, Fourth Edition, 4th Edition, McGraw-Hill Education, 2014.
2. F.H. Moffitt, "Photogrammetry”, 3rd Edition, Harper & Row, 1980.
3. B.D.F. Methely, "computational models in surveying and photogrammetry", Blackie, 2004.
4. E.M Mikhail, J.S. Bethel, et.al, "introduction to modern photogrammetry", wiely, 2001
5. J.C. McGlone, "Manual of Photogrammetry”, 5th Edition, ASPRS, 2004.

Student's field trip:-

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Topic	Week
Preprocessing and formation of photogrammetric blocks	1
Feature extraction and matching	2
Measurement of photographic observations of ground control points	3
Aerial triangulation calculations	4
Production of orthophoto-mosaic	5
Production of digital elevation model and orthophoto-mosaic from satellite images	6

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	12 points
Comprehensive Assignment	---
Mid-Term Exam	---
Final Exam	8 points
Total Points	20 points

Principles of Photogrammetry

Basic Information

Place in Curriculum, title and semester: Core, Principles of Photogrammetry, S3

Number of credits: 3

Course prerequisites

Surveying 1

Course co-requisites:

Fundamentals of Optics and Waves

Teachers

The person in charge: Dr. Hossein Bagheri

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Homepage: https://cet.ui.ac.ir/~h.bagheri

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Other instructors: -

Weekly hours

Guided learning	Laboratory	Problem Solving	Theory
1/3 h	---	1 h	3 h

Course Objectives

The purpose of this course is to acquaint students with the principles and concepts of aerial mapping and photogrammetry

Required Student Resources

References:

1. P. Wolf, B. DeWitt, B. Wilkinson, “Elements of Photogrammetry with Application in GIS”, Fourth Edition, 4th Edition, McGraw-Hill Education, 2014.
2. F.H. Moffitt, "Photogrammetry”, 3rd Edition, Harper & Row, 1980.
3. K. Kraus, "Photogrammetry", Vol.1, Duemmler, Bonn, 1992.
4. J.C. McGlone, "Manual of Photogrammetry”, 5th Edition, ASPRS, 2004.
5. W. Linder, "Digital Photogrammetry: Theory and Applications", Springer-Verlag, 2003.

Web linkes:

Student's field trip:

Visiting is necessary along with the approval of the specialized council of the department.

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Topic	Week
Introduction: Definition of photogrammetry, history of photogrammetry, etc.	1
Basics of photography and imaging	2
Photographic observations	3
Principles of monoscopy in photogrammetry	4
Principles of stereoscopy in photogrammetry	5
Basic principles of image block photogrammetry	6
Plotting and mapping instruments	7
Plotting	8
Digital photogrammetry systems	9
Principles of drawing maps by photogrammetric method	10

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	2 points
Comprehensive Assignment	3 points (at max)
Mid-Term Exam	7 points
Final Exam	8 points
Total Points	20 points

Principles of Photogrammetry Lab

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Principles of Photogrammetry (Lab), S3

Number of credits: 1

COURSE PREREQUISITES

COURSE CO-REQUISITES

Principles of Photogrammetry

TEACHERS

The person in charge: Dr. Hossein Bagheri

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Other instructors: -

WEEKLY HOURS

Guided learning	Laboratory	Problem Solving	Theory
---	1h	---	---

COURSE OBJECTIVES

The aim of this course is to acquaint students with the practical work of instrumental and computational methods of photogrammetry

REQUIRED STUDENT RESOURCES

References:

1. P. Wolf, B. DeWitt, B. Wilkinson, “Elements of Photogrammetry with Application in GIS”, Fourth Edition, 4th Edition, McGraw-Hill Education, 2014.
2. F.H. Moffitt, "Photogrammetry”, 3rd Edition, Harper & Row, 1980.
3. J.C. McGlone, "Manual of Photogrammetry”, 5th Edition, ASPRS, 2004.

Student's field trip:---

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Topic	Week
Familiarity with main characteristics of aerial photos, theoretical comparison of aerial photos and satellite images, information in photo margins, camera calibration elements, photos’ coverage and overlaps.	1
Determining principle and nadir points, establish photo coordinate systems (with fiducial marks) and measure the coordinates of points.	2
Determining the tilt and altitude of the flight height (computational methods), calculating the altitude using the relief displacements, calculating planimetric coordinates of the points in the image.	3
Stereoscopy, parallax measurement, working with parallax bar, three-dimensional motion of the floating mark, height calculation and drawing the height contours in the vertical image.	4
Familiarity with all plotting devices, mechanical instruments.	5
Familiarity with the internal and external orientations of a pair of photos with a digital device.	6
Plotting using digital instruments for a part of a model, familiarity with photogrammetric plotting standards.	7
Flight planning	8

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	12 points
Comprehensive Assignment	---
Mid-Term Exam	---
Final Exam	8 points
Total Points	20 points

Global Navigation Satellite Systems

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Global Navigation Satellite Systems (GNSS), S7

Number of credits: 3

COURSE PREREQUISITES

Fundamentals of Space Geodesy

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Jamal Asgari

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Email address: asgari@eng.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	1 h	---	1/3 h

COURSE OBJECTIVES

To familiarize students with the principles and concepts of GNSS, the structure of global navigation satellite systems, GNSS receivers, GNSS signals, GNSS mathematical models, error analysis and GNSS surveying.

Required Student Resources

Textbooks

1. B. Hofmann-Wellenhof, H. Lichtenegger, and E. Wasle, "GNSS – Global Navigation Satellite Systems, GPS, GLONASS, Galileo, and More", Springer-Verlag, Wien New York 2008.
2. Leick, L. Rapoport and D. Tatarnikov "GPS satellite surveying ", Wiley, Hoboken, 4th Edition 2015.

References

H.D. Curtis, "Orbital Mechanics for Engineering Students", 3rd Edition, Elsevier Butterworth-Heinemann Linacre House, Jordan Hill, Oxford OX2 8DP, 2013.

G. Seeber, "Satellite Geodesy: Foundations, Methods, and Applications", Walter de Gruyter, Berlin New York, 2nd Edition, 2003.

Student's field trip:

Visiting is necessary along with the approval of the specialized council of the department.

Course Schedule/Outline/Calendar of Events

Week	Topic
1	Introduction, introducing global systems: GPS, Galileo, GLONASS, Beidou and Regional systems QZSS, NavIC
2	Satellite orbits: Introduction, Kepler's laws of planetary motion and two body problem, satellite orbit dissemination: Precise, Broadcast, Almanac
3	GNSS system Segments: space, control and users
4	GNSS signals: Concepts and signal structure, modulation, carrier wave, pseudo-random codes, CDMA and FDMA techniques.
5	GNSS receivers and antennas, structure of a generic receiver, receiver signal processing, components of a receiver and their functions, classification of receivers, types of GNSS antennas.
6	GNSS observations: code pseudo-range, phase, and Doppler observations, linear combinations of phase and code measurements
7	Biases and errors: Atmospheric errors, satellite clock and orbit, antenna phase center offset and variations, multipath, cycle slip, noise, UERE and DOP concepts.
8	Mathematical models of positioning absolute and relative positioning, ambiguity resolution
9	Introduction to GNSS positioning techniques:

	Absolute: Code, Code and Phase, PPP Relative: DGPS, Static, Fast static, Kinematics, RTK instant kinematics
10	GNSS post-processing: GNSS Networks, Observations, Processing, adjustment, and Concepts of Accuracy and Reliability in a GNSS Network, mission planning
11	GNSS Surveying: existing techniques: Static, Rapid Static, RTK, Network RTK. limitations and advantages of different technics.

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	2 points
Comprehensive Assignment	3 points (at max)
Mid-Term Exam	7 points
Final Exam	8 points
Total Points	20 points

Global Navigation Satellite Systems (Hands-on)

BASIC INFORMATION

Place in Curriculum, title and semester: Core, GNSS Practices and Computations, S7

Number of credits: 1

COURSE PREREQUISITES

COURSE CO-REQUISITES

Geometrical Geodesy

TEACHERS

The person in charge: Dr. Jamal Asgari

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Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
-	-	2h	-

COURSE OBJECTIVES

To familiarize students with GNSS surveying, data acquisition and processing, accuracy assessment and positioning with different level of accuracies.

REQUIRED STUDENT RESOURCES

References

1. B. Hofmann-Wellenhof, H. Lichtenegger, and E. Wasle, "GNSS – Global Navigation Satellite Systems, GPS, GLONASS, Galileo, and More", Springer-Verlag, Wien New York 2008.
2. Leick, L. Rapoport and D. Tatarnikov "GPS satellite surveying ", Wiley, Hoboken, 4th Edition 2015.
3. H.D. Curtis, "Orbital Mechanics for Engineering Students", 3rd Edition, Elsevier Butterworth-Heinemann Linacre House, Jordan Hill, Oxford OX2 8DP, 2013.
4. G. Seeber, "Satellite Geodesy: Foundations, Methods, and Applications", Walter de Gruyter, Berlin New York, 2nd Edition, 2003.

Student's field trip:

Visiting is necessary along with the approval of the specialized council of the department.

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	GNSS Mission planning, DOP and Almanac Data, Sky plot, and satellite availability,
2	Handheld and Geodetic Receiver Field Operations,
3	GNSS standard formats: NMEA, RINEX, SP3 Formats Projects and Exercises
4	GNSS Surveying Tutorial: Field Surveying and Static and RTK projects,
5	GNSS Processing Software: Format Conversion, Processing and Network Adjustment, Accuracy Assessment
6	GNSS Network Adjustment Programming Project

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	12 points
Comprehensive Assignment	3 points (at max)
Mid-Term Exam	- points
Final Exam	5 points
Total Points	20 points

Fundamentals of Space Geodesy

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Fundamentals of space Geodesy, S4

Number of credits: 2

COURSE PREREQUISITES

Fundamentals of Geodesy

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Jamal Asgari

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

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Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	1 h	---	1/3 h

COURSE OBJECTIVES

Familiarizing students with the principles and concepts of space geodesy including coordinate systems, time systems and atmosphere.

REQUIRED STUDENT RESOURCES

References:

1. D. B. Thomson, "Introduction to Geodetic Astronomy", University of New Brunswick, 1991.
2. G. Seeber, "Satellite Geodesy: Foundations, Methods, and Applications", Walter de Gruyter, Berlin New York, 2nd Edition, 2003.
3. J. Böhm, H. Schuh, “Atmospheric Effects in Space Geodesy”, Springer-Verlag Berlin Heidelberg, 2013
4. M. Soffel and R. Langhans,” Space-Time Reference Systems”, Springer-Verlag Berlin Heidelberg, 2013
5. P. Vanicek and E.J. Krakiwsky, "Geodesy: The Concepts", North-Holland, 1986.

Web links:-

Student's field trip:

Visiting is necessary along with the approval of the specialized council of the department.

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Introduction
2	Part 1: Celestial coordinate systems in space geodesy - The celestial sphere - Celestial coordinate systems (ecliptic, right ascension, hour angle, horizon) - Celestial coordinate systems conversion (position vector, spherical trigonometry) -Special Star Positions, Rising and Setting, Culmination (Transit), Prime Vertical Crossing, Elongation - Changes in celestial coordinates - Polar motion correction - Determining the astronomical azimuth
3	Part 2: Time systems in space geodesy - Time: time systems (atomic, astronomical, solar time), conversion of time systems into one another, irregularity in time systems, transmission, reception and recording of time and its corrections - time systems and satellite geodesy
4	Part 3: Atmosphere in space geodesy - Propagation of waves in the atmosphere: spectrum of electromagnetic waves, stratification of the atmosphere, dispersive and non-dispersive environments,

	atmospheric models - Tropospheric delay and related models - Ionospheric delay and related models

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	2 points
Comprehensive Assignment	3 points (at max)
Mid-Term Exam	7 points
Final Exam	8 points
Total Points	20 points

Geometrical Geodesy

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Geometrical Geodesy, S5

Number of credits: 3

COURSE PREREQUISITES

Fundamentals of Geodesy, Differential Geometry

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Jamal Asgari

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone number: +983137935290

Homepage: https://eng.ui.ac.ir/~asgari

Email address: asgari@eng.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	1 h	---	1/3 h

COURSE OBJECTIVES

The aim of this course is to provide students with a comprehensive understanding of coordinate systems in geodesy, geodetic position calculations, as well as the principles and methodologies of map projections.

REQUIRED STUDENT RESOURCES

References:

1. R.H. Rapp, Geometric geodesy, Part I. Lecture Notes, Ohio State University, 1991.

2. R.H. Rapp, Geometric Geodesy, Part II. Lecture Notes, Ohio State University, 1993
3. C. Jekeli, Geometric Reference Systems in Geodesy, Lecture Notes, Ohio State University, 2006.
4. P. Vanicek and E.J. Krakiwsky, "Geodesy: The Concepts", 2nd Edition, North–Holland, 1989.
5. E.J. Krakiwsky and D.B. Thomson, "Geodetic Position Computations", Lecture Notes, University of New Brunswick, Fredericton, 1974.
6. E.J. Krakiwsky, "Conformal Map Projections in Geodesy", Lecture notes, University of New Brunswick, Fredericton, 1973.

Web links: -

Student's field trip:

Visiting is necessary along with the approval of the specialized council of the department.

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Coordinate systems and Datums in geodesy: Earth's motions, irregularities in Earth's rotation, IERS, ITRF, ITRS, geocentric and topocentric coordinate systems in geodesy, geodetic datums.
2	Ellipsoidal geometry: Radii of curvature on the ellipsoid, Meusnier's theorem, normal sections, geodesic.
3	Reduction of terrestrial geodetic observations: Geometric and gravimetric effects on angles, spatial distance reduction to the ellipsoid.
4	Computation of geodetic positions on the reference ellipsoid: Direct and inverse geodetic problems.
5	Map projections in geodesy: Overview of Tissot's distortion theory, Tissot's indicatrix, and common types of map projections.
6	Conformal mapping: Review of complex numbers, differential geometry, and basics of conformal map projections.

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	2 points
Comprehensive Assignment	3 points (at max)
Mid-Term Exam	7 points
Final Exam	8 points
Total Points	20 points

Geometrical Geodesy (Hands-on)

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Computational methods and hands-on in geometrical geodesy, S5

Number of credits: 1

COURSE PREREQUISITES

COURSE CO-REQUISITES

Geometrical Geodesy

TEACHERS

The person in charge: Dr. Jamal Asgari

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone number: +983137935290

Homepage: https://eng.ui.ac.ir/~asgari

Email address: asgari@eng.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
0 h	0 h	2 h	1/3 h

COURSE OBJECTIVES

To familiarize students with practical computations in geometrical geodesy and enhance their skills in analyzing results.

Required Student Resources

References:

1. P. Vanicek and E.J. Krakiwsky, "Geodesy: The Concepts", 2nd Edition, North–Holland, 2015.
2. E.J. Krakiwsky and D.B. Thomson, "Geodetic Position Computations", Lecture Notes, University of New Brunswick, Fredericton, 1974.
3. E.J. Krakiwsky, "Conformal Map Projections in Geodesy", Lecture notes, University of New Brunswick, Frederiction, 1973.

Web links:-

Student's field trip:-

Course Schedule/Outline/Calendar of Events

Week	Topic
1	Geodetic reference systems: ellipsoid, geoid, and datums, ITRS, ITRF
2	Coordinate systems and transformations between different coordinate systems
3	Transformations between different geodetic datums
4	Corrections and reductions of geodetic observations
	Map projections: Tissot's indicator, scale factor, meridian convergence computation for a selected map projections
6	Local plan to UTM methods. combined scale factor computation and implementation in UTM maps.
7	Mapping of Iran in the Lambert Conformal Conic Projection system (single and double standard parallels), plotting of the Tissot's Indicator on it, and comparison of several non-conformal mapping systems.

Evaluation Procedures and Grading Criteria

Assignments	12 points
Comprehensive Assignment	2 points (at max)
Mid-Term Exam	0 points
Final Exam	6 points
Total Points	20 points

Route Surveying and Geometrical Design

BASIC INFORMATION

Place in Curriculum, title and semester: Mandatory, Route Surveying and Geometrical Design, S3

Number of credits: 3

COURSE PREREQUISITES

Surveying 2

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Iman Khosravi

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, 81746-73441, Isfahan, Iran

Phone number: +98 (31) 37935298

Homepage: https://cet.ui.ac.ir/~i.khosravi

Email address: i.khosravi@cet.ui.ac.ir

Other instructors:

This course can be held like a workshop.

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided Learning
3 h	1 h	-	1 h

COURSE OBJECTIVES

List the objectives, goals, aims, and/or outcomes for the course.

STUDENTS ARE EXPECTED TO

familiarize with the principles and rules of design and implementation of the route in straight

sections and horizontal and vertical arcs, technical buildings, intersections and interchanges.

REQUIRED STUDENT RESOURCES

References:

1. T, F, Hickerson, Route location and design, 1967.
2. A, Soleimni, Route Surveying and curves in road construction, 2016.

Web links:-

Computer Software: Autodesk Civil3D (https://www.autodesk.com/)

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Principles and necessary definitions for road and its types, route classification and their technical specifications, related standards and routing methods in different phases of road construction
2	Getting to know the basics of road design, including the design speed, accesses, technical buildings and road side facilities, types of sight distance and unobstructed lateral distance
3	Providing the basics of traffic and capacity, intersections and interchanges
4	Designing different components of the route, including the longitudinal project line, transverse type, types of horizontal arches (simple, compound, serpentine and connecting arches such as clothoids (spirals) and 3rd degree parabola) and types of vertical arches
5	Different methods of implementing the route in different sections
6	Longitudinal and transverse profiles, section of the brigade and design of the project line
7	Calculations related to the volume of earthworks using different methods
8	Bruckner curve and the best distribution line
9	Familiarity with substructure and road paving including subgrade materials, base and sub-base materials, stabilized materials, bitumen and asphalt mixtures

EVALUATION PROCEDURES AND GRADING CRITERIA

Class seminars 5 points

Classroom activities and projects	5 points
Final Exam	10 Points
Total Points	20 points

Route Surveying and Geometrical Design (Hands-on)

BASIC INFORMATION

Place in Curriculum, title and semester: Mandatory, Field Work Route Surveying and Geometrical Design, S3

Number of credits: 1

COURSE PREREQUISITES

Surveying Operations 2

COURSE CO-REQUISITES

Route Surveying and Geometrical Design

TEACHERS

The person in charge: Dr. Iman Khosravi

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, 81746-73441, Isfahan, Iran

Phone number: +98 (31) 37935298

Homepage: https://cet.ui.ac.ir/~i.khosravi

Email address: i.khosravi@cet.ui.ac.ir

Other instructors:

This course can be held like a workshop.

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided Learning
-	-	4 h	-

COURSE OBJECTIVES

List the objectives, goals, aims, and/or outcomes for the course.

STUDENTS ARE EXPECTED TO:

familiarize with the principles and rules of design and implementation of the route in straight sections and horizontal and vertical arcs, technical buildings, intersections and interchanges.

REQUIRED STUDENT RESOURCES

References:

1. T, F, Hickerson, Route location and design, 1967.
2. A, Soleimni, Route Surveying and curves in road construction, 2016.

Web links:-

Computer Software: Autodesk Civil3D (https://www.autodesk.com/)

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Topography survey for route design
2	Practical road design project: training and using Civil3D in order to design the horizontal plan and the project line and the cross section of the road and calculate Fill and Cut
3	Implementation of technical infrastructure
4	Implementation of simple circular arc in different ways such as offset, polar, from previous points and from non-conventional points
5	Implementation of direct and reverse compound circle arcs
6	Implementation of serpentine arch
7	Implementation of even clothoid and mixed arc (clothoid-circle-clothoid)
8	Implementation of vertical arches and height leveling of the route

EVALUATION PROCEDURES AND GRADING CRITERIA

Class seminars	0 points
Classroom activities and projects	10 points
Final Exam	10 Points
Total Points	20 points

Principles of Surveying Management

BASIC INFORMATION

Place in Curriculum, title and semester: Elective, Principles of Surveying Management, S7

Number of credits: 2

COURSE PREREQUISITES

Route Surveying and Geometrical Design

COURSE CO-REQUISITES

-

TEACHERS

The person in charge: Dr. Iman Khosravi

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone number: +983137935298

Homepage: https://cet.ui.ac.ir/~i.khosravi

Email address: i.khosravi@cet.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	1 h	-	1 h

COURSE OBJECTIVES

List the objectives, goals, aims, and/or outcomes for the course.

STUDENTS ARE EXPECTED TO

Know the principles and concepts of management, organization and planning.

Learn how to manage and control surveying projects (in terms of quality, time, cost and

manpower).

Understand the interrelationship between crisis management and surveying.

Recognize national and international surveying organizations and communities.

Learn how to create and handle a surveying business (company, startup, etc.).

Required Student Resources

References:

1. Y. Jamour, and M. Rajabzadeh. Management in Surveying Engineering. Iranian Society for Surveying & Geomatic Engineering and K. N. Toosi University of Technology Press. 1399 (in Persian).
2. Tariffs for surveying services approved by the High Technical Council of the State Planning and Budget Organization, (1399).

Web linkes:

Course Schedule/Outline/Calendar of Events

Week	Topic
1	Introduction: Definition, social role of managers, evolution of management
2	Organization and the role of human factors in it, designing the structure of an organization, governmental and non-governmental organizations
3	Decision elements and planning elements
4	Elements of evaluation and control and monitoring in surveying
5	Management, guidance and leadership procedures
6	Financial, accounting and marketing issues
7	Definition, project development stages, project management and its importance
8	Organization structure, decision making, information and communication and project management
9	Planning and project control system and its capabilities
10	Methods of scheduling and displaying activities
11	Familiarity with CPM, PERT, and their capabilities
12	Familiarity with project control software

13	Steps of accepting services from government agencies (tenders) in surveying
14	How to finance projects
15	Types of contracts, preparation of service descriptions
16	Introduction of surveying price list and Estimating the price of surveying projects

EVALUATION PROCEDURES AND GRADING CRITERIA

Class seminars	10 points
Classroom activities and projects	5 points
Final Exam	5 Points
Total Points	20 points

2. Practical Training

1. Basic Information

Place in Curriculum, title and semester: Core, Camping, S8

Number of credits: 4

2. Course prerequisites

Global Navigation Satellite Systems (GNSS), Hydrographic Surveying, Geodetic Surveying and Control Networks Analysis, Spatial Databases and Development of Geospatial Information Systems, Close range photogrammetry, Analysis of Remotely Sensed Images,

3. Course co-requisites

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4. Teachers

The person in charge: Dr. Jamshid Maleki

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone number: +983137935294

Homepage: https://cet.ui.ac.ir/~j.maleki

Email address: j.maleki@cet.ui.ac.ir

Other instructors: -

5. Weekly hours

Theory	Problem Solving	Laboratory	Guided learning
---	---	16	---

6. Course Objectives

The purpose of this course is the practical execution of surveying projects during 300 hours of useful work in the form of field operations and computations.

Required Student Resources

Textbooks and References:-

Student's field visit: -

At the discretion of the master.

7. COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Topic	Week
Creating control points: Creating a network of control points using GPS (design, observations, calculations and adjustments). Observations and calculations of a classical geodetic network (identification, creating a network, preliminary analysis, performing observations, required statistical tests and adjustments). Determining the position of points using the astronomical method and also determining the astronomical azimuth of a direction. Comparing the above three methods.	1
Preparation of map: Photographic work, preparation of planimetry and topographic maps (surveying by Total Station and GPS), land partitioning and flattening.	2
Designing and executing a road construction project	3
Accurate observation and industrial surveying: design, implementation and accurate leveling computations, implementation of accurate alignment methods, determining the displacement of points using microgeodesy and GPS.	4
Execution of a close-range photogrammetry project.	5
Steps of preparing a chart from a water basin: design, observations, calculations, drawing.	6
Execution of an underground or route surveying project	7
Spatial database design and development of geospatial information systems	8
Processing and analysis of remote sensing images.	9

8. EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments and projects	20 points
Total Points	20 points

Principles of Cartography

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Principles of Cartography, S3

Number of credits: 3

COURSE PREREQUISITES

Surveying 2

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Jamshid Maleki

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone number: +983137935294

Homepage: https://cet.ui.ac.ir/~j.maleki

Email address: j.maleki@cet.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Guided learning	Laboratory	Problem Solving	Theory
1/3 h	---	---	3 h

COURSE OBJECTIVES

The purpose of this course is to make the ability to prepare a variety of vector and raster maps on paper and digital with existing standards and experience with the principles and concepts of spatial information management.

Required Student Resources

Textbooks and References:

1. Arthur, Robinson. "Elements of Cartography." Editorial John Wiley & Sons Inc. USA (1995).
2. Crampton, Jeremy W. Mapping: A critical introduction to cartography and GIS. Vol. 11. John Wiley & Sons, 2011.
3. Jones, Chris B. Geographical information systems and computer cartography. Routledge, 2014.

Student's field visit:

At least one of the organizations in charge of preparing the map, such as:

National cartographic center

Cadastre Organization

Isfahan Municipality Information and Communication Technology (ICT) Organization

Course Schedule/Outline/Calendar of Events

Topic	Week
Introduction to Cartography: Definition of cartography, history, definition of map and explanation of its necessity, characteristics of map (scale, accuracy, etc.), types of maps, Scope of cartography.	1
Introduction to Earth Shape: Spherical Earth, Elliptical Earth, Geoid, Coordinate Systems, Cartesian and Polar, Two Dimensional and Three-Dimensional.	2
Projected coordinated systems: scale factor, distortion, conformal projection, Equal area projection, azimuthal projection.	3
Data models: raster and vector, 2D, 2.5D and 3D.	4
Data sources: primary resources: surveying, remote sensing, GPS, photogrammetry, aspatial data and resampling, secondary resources: digitizating (manual and automatic), vector to raster conversion methods, raster to vector conversion methods.	5
Data structures: data storing, data structures: vector (spaghetti and topological), raster (uncompressed, compressed such as RLE and QT).	6
Scale conversion: map enrichment, map generalization.	7
Map Visualization: Cartographic Design, Colors and Its Models, Principles of Color and Pattern Design, Principles of Using Color and Pattern in Maps, vector	8

symbols, point symbols (simple symbols - multivariate symbols), linear symbols (simple symbols - multivariate symbols), area symbols (simple symbols - multivariate symbols)), Volumetric symbols (simple symbols - multivariate symbols), raster symbols, animation, principles of photography.	
Plotting and publishing the map.	9
Standards for layering and coding information at scales of 1: 500 and 1: 2000	10

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	6 points
Mid-Term Exam	6 points
Final Exam	8 points
Total Points	20 points

Principles of Cartography Lab

Basic Information

Place in Curriculum, title and semester: Core, Operations of Cartography, S3

Number of credits: 1

Course prerequisites

Course co-requisites

Principle of Cartography

Teachers

The person in charge: Dr. Jamshid Maleki

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Email address: j.maleki@cet.ui.ac.ir

Other instructors: -

Weekly hours

Guided learning	Laboratory	Problem Solving	Theory
1/3 h	---	---	3 h

Course Objectives

The purpose of this course is to practice the topics covered in the Principles of Cartography course.

Required Student Resources

Textbooks and References

1. Arthur, Robinson. "Elements of Cartography." Editorial John Wiley & Sons Inc. USA (1995).

2. Crampton, Jeremy W. Mapping: A critical introduction to cartography and GIS. Vol. 11. John Wiley & Sons, 2011.
3. Jones, Chris B. Geographical information systems and computer cartography. Routledge, 2014.

Student's field visit:

At least one of the organizations in charge of preparing the map, such as:

National cartographic center

Cadastre Organization

Isfahan Municipality Information and Communication Technology (ICT) Organization

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Topic	Week
Introduction to cartography equipments and map preparation	1
Introduction to map sheets, symbolization, annotation and ...	2
Drawing a simple map manually	3
Introduction to map and route drawing softwares	4
Drawing a simple planimetric map with a computer	5
drawing a simple topographic map using data collected by classic surveying instruments	6
Drawing a simple topographic map using data collected by total Stations and other electronic devices	7
Creating thematic maps and map generalization	8
Creating profiles and sections	9

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	12 points
Final Exam	8 points
Total Points	20 points

Cadastre

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Cadastre, S6

Number of credits: 2

COURSE PREREQUISITES

Geospatial Information Systems

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Jamshid Maleki

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone number: +983137935294

Homepage: https://cet.ui.ac.ir/~j.maleki

Email address: j.maleki@cet.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	---	---	1/3 h

COURSE OBJECTIVES

The main purpose of this course is to acquaint students with the principles and concepts of property registration and legal, financial and multi-purpose cadastres and their relationship and differences and issues related to their design.

Required Student Resources

Textbooks and References:

1. M. Pourkamal, Land Registration and Cadastre Systems, Tehran Geographic Information Center Publications, 1997, (In Persian).
2. M. Pourkamal, Introduction to Cadastre and Its Applications, Tehran Geographic Information Center Publications, 1998, (In Persian).
3. Dale, Peter F., John D. Mc Laugh line, Land Information Management, Oxford University Press, 1998.

Student's field visit: -

Course Schedule/Outline/Calendar of Events

Week	Topic
1	Introduction to Land, Parcel and Cadastre
2	History of ownership, Land registration and cadastre progress
3	Property (land), natural resources, the environment and their relationship to human activities
4	Land administration, its aspects, tools and methods
5	Land registration and legal cadastre
6	Fiscal (Tax) cadastre
7	Multipurpose cadastre

Evaluation Procedures and Grading Criteria

Assignments	6 points
Mid-Term Exam	6 points
Final Exam	8 points
Total Points	20 points

Global Navigation Satellite Systems

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Global Navigation Satellite Systems (GNSS), S7

Number of credits: 3

COURSE PREREQUISITES

Fundamentals of Space Geodesy

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Jamal Asgari

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

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Email address: asgari@eng.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	1 h	---	1/3 h

COURSE OBJECTIVES

To familiarize students with the principles and concepts of GNSS, the structure of global navigation satellite systems, GNSS receivers, GNSS signals, GNSS mathematical models, error analysis and GNSS surveying.

Required Student Resources

Textbooks

1. B. Hofmann-Wellenhof, H. Lichtenegger, and E. Wasle, "GNSS – Global Navigation Satellite Systems, GPS, GLONASS, Galileo, and More", Springer-Verlag, Wien New York 2008.
2. Leick, L. Rapoport and D. Tatarnikov "GPS satellite surveying ", Wiley, Hoboken, 4th Edition 2015.

References

H.D. Curtis, "Orbital Mechanics for Engineering Students", 3rd Edition, Elsevier Butterworth-Heinemann Linacre House, Jordan Hill, Oxford OX2 8DP, 2013.

G. Seeber, "Satellite Geodesy: Foundations, Methods, and Applications", Walter de Gruyter, Berlin New York, 2nd Edition, 2003.

Student's field trip:

Visiting is necessary along with the approval of the specialized council of the department.

Course Schedule/Outline/Calendar of Events

Week	Topic
1	Introduction, introducing global systems: GPS, Galileo, GLONASS, Beidou and Regional systems QZSS, NavIC
2	Satellite orbits: Introduction, Kepler's laws of planetary motion and two body problem, satellite orbit dissemination: Precise, Broadcast, Almanac
3	GNSS system Segments: space, control and users
4	GNSS signals: Concepts and signal structure, modulation, carrier wave, pseudo-random codes, CDMA and FDMA techniques.
5	GNSS receivers and antennas, structure of a generic receiver, receiver signal processing, components of a receiver and their functions, classification of receivers, types of GNSS antennas.
6	GNSS observations: code pseudo-range, phase, and Doppler observations, linear combinations of phase and code measurements
7	Biases and errors: Atmospheric errors, satellite clock and orbit, antenna phase center offset and variations, multipath, cycle slip, noise, UERE and DOP concepts.
8	Mathematical models of positioning absolute and relative positioning, ambiguity resolution
9	Introduction to GNSS positioning techniques:

	Absolute: Code, Code and Phase, PPP Relative: DGPS, Static, Fast static, Kinematics, RTK instant kinematics
10	GNSS post-processing: GNSS Networks, Observations, Processing, adjustment, and Concepts of Accuracy and Reliability in a GNSS Network, mission planning
11	GNSS Surveying: existing techniques: Static, Rapid Static, RTK, Network RTK. limitations and advantages of different technics.

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	2 points
Comprehensive Assignment	3 points (at max)
Mid-Term Exam	7 points
Final Exam	8 points
Total Points	20 points

Global Navigation Satellite Systems (Hands-on)

BASIC INFORMATION

Place in Curriculum, title and semester: Core, GNSS Practices and Computations, S7

Number of credits: 1

COURSE PREREQUISITES

COURSE CO-REQUISITES

Geometrical Geodesy

TEACHERS

The person in charge: Dr. Jamal Asgari

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

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Email address: asgari@eng.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
-	-	2h	-

COURSE OBJECTIVES

To familiarize students with GNSS surveying, data acquisition and processing, accuracy assessment and positioning with different level of accuracies.

REQUIRED STUDENT RESOURCES

References

1. B. Hofmann-Wellenhof, H. Lichtenegger, and E. Wasle, "GNSS – Global Navigation Satellite Systems, GPS, GLONASS, Galileo, and More", Springer-Verlag, Wien New York 2008.
2. Leick, L. Rapoport and D. Tatarnikov "GPS satellite surveying ", Wiley, Hoboken, 4th Edition 2015.
3. H.D. Curtis, "Orbital Mechanics for Engineering Students", 3rd Edition, Elsevier Butterworth-Heinemann Linacre House, Jordan Hill, Oxford OX2 8DP, 2013.
4. G. Seeber, "Satellite Geodesy: Foundations, Methods, and Applications", Walter de Gruyter, Berlin New York, 2nd Edition, 2003.

Student's field trip:

Visiting is necessary along with the approval of the specialized council of the department.

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	GNSS Mission planning, DOP and Almanac Data, Sky plot, and satellite availability,
2	Handheld and Geodetic Receiver Field Operations,
3	GNSS standard formats: NMEA, RINEX, SP3 Formats Projects and Exercises
4	GNSS Surveying Tutorial: Field Surveying and Static and RTK projects,
5	GNSS Processing Software: Format Conversion, Processing and Network Adjustment, Accuracy Assessment
6	GNSS Network Adjustment Programming Project

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	12 points
Comprehensive Assignment	3 points (at max)
Mid-Term Exam	- points
Final Exam	5 points
Total Points	20 points

Fundamentals of Space Geodesy

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Fundamentals of space Geodesy, S4

Number of credits: 2

COURSE PREREQUISITES

Fundamentals of Geodesy

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Jamal Asgari

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Homepage: https://eng.ui.ac.ir/~asgari

Email address: asgari@eng.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	1 h	---	1/3 h

COURSE OBJECTIVES

Familiarizing students with the principles and concepts of space geodesy including coordinate systems, time systems and atmosphere.

REQUIRED STUDENT RESOURCES

References:

1. D. B. Thomson, "Introduction to Geodetic Astronomy", University of New Brunswick, 1991.
2. G. Seeber, "Satellite Geodesy: Foundations, Methods, and Applications", Walter de Gruyter, Berlin New York, 2nd Edition, 2003.
3. J. Böhm, H. Schuh, “Atmospheric Effects in Space Geodesy”, Springer-Verlag Berlin Heidelberg, 2013
4. M. Soffel and R. Langhans,” Space-Time Reference Systems”, Springer-Verlag Berlin Heidelberg, 2013
5. P. Vanicek and E.J. Krakiwsky, "Geodesy: The Concepts", North-Holland, 1986.

Web links:-

Student's field trip:

Visiting is necessary along with the approval of the specialized council of the department.

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Introduction
2	Part 1: Celestial coordinate systems in space geodesy - The celestial sphere - Celestial coordinate systems (ecliptic, right ascension, hour angle, horizon) - Celestial coordinate systems conversion (position vector, spherical trigonometry) -Special Star Positions, Rising and Setting, Culmination (Transit), Prime Vertical Crossing, Elongation - Changes in celestial coordinates - Polar motion correction - Determining the astronomical azimuth
3	Part 2: Time systems in space geodesy - Time: time systems (atomic, astronomical, solar time), conversion of time systems into one another, irregularity in time systems, transmission, reception and recording of time and its corrections - time systems and satellite geodesy
4	Part 3: Atmosphere in space geodesy - Propagation of waves in the atmosphere: spectrum of electromagnetic waves, stratification of the atmosphere, dispersive and non-dispersive environments,

	atmospheric models - Tropospheric delay and related models - Ionospheric delay and related models

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	2 points
Comprehensive Assignment	3 points (at max)
Mid-Term Exam	7 points
Final Exam	8 points
Total Points	20 points

Geometrical Geodesy

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Geometrical Geodesy, S5

Number of credits: 3

COURSE PREREQUISITES

Fundamentals of Geodesy, Differential Geometry

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Jamal Asgari

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone number: +983137935290

Homepage: https://eng.ui.ac.ir/~asgari

Email address: asgari@eng.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	1 h	---	1/3 h

COURSE OBJECTIVES

The aim of this course is to provide students with a comprehensive understanding of coordinate systems in geodesy, geodetic position calculations, as well as the principles and methodologies of map projections.

REQUIRED STUDENT RESOURCES

References:

1. R.H. Rapp, Geometric geodesy, Part I. Lecture Notes, Ohio State University, 1991.

2. R.H. Rapp, Geometric Geodesy, Part II. Lecture Notes, Ohio State University, 1993
3. C. Jekeli, Geometric Reference Systems in Geodesy, Lecture Notes, Ohio State University, 2006.
4. P. Vanicek and E.J. Krakiwsky, "Geodesy: The Concepts", 2nd Edition, North–Holland, 1989.
5. E.J. Krakiwsky and D.B. Thomson, "Geodetic Position Computations", Lecture Notes, University of New Brunswick, Fredericton, 1974.
6. E.J. Krakiwsky, "Conformal Map Projections in Geodesy", Lecture notes, University of New Brunswick, Fredericton, 1973.

Web links: -

Student's field trip:

Visiting is necessary along with the approval of the specialized council of the department.

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Coordinate systems and Datums in geodesy: Earth's motions, irregularities in Earth's rotation, IERS, ITRF, ITRS, geocentric and topocentric coordinate systems in geodesy, geodetic datums.
2	Ellipsoidal geometry: Radii of curvature on the ellipsoid, Meusnier's theorem, normal sections, geodesic.
3	Reduction of terrestrial geodetic observations: Geometric and gravimetric effects on angles, spatial distance reduction to the ellipsoid.
4	Computation of geodetic positions on the reference ellipsoid: Direct and inverse geodetic problems.
5	Map projections in geodesy: Overview of Tissot's distortion theory, Tissot's indicatrix, and common types of map projections.
6	Conformal mapping: Review of complex numbers, differential geometry, and basics of conformal map projections.

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	2 points
Comprehensive Assignment	3 points (at max)
Mid-Term Exam	7 points
Final Exam	8 points
Total Points	20 points

Geometrical Geodesy (Hands-on)

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Computational methods and hands-on in geometrical geodesy, S5

Number of credits: 1

COURSE PREREQUISITES

COURSE CO-REQUISITES

Geometrical Geodesy

TEACHERS

The person in charge: Dr. Jamal Asgari

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

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Homepage: https://eng.ui.ac.ir/~asgari

Email address: asgari@eng.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
0 h	0 h	2 h	1/3 h

COURSE OBJECTIVES

To familiarize students with practical computations in geometrical geodesy and enhance their skills in analyzing results.

Required Student Resources

References:

1. P. Vanicek and E.J. Krakiwsky, "Geodesy: The Concepts", 2nd Edition, North–Holland, 2015.
2. E.J. Krakiwsky and D.B. Thomson, "Geodetic Position Computations", Lecture Notes, University of New Brunswick, Fredericton, 1974.
3. E.J. Krakiwsky, "Conformal Map Projections in Geodesy", Lecture notes, University of New Brunswick, Frederiction, 1973.

Web links:-

Student's field trip:-

Course Schedule/Outline/Calendar of Events

Week	Topic
1	Geodetic reference systems: ellipsoid, geoid, and datums, ITRS, ITRF
2	Coordinate systems and transformations between different coordinate systems
3	Transformations between different geodetic datums
4	Corrections and reductions of geodetic observations
	Map projections: Tissot's indicator, scale factor, meridian convergence computation for a selected map projections
6	Local plan to UTM methods. combined scale factor computation and implementation in UTM maps.
7	Mapping of Iran in the Lambert Conformal Conic Projection system (single and double standard parallels), plotting of the Tissot's Indicator on it, and comparison of several non-conformal mapping systems.

Evaluation Procedures and Grading Criteria

Assignments	12 points
Comprehensive Assignment	2 points (at max)
Mid-Term Exam	0 points
Final Exam	6 points
Total Points	20 points

Close Range Photogrammetry

BASIC INFORMATION

Place in Curriculum, title and semester: Elective, Introduction and understanding of construction sites, S7

Number of credits: 3

COURSE PREREQUISITES

Principles of triangulation in photogrammetry, geodetic mapping and analysis of control networks

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Ali Abzal

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone number: +983137935275

Homepage: https://cet.ui.ac.ir/~a.abzal

Email address: a.abzal@cet.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Guided learning	Laboratory	Problem Solving	Theory
3h	1h	-	1h

COURSE OBJECTIVES

The purpose of this course is to get familiar with how photogrammetry interacts with other disciplines, such as medicine, industry, topography, environment, and the like.

REQUIRED STUDENT RESOURCES

References:

1. K.B. Atkinson, “close range photogrammetry and machine vision”, UK, Wittles publishing, 2001.
2. T. Luhmann S.Robson، "close range photogrammetry: principles, methods and applications" ,whittles،2006.

Web links: ---

Computer Software: ---

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	An introduction to Close-range photogrammetry.
2	Close range photogrammetry applications.
3	Close range photogrammetric cameras.
4	Network design and camera calibration.
5	Basic concepts in reconstruction and three-dimensional modeling of objects.
6	Architectural photogrammetry.
7	Features of architectural photogrammetry among the types of close range photogrammetry applications.
8	History of architecture Photogrammetry.
9	Importance of architectural photogrammetry.
10	Practical examples of architectural photogrammetry applications.
11	Industrial photogrammetry.
12	Industrial photogrammetry applications.
13	3D modeling and change and deformation detection in industrial parts.
14	Medical photogrammetry.
15	The difference between medical photogrammetry and other close range photogrammetry applications.
16	Medical photogrammetry applications.
17	3D modeling and change and deformation detection in industrial

	parts.
18	Medical photogrammetry.
19	The difference between medical photogrammetry and other close range photogrammetry applications.
20	Medical photogrammetry applications.
21	Special equipment and techniques in 3D measurements in medicine.
22	Laser scanner systems.
23	Basics of laser scanners.
24	Terrain and airborne laser scanners. Scanner data.
25	Acquisition, processing and data production.
26	UAV history.
27	Motivation to use drones in mapping and surveying.
28	Various UAV's and their categories.
29	Drones: what they are, how they work.
30	Workflow in a UAV photogrammetry project.

EVALUATION PROCEDURES AND GRADING CRITERIA

Classroom activities and projects	10 points
Final Exam	10 Points
Total Points	20 points

Hydrographic Surveying

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Hydrographic Surveying, S7

Number of credits: 2

COURSE PREREQUISITES

Geodetic Surveying

COURSE CO-REQUISITES:

TEACHERS

The person in charge: Dr. Jamal Asgari

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone number: +983137935290

Homepage: https://eng.ui.ac.ir/~asgari

Email address: asgari@eng.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	1 h	---	1/3 h

COURSE OBJECTIVES

To familiarize students with the principles, concepts, and applications of hydrography, marine positioning systems, and hydrographic chart production.

REQUIRED STUDENT RESOURCES

References:

1. C.D. de Jong, G. Lachapelle, S. Skone and I.A. Elema, “Hydrography”, VSSD, First edition 2002, corrected 2011.
2. A.E. Ingham, "Hydrography for The Surveyor and Engineer", Wiley-Blackwell; 3 edition, 1993.
3. D.B. Thomson, D.E. Wells and W.H. Falkerberge, "An Introduction to Hydrographic Surveying", University of New Brunswick, Canada, 1979.
4. US Army Corps of Engineers, "Hydrographic Surveying", EM 1110-2-1003, US Army Corps of Engineers, 2001.
5. W. D. Forrester, "Canadian Tidal Manual", Department of Fisheries and Oceans, Canada, 1983.
6. US Army Corps of Engineers, "Hydrographic Surveying (Technical Engineering and Design Guidess as Adapted from the Us Army Corps of Engineers)", American Society of Civil Engineers, 1998.
7. R.P. Loweth, "Manual of Offshore Surveying for Geoscientists and Engineers", Kluwer Academic Publishers, 1997

Web links:-

Student's field trip:

Visiting is necessary along with the approval of the specialized council of the department.

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Introduction: definitions, historical overview, tasks and applications, relevant international organizations.
2	Nautical Chart: Chart definition, chart information, types of charts, comparison with maps.
3	Bathymetry: Basic concepts, speed of sound in water and its variations, depth sounding devices (echo sounders), components and principles of operation, errors and corrections in depth sounding, echo sounder calibration, alternative depth sounding methods.
4	Marine Positioning and Navigation: General principles, mathematical models, accuracy of position determination, satellite-based and offshore positioning methods.
5	Magnetic Declination: Definitions, applications, variations, extraction methods.
6	Tides and Currents: Definition, different factors influencing tides and currents,

	impact on different regions, measurement of tides and currents, tide calculations and prediction, applications, global models, correction of measured depths, reference surfaces.
7	Marine Currents: Origin of marine currents, measurement methods, variations.
8	National and International Standards in Hydrographic Chart Production.
9	Charting a Water Basin: Planning and design, observational methods, processing, quality control.

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	2 points
Comprehensive Assignment	3 points (at max)
Mid-Term Exam	7 points
Final Exam	8 points
Total Points	20 points

Surveying 2 (Hands-on)

BASIC INFORMATION

Place in Curriculum, title, and semester: Core, Surveying 2 (Hands-on), S2

Number of credits: 1

COURSE PREREQUISITES

COURSE CO-REQUISITES

Surveying 2

TEACHERS

The person in charge: Dr. Seyed Bagher Fatemi

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone number: +983137935332

Homepage: https://eng.ui.ac.ir/~sb.fatemi

Email address: sb.fatemi@eng.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Guided learning	Laboratory	Problem Solving	Theory
---	4 h	---	---

COURSE OBJECTIVES

Field and office procedures in support of material studied in Surveying 2

REQUIRED STUDENT RESOURCES

References:

1. Schofield, Wilfred, and Mark Breach. Engineering surveying. CRC Press, 2007.

2. A.Bannister and R.Baker, "Solving Problems in Surveying", 2nd Edition, Longman, 1996.
3. D. Wolf and C.Ghilani, "Elementary Surveying", 10th Edition, prentice- Hall, 2001.
4. Ghilani, Charles D., Paul R. Wolf, and Anthony Gidudu. Elementary surveying: An introduction to geomatics. Upper Saddle River: Pearson Prentice Hall, 2008.
5. Schofield, Wilfred. Engineering Surveying: Theory and examination problems for students. Elsevier, 2013.

Student's field trip:

Visiting is necessary along with the approval of the specialized council of the department.

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Topic	Week
Introduction to Total Stations	1
Hands-On Practical Exercises of Alignment and Orientation	2
Practice On Traverse	3
Determining The Coordinates of Control Points Through Triangulation	4
Intersection and Resection	5
Topographic Mapping Using Total Stations at Two Different Scales	6
Map Layout (Stakeout Surveying)	7
Land Partitioning and Area Calculation	8

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	10 points
Comprehensive Assignment	0 points (at max)
Final Exam	10 points
Total Points	20 points

Geodetic Surveying and Control Networks Analysis (Hands-on)

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Geodetic Surveying and Control Networks Analysis (Hands-on), S3

Number of credits: 1

COURSE PREREQUISITES

COURSE CO-REQUISITES

Geodetic Surveying and Control Networks Analysis

TEACHERS

The person in charge: Dr. Hamid Mehrabi

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone number: +983137935297

Homepage: https://eng.ui.ac.ir/~h.mehrabi

Email address: h.mehrabi@eng.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	---	---	--

COURSE OBJECTIVES

The purpose of this course is to acquaint students with the investigation and analysis of errors in various surveying measurements, calibration of measuring instruments, planning, design, and analysis of networks of planar and height control points in an operational manner, including computer programming and field works operations

Required Student Resources

References:

1. M. A. R. Cooper, "Control Surveys in Civil Engineering", Collins Professional and Technical Books, 1987.
2. E. W. Grafarend and F. Sanso, "Optimization and Design of Geodetic Networks", Springer-Verlag, 1985.
3. A. Johnson, "Plane and Geodetic Surveying: The Management of Control Networks", Spon Press, 2004.
4. S. Kuang, "Geodetic Network Analysis and Optimal Design", Sams Publications, 1996.
5. US. Army Corps of Engineers, “Geodetic and Control Surveying", University Press of the Pacific, 2004.
6. M. Berber, "Robustness analysis of geodetic networks", UNB Technical Report, 2006.

Web linkes:-

Student's field trip:

Visiting is necessary along with the approval of the specialized council of the department.

Course Schedule/Outline/Calendar of Events

Week	Topic
1	Examination and analysis of errors in geodetic measurements through repeated observations and evaluation of errors with different land surveying instruments (such as level, theodolite, and total station).
2	Programming for error propagation analysis in traverses and geodetic networks.
3	Analysis and design of different orders of control networks using trial-and-error and analytical methods based on accuracy and reliability criteria, including zeroth-order design, first-order design, second-order design, and third-order design for the improvement and expansion of existing networks.

Evaluation Procedures and Grading Criteria

Assignments	2 points
Comprehensive Assignment	3 points (at max)
Mid-Term Exam	7 points
Final Exam	8 points

Total Points	20 points

Remotely Sensed Image Processing Lab

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Remotely Sensed Image Processing Lab, S5

Number of credits: 1

COURSE PREREQUISITES

COURSE CO-REQUISITES

Remotely Sensed Image processing

TEACHERS

The person in charge: Dr. Mehdi Momeni

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone number: +983137935288

Homepage: https://eng.ui.ac.ir/~momeni

Email address: momeni@surv.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
-	-	2 h	1/3 h

COURSE OBJECTIVES

Follow workflow of the image processing in Remote sensing

Become familiar with the basic processing of remote sensing images

REQUIRED STUDENT RESOURCES

1. Richards, J. A., "Remote Sensing Digital Image Analysis: An Introduction", Springer, 2013.

2. Gieske A.S.M., Hecker C.A., Huurneman G.C., van der Horn J.A., Tempfli K., Grabmaier K.A., Janssen L.L.F., Feringa W.F., Bakker W.H., "Principles of remote sensing : an introductory textbook", ITC Educational Textbook Series 2, 2009.

References:

1. Rees W. G., "Physical Principles of Remote Sensing", 3rd Edition, University of Cambridge, 2012.

Emery W., Camps A., "Introduction to Satellite Remote Sensing, Atmosphere, Ocean, Cryosphere and Land Applications", Elsevier Science, 2017.

Thenkabail P.S., "Remotely Sensed Data Characterization, Classification, and Accuracies", 1st Edition, CRC Press, 2015.

Web links:-

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Use of image processing software (general and remote sensing professional)
2	Image loading (different formats and structures, linking images)
3	Image data retrieval (DN data, radiometric data)
4	Data subsets (spatial, spectral)
5	Data subsets: Regions of Interest
6	Color composites and visual interpretation
7	Band arithmetic and interpretations
8	Geometric correction (in different spatial resolutions, using different GCP sources)
9	Color spaces and image fusion
10	Spatial domain filtering (mean, median, morphologic, second order statistics)
11	Image correction (radiometric, atmospheric)

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	10 points
Comprehensive Assignment	5 points
Mid-Term Exam	- points
Final Exam	5 points

Total Points	20 point

Principles of Remote Sensing

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Principles of Remote Sensing, S4

Number of credits: 3

COURSE PREREQUISITES

Principles of Photogrammetry, Surveying 2

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Mina Moradizadeh

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone number: +983137935312

Homepage: https://eng.ui.ac.ir/~m.moradizadeh

Email address: m.moradizadeh@eng.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	1 h	-	-

COURSE OBJECTIVES

The purpose of this course is to familiarize students with the principles and concepts of remote sensing.

Students are expected to:

7. Be familiar with the principles and concepts of the remote sensing
8. Get sufficient knowledge in physics of remote sensing

9. Acquire some skills in extracting information from remote sensing images
10. Know the types of platforms and sensors and their characteristics
11. Be able to make corrections to satellite images

REQUIRED STUDENT RESOURCES

Textbooks:

1. Richards, J. A., "Remote Sensing Digital Image Analysis: An Introduction", Springer, 2013.
2. Fatemi, S. B., Rezaei, Y., " Principles of Remote Sensing ", 3rd ed., Azadeh Press, 2017.

References:

1. Rees W. G., "Physical Principles of Remote Sensing", 3rd Edition, University of Cambridge, 2012.

Emery W., Camps A., "Introduction to Satellite Remote Sensing, Atmosphere, Ocean, Cryosphere and Land Applications", Elsevier Science, 2017.

Principles of remote sensing : an introductory textbook. Edition: ITC Educational Textbook Series 2, Editors: Tempfli K, G.C. Huurneman, W.H. Bakker, and L.L.F. Janssen, University of Twente Faculty of Geo-Information and Earth Observation (ITC), 2009.

Web linkes: ---

Student's field trip:

Visiting is necessary along with the approval of the specialized council of the department.

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Introduction and history, remote sensing systems, developments
2	Applications and importance of remote sensing
3	Physics of remote sensing (energy sources in remote sensing, atmospheric effect)
4	Physics of remote sensing (spectral characteristics of earth surface effects)
5	Platforms, introduction of orbits, characteristics of satellites (orbital parameters, data storage and transmission)
6	Sensors, different types of sensors, characteristics of sensors (spatial, spectral, radiometric and temporal resolution)
7	Introduction of some special platforms and sensors

8	Digital images and the concept of pixels in remote sensing
9	An introduction to image processing
10	Electro-optical sensors: introduction, structure, types, characteristics, distortions, applications
11	Radar sensors: introduction, structure, types, characteristics, distortions, application
12	Basic corrections (missed lines, stripping, noise)
13	Geometric correction of images: geometric errors, types of transformation, methods of geometric correction, control points, resampling methods
14	Basics of extracting information from images, general introduction of band calculations, classification, and segmentation

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	2 points
Comprehensive Assignment	0 points (at max)
Mid-Term Exam	8 points
Final Exam	10 points
Total Points	20 points

Physical Geodesy

Basic Information

Place in Curriculum, title and semester: Core, Physical Geodesy, S7

Number of credits: 3

Course prerequisites

Geometrical Geodesy, Engineering Mathematics

Course co-requisites

Teachers

The person in charge: Dr. Abdol Hossein Mousavi al Kazemi

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone Number: +983137935287

Homepage: https://eng.ui.ac.ir/~hmoossavi

Email Address: hmoossavi@surv.ui.ac.ir

Other instructors: -

Weekly hours

Guided learning	Laboratory	Problem Solving	Theory
---	---	1 h	3 h

Course Objectives

The purpose of this course is to acquaint students with the mathematical principles and concepts of physical geodesy, principles of gravimetry, geoid determination methods and height datums.

Required Student Resources

References:

1. A. Safari, “Physical Geodesy”, Tehran University Press, 2011.
2. W. Heiskanen and H. Moritz, "Physical Geodesy", Springer, 2005.
3. N. Sneeuw, “Physical Geodesy”, Lecture Note, Institute of geodesy, University of Stuttgart, 2006.
4. W. Torge, "Gravimetry", De Gruyter, 1984.
5. W. Torge, "Geodesy", 3rd Edition, De Gruyter, 2001.
6. P. Vanicek and E.J. Krakiwsky, "Geodesy: The Concepts", North-Holland, 2015.
7. J. Wahr, "Geodesy and Gravity", Samizdat Press, 1996.

Web links:-

Student's field trip:-

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Topic	Week
Introduction: Physical geodesy and its connections to the earth sciences, Applications in engineering, some vector calculus rules, Divergence, Laplacian, Gradient and Curl operators.	1
Earth's gravity potential field: Newtonian gravitation, vectorial attraction of a point mass, gravitational potential, discrete and continuous superposition, gravitational potential and attraction of a solid homogeneous sphere and a spherical shell and a solid homogeneous cylinder, centrifugal acceleration and potential, gravity attraction and potential.	2
Gravimetry: Gravimetric measurement principles (pendulum, spring, free fall), Gravity networks (Gravity observation procedures, Relative gravity observation equation),	3
Solving Laplace’s equation: Boundary value problem, Poisson and Laplace equations, properties of spherical harmonics, orthogonal and orthonormal base functions, solving Laplace’s equation for potential field of the earth in spherical coordinates, physical interpretation of spherical harmonic coefficients.	4
The normal field: Normal potential and gravity, gravity anomaly, potential anomaly, disturbing potential and gravity, Bruns’s second formula.	5
Gravity reductions: Free air reduction, Bouguer reduction, isostasy.	6
Geoid determination: The Stokes approach, determination of vertical deflection components by Vening-Meinesz formula.	7
Geoidal height determination by astro-gravimetric and astro-geodetic procedures, geopotential models, introduction to selected satellite gravimetry missions.	8
Height systems: Dynamic, Orthometric, Normal	9

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	2 points
Comprehensive Assignment	3 points (arbitrary)
Mid-Term Exam	7 points
Final Exam	8 points
Total Points	20 points

Fundamentals of Geodesy

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Fundamentals of Geodesy, S3

Number of credits: 2

COURSE PREREQUISITES

Surveying 1

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Abdol Hossein Mousavi al Kazemi

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

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Email address: hmoossavi@surv.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Guided learning	Laboratory	Problem Solving	Theory
---	---	1 h	2 h

COURSE OBJECTIVES

The purpose of this course is to acquaint students with the basic concepts and applications of geodesy.

REQUIRED STUDENT RESOURCES

References:

1. P. Vanicek and E.J. Krakowski, "Geodesy: The Concepts", 2nd Edition, North-Holland, 2015.
2. W. Torge, "Geodesy", 3rd Edition, Gruyter, Berlin, 2001.
3. J. R. Smith, “introduction to geodesy”, John Wiley & sons, 1997.

Web linkes:-

Student's field trip:-

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Topic	Week
Introduction: Definition of geodesy, The objective of geodesy, tasks, geodesy divisions (global, reginal, local).	1
History and historical development of geodesy: Evidences that the earth is not flat, Different eras in the history of geodesy.	2
Earth and its Size and Shape: Some Ideas for determining the size of the spherical earth, Importance of determining the size of the earth, the figure of the earth, Actual shape of the earth, Instantaneous and mean sea level, Geoid, Sea surface topography, Ellipsoid, Spheroid, Reference ellipsoid parameters, Temporal evolution of the reference ellipsoid parameters, Geoid as an equipotential surface, Relationship between geoid and ellipsoid.	3
Earth and its Motions: types of earth’s motions, Kepler's laws, theory of gyroscope, Solstices and equinoxes, Length of day, Tensor of Inertia, Natural coordinate system, Precision and notation, Euler's equation, Polar motion and spin velocity variations.	4
Earth and its gravity field: Gravity as a combination of gravitation and centrifugal attraction, Gravitational potential, Variations and irregularities in the Earth’s gravity field.	5
Earth and its Deformations in Time: Types of temporal variations, viscoelastic body, dynamic phenomena, tidal phenomena (definition, characteristics, tidal acceleration and potential and its formula), Tidal deformations, Crustal loading deformations, Isostasy theories, Tectonic deformations and crustal motions, Man-made deformations.	6
Earth and its Atmosphere: Definition, Layers of the atmosphere, Physical properties of the atmosphere, Atmospheric effects on geodetic and surveying measurements.	7

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	2 points
Comprehensive Assignment	3 points (arbitrary)

Mid-Term Exam	7 points
Final Exam	8 points
Total Points	20 points

Differential Geometry

Basic Information

Place in Curriculum, title and semester: Core, Differential Geometry, S4

Number of credits: 2

Course prerequisites

Differential Equations

Course co-requisites

Teachers

The person in charge: Dr. Abdol Hossein Mousavi al Kazemi

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone number: +983137935287

Homepage: https://eng.ui.ac.ir/~hmoossavi

Email address: hmoossavi@surv.ui.ac.ir

Other instructors: -

Weekly hours

Guided learning	Laboratory	Problem Solving	Theory
---	---	1 h	2 h

Course Objectives

The purpose of this course is to teach topics related to differential geometry so that students can understand the concepts of physical geodesy and geometric geodesy courses.

Required Student Resources

References:

1. 1.H. N. Schäfer and J. P. Schmidt "Tensor Analysis and Elementary Differential Geometry for Physicists and Engineers", 2nd Edition, Springer 2017.
2. M. M. Lipschutz, "Schaum's Outline of Theory and Problems of Differential Geometry", McGraw–Hill, 1969.
3. W. Kuhnel, "Differential Geometry: Curves - Surfaces – Manifold", American Mathematical Society, 2015.
4. A. Pressley, "Elementary Differential Geometry", 2nd edition, Springer, 2010.
5. T. Aubin, "A Course in Differential Geometry", American Mathematical Society, 2001.
6. Y. Aminov, "Differential Geometry and Topology of Curves", Taylor & Francis, 2001.
7. G. Valiron, "Classical Differential Geometry of Curves and Surfaces", Math. Science Press, 1987.

Web linkes:-

Student's field trip:-

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Topic	Week
Mathematical Representation of a curve: Regular representations, Regular curves, Orthogonal projections, Implicit representations of curves, Regular curves of class c^m, Definition of arc length, Arclength as a parameter.	1
Curvature and Torsion: Unit tangent vector, Tangent line and normal plane, Curvature, Principal normal unit vector, Principal normal line and osculating plane, Binormal, Moving trihedron,Torsion, Spherical indicatrices.	2
The Theory of Curves: Frenet equations, Intrinsic equations, The fundamental existence and uniqueness theorem, Canonical representation of a curve, Involutes, Evolutes, Theory of contact, Osculating curves and surfaces.	3
Elementary Topology in Euclidean Spaces: Open sets, Closed sets, Limit points, connected sets, Compact sets, Continuous Mappings, Homeomorphisms.	4
Vector Functions of a Vector Variable: Linear functions, Continuity and limits, Directional derivatives, Differentiable functions, Composite	5

functions, Functions of class c^m, Taylor's formula, Inverse function theorem.	
Mathematical Representation of a Surface: Regular parametric representations, Coordinate patches, Definition of a simple Surface, Tangent plane and normal line, Topological properties of simple surfaces, Compact and Connected surfaces, Flexible Surfaces, Simple Surfaces.	6
First and Second Fundamental Forms: First fundamental form, Arc length and surface area, Second fundamental form, Normal curvature, Principal curvatures and directions, Gaussian and mean curvature, Lines of curvature, Rodrigues' formula. Asymptotic lines. Conjugate families of curves.	7
Intrinsic Geometry: Mappings of surfaces, Isometric mappings, Intrinsic geometry, Geodesic curvature, Geodesic coordinates, Geodesic polar coordinates, Arcs of minimum length, Surfaces with constant Gaussian curvature, Gauss-Bonnet theorem.	8

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	2 points
Comprehensive Assignment	3 points (at max)
Mid-Term Exam	7 points
Final Exam	8 points
Total Points	20 points

Site and Underground Surveying

BASIC INFORMATION

Place in Curriculum, title and semester: Elective, Site and Underground Surveying, S7

Number of credits: 2

COURSE PREREQUISITES

Route Surveying and Geometrical Design

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Mehran Sattari

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone number: +983137935320

Homepage: https://eng.ui.ac.ir/~sattari

Email address: sattari@eng.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	1 h	-	1 h

COURSE OBJECTIVES

Develop proficiency in utilizing advanced surveying instruments and techniques tailored for construction site and underground environments, including Total Stations, GPS, laser scanning, and 3D modeling.

Understanding of safety protocols and risk assessment procedures relevant to surveying in construction sites, tunnels, and mining areas, ensuring students are well-equipped to prioritize and maintain safety standards in their professional practice.

Develop proficiency in the specialized terminology, safety protocols, and advanced surveying techniques required in construction and mining sites.

Gain practical experience in planning, executing and controlling surveying task, encompassing surface and underground measurement, geo-referencing , and mapping.

Collaborate seamlessly with professionals from related fields, such as civil engineering, geology, and architecture, emphasizing effective communication and coordination in interdisciplinary projects involving site and underground surveying.

REQUIRED STUDENT RESOURCES

References:

1. JO Ogundare, Precision surveying: the principles and geomatics practice, 2015.
2. V. Borshch-Komponiets, A. Naritny and G. Knysh, Mine Surveying, Mir, Moscow, 1989.
3. R. Williams, Mine Mapping and Layout, Prentice Hall, 1982.
4. J. Underhill, Mineral Land Surveying, Landmark Enterprises,1979.
5. All books, papers, thesis, and letters in Site and Underground surveying.

Web linkes: ---

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1-2	Overview of course objectives, structure, and expectations. Introduction to basic surveying principles, equipment, and specific terminology used in underground surveying. Assignment 1: Research and present a case study on a construction or mining project.
3	In-depth exploration of advanced surveying instruments: Total Stations, GPS, laser scanning, and 3D modeling. Hands-on exercises using advanced instruments. Assignment 2: Demonstrate proficiency in utilizing advanced surveying instruments.
4	Exploration of common surveying practices in pipeline and tunnel construction surveys. Culvert and bridge construction surveys, quantity surveys, and final surveys. Assignment 3: Case study analysis of a specific construction project.

5	Detailed discussion on safety protocols in construction, tunnels, and mining. Introduction to risk assessment methodologies. Guest speaker: Safety expert from the industry. Assignment 4: Develop a safety plan for a hypothetical surveying project.
6	Field trip to a construction site or mining facility. Practical exercises on surface and underground measurement, geo-referencing, and mapping. Assignment 5: Report on practical experiences and lessons learned during the field trip.
7	Examination of various equipment used in underground surveying. Hands-on training with underground surveying instruments. Assignment 6: Demonstrate proficiency in using underground surveying equipment.
8	Overview of interdisciplinary collaboration in construction projects. Group project: Collaborative design and surveying task with students from other engineering disciplines. Guest speaker: Civil engineer involved in interdisciplinary projects. Assignment 7: Present findings and collaborative efforts.
9-10	Application of setting out and dimensional control in construction projects. Focus on pile, foundation, column, beam, and ceiling dimensions. Group project: Execute dimensional control in a simulated construction scenario. Principles of project management applied to surveying projects. Group project: Develop and present a comprehensive project plan for a surveying task. Assignment 8: Execute and control a surveying task, considering safety protocols and advanced techniques.
11-12	Techniques for controlling and monitoring structures during and after excavation. Case studies of successful structural control in construction projects. Introduction to environmental considerations in surveying. Guest speaker: Environmental expert in construction and mining. Group project: Conduct an environmental impact assessment for a surveying project. Assignment 9: Present environmental impact assessment findings.

13-14	Understanding datum and map projection in the context of underground surveying. Practical exercises in datum and map projection. Methods for measuring azimuth with corresponding corrections. Correlation in underground construction projects. Underground and aboveground traversing using classical and satellite-based methods.
15-16	Underground leveling techniques. Methods for extracting cross-sections in tunnels, calculating earthwork volumes, concrete pouring, and calculating mesh and shotcrete surfaces. Drilling methods in open and underground tunnels. Alignment for drilling using various surveying equipment and relevant software. Preparation of as-built maps and contractor invoices.
17-18	Review of course materials and key concepts. Preparation for the final examination. Final examination covering course materials. Group presentations of semester projects, demonstrating proficiency in advanced surveying techniques, safety protocols, interdisciplinary collaboration, and project management.

EVALUATION PROCEDURES AND GRADING CRITERIA

Class seminars	10 points
Classroom activities and projects	5 points
Final Exam	5 Points
Total Points	20 points

Analytical Photogrammetry

9. BASIC INFORMATION

3. Place in Curriculum, title and semester: Elective, Analytical Photogrammetry, S7
4. Number of credits: 3

1. COURSE PREREQUISITES

5. Principles of Photogrammetry, Adjustment Calculations and Statistical Tests

1. COURSE CO-REQUISITES

6. ---

1. TEACHERS

7. The person in charge: Dr. Mehran Sattari
8. Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran
9. Phone number: +983137935320
10. Homepage: https://eng.ui.ac.ir/~sattari
11. Email address: sattari@eng.ui.ac.ir
12. **Other instructors: -**

1. WEEKLY HOURS

13. Theory	14. Problem Solving	15. Laboratory	16. Guided learning
17. 3 h	18. 1 h	19. -	20. 1 h

1. COURSE OBJECTIVES

Comprehend the methodologies used to establish the relationship between image space and object space.

Master the mathematical calculations involved in determining point coordinates, utilizing camera calibration parameters, measured image coordinates, and ground control points.

Gain knowledge of the systematic procedures employed in producing a variety of photogrammetric products, including 2D and 3D maps, rectified images, and orthophotos.

2. REQUIRED STUDENT RESOURCES

21. **References:**

1. P. Wolf, B. DeWitt, B. Wilkinson, “Elements of Photogrammetry with Application in GIS”, Fourth Edition, 4th Edition, McGraw-Hill Education, 2014.
2. F.H. Moffitt، "Photogrammetry"، 3rd Edition، Harper & Row، 1980.
3. K. Kraus، "Photogrammetry"، Vol.1، Duemmler، Bonn، 1992.
4. J.C. McGlone، "Manual of Photogrammetry"، 5th Edition، ASPRS، 2004.
5. W. Linder، "Digital Photogrammetry: Theory and Applications"، Springer-Verlag، 2003.
6. All books, papers, theses, and letters in management fields.

22. **Web linkes:**

1. COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

23. Week	**24. Topic**
25. 1	26. Introduction to Analytical Photogrammetry.
27. 2	28. Overview of Photogrammetric Classifications, with Emphasis on Projection Systems and Cameras.
29. 3	30. Geometric Transformations and Projections - Review of 2D and 3D Methods in Euclidean Coordinate Systems and Introduction to Homogeneous Coordinate Representation.
31. 4	32. Methodologies for Rotating a Three-dimensional Coordinate System in Photogrammetry and Computer Vision.
33. 5	34. Intrinsic Orientation in Euclidean and Homogeneous Space.
35. 6	36. Systematic Errors in Photogrammetric Measurements and Camera Calibration.
37. 7	38. Extrinsic Orientation in Euclidean and Homogeneous Space.
39. 8-9	40. Simultaneous Space Resection and Intersection Techniques.
41. 1	42. Self-Calibration in Photogrammetry.

0	
43. 11-12	44. Relative Orientation in Euclidean Space based on Coplanarity and Collinearity Condition Equations.
45. 13	46. Relative Orientation in Homogeneous Space Based on Essential and Fundamental Matrices.
47. 14	48. Absolute Orientation in Euclidean and Homogeneous Space.
49. 15	50. Digital Image Rectification Techniques.
51. 16	52. Methods for Orthophoto Generation.

1. EVALUATION PROCEDURES AND GRADING CRITERIA

53. Class seminars 2 points
54. Classroom activities and projects 3 points
55. Final Exam 15 Points
56. Total Points 20 points

Analytical Photogrammetry Lab

BASIC INFORMATION

Place in Curriculum, title and semester: Elective, Aerial Photogrammetry Lab, S7

Number of credits: 1

COURSE PREREQUISITES

Principles of Photogrammetry Lab

COURSE CO-REQUISITES

Analytical Photogrammetry

TEACHERS

The person in charge: Dr. Mehran Sattari

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone Number: +983137935320

Homepage: https://eng.ui.ac.ir/~sattari

Email Address: sattari@eng.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
---	---	2 h	1 h

COURSE OBJECTIVES

Cultivate proficiency in both programming and the utilization of photogrammetric software through the Analytical Photogrammetry Lab.

Focus on enhancing skills in geometric transformations, image rectification, and precise measurement techniques during the lab sessions.

Delve into algorithm development, gaining insights into error analysis, quality assessment, and the practical applications of analytical photogrammetry in real-world scenarios.

Achieve the overarching goal of empowering themselves with practical skills and knowledge for precise spatial analysis and mapping. This is realized through a comprehensive understanding and application of both programming techniques and photogrammetric software tools in analytical photogrammetry.

REQUIRED STUDENT RESOURCES

References:

1. P. Wolf, B. DeWitt, B. Wilkinson, “Elements of Photogrammetry with Application in GIS”, Fourth Edition, 4th Edition, McGraw-Hill Education, 2014.
2. F.H. Moffitt، "Photogrammetry"، 3rd Edition، Harper & Row، 1980.
3. J.C. McGlone، "Manual of Photogrammetry"، 5th Edition، ASPRS، 2004.
4. All books, papers, theses, and letters in management fields.

Web linkes: -

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Interior Orientation Using Photogrammetric Software
2	Interior Orientation Programming
3	Relative Orientation Using Photogrammetric Software
4	Relative Orientation Programming
5	Absolute Orientation Using Photogrammetric Software
6	Absolute Orientation Programming
7	Space Resection Using Photogrammetric Software
8	Space Resection Programming
9	Space Intersection Using Photogrammetric Software
10	Space Intersection Programming
11	Simultaneous Space Resection and Intersection Using Photogrammetric Software
12	Simultaneous Space Resection and Intersection Programming
13	Camera Calibration Using Photogrammetric Software
14	Stereo Plotting Using Photogrammetric Software

15	3D Map Generation Using Photogrammetric Software
16	Digital Surface Model Generation Using Photogrammetric Software

EVALUATION PROCEDURES AND GRADING CRITERIA

Classroom activities and projects	15 points
Final Report	5 Points
Total Points	20 points

Hydrographic Surveying

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Hydrographic Surveying, S7

Number of credits: 2

COURSE PREREQUISITES

Geodetic Surveying

COURSE CO-REQUISITES:

TEACHERS

The person in charge: Dr. Jamal Asgari

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone number: +983137935290

Homepage: https://eng.ui.ac.ir/~asgari

Email address: asgari@eng.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	1 h	---	1/3 h

COURSE OBJECTIVES

To familiarize students with the principles, concepts, and applications of hydrography, marine positioning systems, and hydrographic chart production.

REQUIRED STUDENT RESOURCES

References:

1. C.D. de Jong, G. Lachapelle, S. Skone and I.A. Elema, “Hydrography”, VSSD, First edition 2002, corrected 2011.
2. A.E. Ingham, "Hydrography for The Surveyor and Engineer", Wiley-Blackwell; 3 edition, 1993.
3. D.B. Thomson, D.E. Wells and W.H. Falkerberge, "An Introduction to Hydrographic Surveying", University of New Brunswick, Canada, 1979.
4. US Army Corps of Engineers, "Hydrographic Surveying", EM 1110-2-1003, US Army Corps of Engineers, 2001.
5. W. D. Forrester, "Canadian Tidal Manual", Department of Fisheries and Oceans, Canada, 1983.
6. US Army Corps of Engineers, "Hydrographic Surveying (Technical Engineering and Design Guidess as Adapted from the Us Army Corps of Engineers)", American Society of Civil Engineers, 1998.
7. R.P. Loweth, "Manual of Offshore Surveying for Geoscientists and Engineers", Kluwer Academic Publishers, 1997

Web links:-

Student's field trip:

Visiting is necessary along with the approval of the specialized council of the department.

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Introduction: definitions, historical overview, tasks and applications, relevant international organizations.
2	Nautical Chart: Chart definition, chart information, types of charts, comparison with maps.
3	Bathymetry: Basic concepts, speed of sound in water and its variations, depth sounding devices (echo sounders), components and principles of operation, errors and corrections in depth sounding, echo sounder calibration, alternative depth sounding methods.
4	Marine Positioning and Navigation: General principles, mathematical models, accuracy of position determination, satellite-based and offshore positioning methods.
5	Magnetic Declination: Definitions, applications, variations, extraction methods.
6	Tides and Currents: Definition, different factors influencing tides and currents,

	impact on different regions, measurement of tides and currents, tide calculations and prediction, applications, global models, correction of measured depths, reference surfaces.
7	Marine Currents: Origin of marine currents, measurement methods, variations.
8	National and International Standards in Hydrographic Chart Production.
9	Charting a Water Basin: Planning and design, observational methods, processing, quality control.

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	2 points
Comprehensive Assignment	3 points (at max)
Mid-Term Exam	7 points
Final Exam	8 points
Total Points	20 points

Elective Courses

Satellite Mapping and Updating

BASIC INFORMATION

Place in Curriculum, title and semester: Elective, Satellite mapping and updating, Q7

Number of credits: 2

COURSE PREREQUISITES:

Remotely Sensed Image processing

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Mina Moradizadeh

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone number: +983137935312

Homepage: https://eng.ui.ac.ir/~m.moradizadeh

Email address: m.moradizadeh@eng.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	-	-	1/3 h

COURSE OBJECTIVES

The purpose of this course is to learn the theoretical principles and operational steps of extracting large-scale maps from satellite images and the principles of periodic revision of maps.

Students are expected to:

3. Know the theoretical principles and operational steps of extracting large-scale cover maps from satellite imagery and the principles of periodic revision

4. Be familiar with preparing and updating maps
5. Acquire some skills in registration and transformation of image coordinate systems
6. Be familiar with proper satellite data for large-scale mapping
7. Get sufficient knowledge in image fusion

Know the methods of image processing for mapping

REQUIRED STUDENT RESOURCES

Textbooks:

1. Momeni, M., Khosravi, I. Mostajeran, B., "Objectivism in remote sensing image processing ", University of Isfahan, 2013.

References:

1. Okujeni, van der Linden & Hostert, “Extending the Vegetation-Impervious-Soil model using simulated EnMAP data and machine learning” Remote Sensing of Environment 108, 69-80, 2015.
2. Linden, S., Investigating the potential of hyperspectral remote sensing data for the analysis of urban imperviousness, Humboldt-Universidad zu Berlin, Mathematisch-Naturwissenschaftliche Fakultät II, 2008.
3. Griffiths et al. Mapping megacity growth with multi-sensor data. Remote Sensing of Environment, 114, 426-439, 2010.
4. Taubenböck et al., Monitoring urbanization in mega cities from space. Remote Sensing of Environment, 117, 162-176, 2012.
5. Baatz, M., Benz, U., Dehghani, S., Heynen, M., Höltje, A., Hofmann, P., Lingenfelder, I., Mimler, M., Sohlbach, M., Weber, M. and Willhauck, G., cognition Professional: User Guide 5, Munich: Definiens-Imaging, 2004.
6. Buyuksalih, G., Akcin, H., Jacobsen, K., 2006. Geometry of Orb View- 3 Images, ISPRS Workshop, Ankara, 2006.

Web linkes: ---

Student's field trip: ---

1. COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Introduction, the basic concepts of preparing and updating the urban maps
2	The history of preparing and updating urban/rural maps in the world,

	statement of Iran's situation in this field
3	Necessity and stages of updating maps
4	Types of satellite data suitable for large-scale maps
5	Data preparation and how to buy and receive, data format and application software
6	Data coordinate systems, Mathematical models of image coordinate systems transformation, level 2 processing
7	Selection and measurement of control points in satellite images, coordinate transformation calculations and error control
8	Basic concepts of satellite images fusion, introduction of some common methods for producing images - Pan Sharpen
9	Compatibility of vector and raster data in software
10	Image processing methods in mapping
11	Manual drawing method and visual review and standards
12	Classification methods and post-processing
13	Extraction of parts and lines, feature vectors and GLCM
14	Examples of internal and external projects implemented to prepare and update maps

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	0 points
Comprehensive Assignment	4 points (at max)
Mid-Term Exam	7 points
Final Exam	9 points
Total Points	20 points

Applied Remote Sensing

BASIC INFORMATION

Place in curriculum, title and semester: elective, Applied Remote Sensing, S7

Number of credits: 2

COURSE PREREQUISITES:

Principles of Remote Sensing

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Mina Moradizadeh

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone number: +983137935312

Homepage: https://eng.ui.ac.ir/~m.moradizadeh

Email address: m.moradizadeh@eng.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2h	-	-	-

COURSE OBJECTIVES

The purpose of this course is to familiarize students with the principles and practical concepts of remote sensing.

REQUIRED STUDENT RESOURCES

Textbooks:

1. Lillesand, T.M. and Kiefer, R.W., "Remote Sensing and Image Interpretation", 7th Edition, John Wiley, 2015.
2. Richards, J., "Remote Sensing Digital Image Analysis", Springer–Verlag Publication, 5th Edition, 2012.

References:

1. Avery, T.E and Berlin, G.L., "Fundamentals of Remote Sensing and Airphoto Interpretation", 5th Edition, Maxwell Macmillan International, 1992.

Mather, P.M., Koch, M., "Computer Processing of Remotely- Sensed Images: an Introduction", 4th Edition, John Wiley, 2010.

Khorram, S., Wiele, C.F., Koch, F.H., Nelson, S.A.C., Potts, M.D., "Principles of Applied Remote Sensing", Springer Cham, 2016.

Student's field trip:

Visiting is necessary along with the approval of the specialized council of the department.

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Introduction and overview of the basics of remote sensing
2	The importance and necessity of using remote sensing
3	Application of remote sensing in drought analysis
4	Different stages of remote sensing project
5	Applications of remote sensing in agriculture
6	Application of remote sensing in drought analysis
7	Application of remote sensing in retrieving land surface parameters
8	Application of remote sensing in retrieving atmospheric parameters
9	Application of remote sensing in environment and forestry
10	Application of remote sensing in geology, oceanography and urban management
11	Satellite image classification and methods
12	Change detection from satellite images and methods
13	Damage estimation of natural disasters from remote sensing images
14	Understanding the relationship between remote sensing and GIS

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	2 points
Comprehensive Assignment	3 points (at max)
Mid-Term Exam	7 points

Final Exam	8 points
Total Points	20 points

57.Project

1. Basic Information

Place in Curriculum, title and semester: Elective, Project, Q7

Number of credits: 2

2. Course prerequisites

Analytical Photogrammetry

3. Course co-requisites

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4. Teachers

The person in charge: Dr. Iman Khosravi

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone number: +983137935298

Homepage: https://cet.ui.ac.ir/~i.khosravi

Email address: i.khosravi@cet.ui.ac.ir

Other instructors: -

5. Weekly hours

Theory	Problem Solving	Laboratory	Guided learning
-	1 h	2 h	1 h

6. Course Objectives

List the objectives, goals, aims, and/or outcomes for the course.

Students are expected to:

Be able to handle and accomplish an applied project in surveying and geomatics field.

7. Required Student Resources

References:

All books, papers, theses, and letters in surveying fields (based on the projects defined by supervisor for the students)

Web links:-

8. Course Schedule/Outline/Calendar of Events

Week	Topic
1	Defining a research project in surveying field by supervisor
2	Approval of the project subject in the group council
3	Presenting and defending the project by the student in the presence of the supervisor and a member of the group

9. Evaluation Procedures and Grading Criteria

Project	20 points
Total Points	20 points

Technical Language for Surveying

BASIC INFORMATION

Place in Curriculum, title and semester: Elective, Technical Language for Surveying, S6

Number of credits: 2

COURSE PREREQUISITES

Fundamentals of Geodesy, Principles of Photogrammetry

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Iman Khosravi

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, 81746-73441, Isfahan, Iran

Phone Number: +98 (31) 37935298

Homepage: https://cet.ui.ac.ir/~i.khosravi

Email Address: i.khosravi@cet.ui.ac.ir

Other instructors:

This course can be held like a workshop.

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	1 h	-	1 h

COURSE OBJECTIVES

List the objectives, goals, aims, and/or outcomes for the course.

Students are expected to Learn the technical words and terms in geomatics and surveying science.

Be able to use English scientific, technical books, publications and documents in surveying field.

Required Student Resources

References:

1. W. Kuhnel, “Differential Geometry: Curves - Surfaces – Manifold”, American Mathematical Society, 2002.
2. E. M. Mikhail and F. Ackermann, “Observations and Least Squares”, IEP-A Dun-Donnelley Publisher, 1976.
3. T. Kariya and H. Kurata, “Generalized Least Squares”, John Wiley, 2004.
4. Johnson, “Plane and Geodetic Surveying: The Management of Control Networks”, Spoon Press, 2004.
5. P.R. Wolf and B.A. Dewitt, “Elements of Photogrammetry with Applications in GIS”, 3 rd Edition, McGraw Hill, 2000.
6. T.M. Lille sand and R.W. Kiefer, “Remote Sensing and Image Interpretation”, 6 th Edition, John Wiley, 2008.
7. P. Vanicek and E.J. Krakiwsky, “Geodesy: The Concepts”, 2 nd Edition, North–Holland, 1989.

Web links:-

Course Schedule/Outline/Calendar of Events

Week	Topic
1	Reading comprehension using lectures, books, papers and texts in surveying fields such as surveying and geomatics, geodesy, photogrammetry, remote sensing, geospatial information system, cadastral, cartography etc.
2	English Grammar for simple and complex clauses
3	Technical words and terms in surveying
4	The principles of translation in surveying
5	Translation of scientific texts from English to Persian
6	Translation of scientific texts from Persian to English
7	Abbreviations and acronyms in surveying

Evaluation Procedures and Grading Criteria

Classroom activities and projects	5 points

Mid-Term Exam	5 points
Final Exam	10 Points
Total Points	20 points

Entrepreneurship

Basic Information

Place in Curriculum, title and semester: Elective, Entrepreneurship, S6

Number of credits: 2

Course prerequisites

Principles of Photogrammetry, Fundamentals of Geodesy

Course co-requisites

Teachers

The person in charge: Dr. Iman Khosravi

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, 81746-73441, Isfahan, Iran

Phone number: +98 (31) 37935298

Homepage: https://cet.ui.ac.ir/~i.khosravi

Email address: i.khosravi@cet.ui.ac.ir

Other instructors:-

Weekly hours

Theory	Problem Solving	Laboratory	Guided learning
2 h	-	-	-

Course Objectives

Be able to know the basic concepts of entrepreneurship and creating new and knowledge-based businesses
Be able to know the principles of business plan formulation, company launch, marketing and sales

Required Student Resources

References:

1. E. Ries, The Learn Startup: How today' s entrepreneurs use continuous innovation to ctreat radically successful businesses, Crown Book, 2011.
2. S. Case, The third wave: An entrepreneur's vision ofthe future, Simon and Schuster, 2017.
3. Osterwalder, Y. Pigneur, M, A, Y. Oliverian, and J. J. P. Ferreria, Business Model Generation: A handbook for visionaries, game changers and challengers, African journal of business management, 2011.
4. J. Memiyy, and J. Fiefer, Start Your Own Business: The only Startup Book You'll Ever Need, 7th Edition, Entrepreneur, 2018.

Web links:-

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Concepts and definitions of entrepreneurship, evolution of entrepreneurship in the world, importance and necessity of entrepreneurship
2	Definition of innovation and creativity, innovation process, levels and types of innovation, principles of invention and innovation, idea and opportunity
3	Organization and structure of a business, types of organizational structures, management and business stages, duties of a business manager, familiarity with different types of companies, stages of setting up knowledge-based companies and business leadership
4	Familiarity with company regulations, business laws, brand registration, trademark and licensing procedures
5	Familiarity with financial management, definition of financial activities, capital estimation, capital sources, preparation of company's financial documents, asset management, profit and loss account and expenses
6	Familiarity with marketing and sales, marketing tools, definition of advertising and the purpose of advertising, use of media and advertising tools, digital marketing in the future world, international business (trade and export) and entrepreneurial culture
7	Preparing a business model, the difference between a business model and a business plan, how to set up and present a business plan, familiarization with growth and entrepreneurship centers and methods of acquiring capital

EVALUATION PROCEDURES AND GRADING CRITERIA

Class seminars	10 points
Classroom activities and projects	5 points

Final Exam	5 Points
Total Points	20 points

Computational Geometry in GIS

BASIC INFORMATION

Place in Curriculum, title and semester: Elective, Computational Geometry in GIS, S7

Number of credits: 2

COURSE PREREQUISITES

Geospatial Information System (GIS)

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Iman Khosravi

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

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Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	1 h	-	1 h

COURSE OBJECTIVES

Learn about the principles and concepts of computational geometry;

Learn its role in engineering and design/ranking of algorithms.

REQUIRED STUDENT RESOURCES

References:

1. De Berg, M., Van Kreveld, M., Overmars, M., & Schwarzkopf, O. (1997). Computational geometry. Springer, Berlin, Heidelberg.

Web links: -

Computer Software: -

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Introductory to the principles and concepts of computational geometry
2	An overview on the basic principles of geometry of line, surface and volume
3	An overview on the basic relationships such as length, perimeter, area, volume and distances between different geometric shapes such as two points, point and line, two lines, point and polygon, line and polygon, polygon and polygon considering the specific state of the circle for the polygon, center of gravity and …
4	Convex hull
5	Point and line in polygon
6	Line intersection algorithms and determine the orientation of the point relative to the line
7	Polygon triangulation
8	Linear programming: gradual, random, borderless
9	Vertical search algorithms
10	Introduction of graphs and graph scanning algorithms
11	Algorithms for determining Veronese diagrams
12	Delaney triangulation algorithms

EVALUATION PROCEDURES AND GRADING CRITERIA

Class Project	5 points
Assignments & Oral Exam	5 points
Final Exam	10 points
Total Points	20 points

Engineering Geology

BASIC INFORMATION

Place in Curriculum, title and semester: Elective, Principles of Surveying Management, S3

Number of credits: 2

COURSE PREREQUISITES

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Ali Abzal

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

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Other instructors: -

WEEKLY HOURS

Guided learning	Laboratory	Problem Solving	Theory
١ h	-	١ h	٢ h

COURSE OBJECTIVES

The aim of this course is to get familiar with the principles and concepts of geology and geomorphology with emphasis on their application in the field of surveying engineering while referring to examples in the geography of Iran.

REQUIRED STUDENT RESOURCES

References:

1. H. Architects, Geology for Engineers, 11th edition, University of Tehran, 2018.
2. R. B. Johnson and J. V. DeGraff, "Principles of Engineering Geology", John Wiley, 1988
3. F. G. Bell, "Fundamentals of Engineering Geology", Butterworths, 1983.
4. P. B. Attewell and I. W. Farmer, "Principles of Engineering Geology", Chapman and Hall, 1976.
5. D. G. Price, "Engineering Geology: Principals and Practice", Springer, 2007.

Web links: -

Computer Software: -

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Topic	Week
General familiarity with the principles and concepts of geology and .geomorphology and their role in surveying engineering	١
The shape of the earth, the internal structure of the earth and getting .familiar with geodynamics	٢
Petrological mineralogy and the processes that change rocks, the role of rocks in the formation of low elevations, a brief classification of rocks and .soils	٣
.Sudden change factors: volcanoes, earthquakes, floods	۴
.Brief of paleontology, stratigraphy	۵

EVALUATION PROCEDURES AND GRADING CRITERIA

Classroom activities and projects	10 points
Final Exam	10 Points
Total Points	20 points

An Introduction to Construction Sites

BASIC INFORMATION

Place in Curriculum, title and semester: Elective, Principles of Surveying Management, S7

Number of credits: 2

COURSE PREREQUISITES

Route mapping and road geometric plan

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Ali Abzal

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone number: +983137935275

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Other instructors: -

WEEKLY HOURS

Guided learning	Laboratory	Problem Solving	Theory
1 h	-	1 h	2 h

COURSE OBJECTIVES

The purpose of this course is to open up the minds of students with the types of construction sites, terms used in them and to explain the role of the surveyor engineer in related projects.

REQUIRED STUDENT RESOURCES

References:

1. M. Zamani, a collection of frequently used terms in construction operations, 2013.
2. M. Maleki, Z. Masoumi, Getting to know the description of the contractor's duties, basic workshop issues and implementation tips, 2018.
3. K. Banya Shahri, road construction executive operation, 2019.
4. F. Moghadisnejad, Management of road construction machines, 2015.
5. H. Ghasemzadeh Tehrani, road construction and road geometric design, 1382.
6. S. Ebrahimzadeh, construction and road construction machinery, 2017.

Web links: -

Computer Software: -

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Topic	Week
Introduction of the various sites, its types and project site stuffs including employer, consultant, contractor and machine.	۱
Workshop equipment.	۲
Road site: An overview of various road construction solutions and various dimensions, including decoupage, substructure of dor-bins and sub-bins, paving and asphalt coating, types of beams.	۳
Various laboratories in different layers and soil density	۴
Oil and gas pipeline sites, water and sewage, canals.	۵
Tunnel, subway, subway station and its routes and bridges.	۶
Drains including road drains and irrigation drains.	۷
Implementation of construction sites for buildings, foundations, cement, sand, excavation and its stabilization, familiarization with steel and concrete structures, columns, roofs, slope of roof and floor, separation joint.	۸
Introducing the operation of various machines (loader, bulldozer, grader, asphalt spreader, roller, and finisher).	۹
General and private conditions of the plan and statement of temporary and definitive situations.	۱۰
Reading maps and getting familiar with commonly used signs and	۱۱

EVALUATION PROCEDURES AND GRADING CRITERIA

Classroom activities and projects	10 points
Final Exam	10 Points
Total Points	20 points

Advanced Computer Programming

BASIC INFORMATION

Place in Curriculum, title and semester: Elective, Advanced Computer Programming
Number of credits: 2

COURSE PREREQUISITES:

Basics of computer and programming

COURSE CO-REQUISITES: -

TEACHERS

The person in charge: Dr. Ali Abzal
Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran
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Other instructors: -

WEEKLY HOURS

Guided learning	Laboratory	Problem Solving	Theory
1 h	-	1 h	2 h

COURSE OBJECTIVES

The purpose of this course is to empower students to develop computer programs for mapping applications and scientific problems using MATLAB and one of the high-level programing languages such as Python, C#, VB.net or Java.

REQUIRED STUDENT RESOURCES

References:

Shashi Kant Mishra, Bhagwat Ram - Introduction to Linear Programming with MATLAB-Taylor & Francis, CRC Press_Chapman and Hall_CRC (2018)

Mikhailov, Eugeniy E - Programming with MATLAB for Scientists _ A Beginner's Introduction-CRC Press (2018)

Steven I. Gordon, Brian Guilfoos - Introduction to Modeling and Simulation with MATLAB® and Python-Chapman and Hall CRC Taylor & Francis (2017)

Brian D. Hahn_ Daniel T Valentine - Essential MATLAB for Engineers and Scientists-Academic Press (2019)

Web links: -

Computer Software: -

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Topic	Week
Introducing low, medium and high-level programming languages and explaining the importance of MATLAB programming among others.	۱
Familiarity with algorithm design methods in order to develop computer programs.	۲
Familiarity with different parts of the MATLAB software environment (introduction of the software environment, main menus and commands, constants and formula writing).	۳
Introduction of general MATLAB functions including mathematical functions, matrices definition, types of special matrices, mathematical operations on matrices such as determinant and inverse of matrix, solution of linear equations, cell and structural arrays.	۴
Programming in MATLAB including logical and conditional operators, loops, "mfiles", interpolation or extrapolation functions, fitting polynomials and derivation.	۵
Input/Output Function's, including text files and images, diagrams, two-dimensional and three-dimensional procedures.	۶
Getting to know raster and vector functions in MATLAB.	۷
GUI learning.	۸
speed Increasing of the program by removing unnecessary elements such as loops.	۹
Familiarity with different IDE programming environments such as Microsoft Visual Studio and Eclipse.	۱۰
Basic routine programming reminder.	۱۱
Familiarity with object-oriented programming, including the concepts of class, object, feature, method, and libraries.	۱۲
Learning one of Python, VB.net, C# or Java language programming.	۱۳

۱۴	.Learning to define a class, build a library of objects, and create an object from a class
۱۵	.Familiarity with the use of existing libraries in a program
۱۶	Familiarity with Deployment Tool in MATLAB to convert programs into MATLAB libraries .that can be used in other programming languages
۱۷	Using functions converted from MATLAB to standard libraries in a high-level programming .environment such as Python, VB.net, C# or Java

EVALUATION PROCEDURES AND GRADING CRITERIA

1. Classroom activities and projects	10 points
2. Final Exam	10 Points
Total Points	20 points

Map Projections in Cartography

BASIC INFORMATION

Place in Curriculum, title and semester: Elective, Map Projections in Cartography, S6

Number of credits: 2

COURSE PREREQUISITES

Geometrical Geodesy

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Jamal Asgari

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone number: +983137935290

Homepage: https://eng.ui.ac.ir/~asgari

Email address: asgari@eng.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	1 h	---	1/3 h

COURSE OBJECTIVES

This course is designed to familiarize students with the fundamental principles and mathematical concepts of map projection systems. Additionally, it aims to enhance students' practical skills in performing transformations between various map projection systems.

REQUIRED STUDENT RESOURCES

References:

1. E. W. Grafarend, R. J. You, R. Syffus, " Map Projections: Cartographic Information Systems ", 2nd Edition, Springer Berlin Heidelberg, 2017.
2. F. Canters, “Small-Scale Map Projection Design”, Taylor & Francis, 2002.
3. J. P. Snyder, “Map Projections a Working Manual”, U.S. Geological Survey Professional Paper, 1987.
4. M Lapaine, E. L. Usury, "Choosing a Map Projection", Springer, 2017.

Web links:-

Student's field trip:

Visiting is necessary along with the approval of the specialized council of the department.

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Introduction
2	Classification of Map Projection Systems
3	Surface Theory, Gaussian Curvature and Geodesic, Mapping theory, Mapping of the Sphere onto a Plane
4	Distortion Theory, Tissot's Indicatrix
5	Differential Equations of Map Projection Systems
6	Conformal Map Projection Systems: Cauchy–Riemann Equations
7	Equal-Area Map Projection Systems
8	Equidistant Map Projection Systems
9	Conic Map Projection Systems: General Definitions and Properties, Lambert Conformal Conic Map Projection System (Equations, Properties, and Applications), Equal-Area Conic Map Projection Systems (Equations, Properties, and Applications), Equidistant Conic Map Projection Systems (Equations, Properties, and Applications)
10	Azimuthal Map Projection Systems: General Definitions and Properties, Stereographic Map Projection System (Equations, Properties, and Applications), Orthographic Map Projection System (Equations, Properties, and Applications), Gnomonic Map Projection System (Equations, Properties, and Applications)
11	Cylindrical Map Projection Systems: General Definitions and Properties, Mercator Map Projection System (Equations, Properties, and Applications), Transverse Mercator and UTM Map Projection Systems (Equations, Properties, and

	Applications), Lambert Cylindrical Equal-Area Map Projection System (Equations, Properties, and Applications), Cylindrical Equidistant Map Projection System (Equations, Properties, and Applications)
12	Optimization of Map Projection Systems: Local Evaluation Criteria, Regional Evaluation Criteria, Optimization using Least Squares Method
13	Working with Existing Software and Utilizing Tools for Map Projection Systems in Matlab or Python and Transforming between Map Projection Systems.

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	2 points
Comprehensive Assignment	3 points (at max)
Mid-Term Exam	7 points
Final Exam	8 points
Total Points	20 points

Urban Construction and Architectural Design

BASIC INFORMATION

Place in Curriculum, title and semester: Elective, Urban Construction and Architectural Design,

Number of credits: 2

COURSE PREREQUISITES

Cadaster

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Hossein Bagheri

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone number: +983137935299

Homepage: https://cet.ui.ac.ir/~h.bagheri

Email address: h.bagheri@cet.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2h	---	---	---

COURSE OBJECTIVES

The purpose of this course is to acquaint students with the theory of architecture, to know the types of functions in architecture, to study the relationships and spaces of architecture, to get acquainted with the basic concepts of urban planning, to know the environment and urban spaces and the function of responsive urban spaces.

Required Student Resources

References:

1. F., DK, Ching. Architecture: Form, Space and Order, John Wiley & Sons, 2014.

Student's field trip:-

Course Schedule/Outline/Calendar of Events

Week	Topic
1	An overview of architectural concepts
2	Factors affecting building analysis
3	An overview of urban planning concepts
4	City appearance and its constituent factors
5	The concept of quality in urban space
6	Responsive urban environments and its features

Evaluation Procedures and Grading Criteria

Assignments	3 points
Comprehensive Assignment	3 points (at max)
Mid-Term Exam	7 points
Final Exam	7 points
Total Points	20 points

Urban Construction and Architectural Design

BASIC INFORMATION

Place in Curriculum, title and semester: Elective, Urban Construction and Architectural Design,

Number of credits: 2

COURSE PREREQUISITES

Cadaster

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Hossein Bagheri

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone number: +983137935299

Homepage: https://cet.ui.ac.ir/~h.bagheri

Email address: h.bagheri@cet.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Guided learning	Laboratory	Problem Solving	Theory
---	---	---	2h

COURSE OBJECTIVES

The purpose of this course is to acquaint students with the theory of architecture, to know the types of functions in architecture, to study the relationships and spaces of architecture, to get acquainted with the basic concepts of urban planning, to know the environment and urban spaces and the function of responsive urban spaces.

Required Student Resources

References:

1. F., DK, Ching. Architecture: Form, Space and Order, John Wiley & Sons, 2014.

Student's field trip:-

Course Schedule/Outline/Calendar of Events

Topic	Week
An overview of architectural concepts	1
Factors affecting building analysis	2
An overview of urban planning concepts	3
City appearance and its constituent factors	4
The concept of quality in urban space	5
Responsive urban environments and its features	6

Evaluation Procedures and Grading Criteria

Assignments	3 points
Comprehensive Assignment	3 points (at max)
Mid-Term Exam	7 points
Final Exam	7 points
Total Points	20 points

Construction Materials

BASIC INFORMATION

Place in Curriculum, title and semester: Elective, Construction materials, S5

Number of credits: 2

COURSE PREREQUISITES

COURSE CO-REQUISITES

Statics and Strength of Materials

TEACHERS

The person in charge: Dr. Seyed Bagher Fatemi

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

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Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	----	------	-----

COURSE OBJECTIVES

Students are expected to:

become familiar with different types of construction materials properties and, become familiar with concrete properties and its production

REQUIRED STUDENT RESOURCES

References:

1. N. Jackson and R. K. Dhir, “Civil Engineering Materials”, Macmillan Education, 1988.
2. J. M. Illuston, “Construction Materials”, E&FN Spon, 1994.
3. A. R. Lyons, “Materials for Architects and Builders: An Introduction”, Arnold, London, 1997.
4. R. C. Smith and C. K. Andres, “Materials of Construction”, McGraw-Hill, 1989.
5. A. M. Neville and J. J. Brooks, “Concrete Technology”, Longman Scientific & Technical, Singapore, 1987

Student's field trip:

Visiting is necessary along with the approval of the specialized council of the department.

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Definitions and Terminology
2	Understanding construction materials
3	Soil, sand, gravel
4	Cement, Gypsum, Lime, Mortar
5	Stone, Brick
6	Glass, Metals, Wood
7	Bitumen, Polymers, Heat Insulating and Water Proofing Materials
8	Understanding Concrete Technology: Cement, Sand, Gravel, Concrete Mix Design

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	5 points
Final Exam	15 points
Total Points	20 points

Spatial Planning

BASIC INFORMATION

Place in Curriculum, title and semester: Elective, Spatial Planning, Q7

Number of credits: 2

COURSE PREREQUISITES

Principles of Remote Sensing

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Iman Khosravi

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Email address: i.khosravi@cet.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	1 h	-	1 h

COURSE OBJECTIVES

List the objectives, goals, aims, and/or outcomes for the course.

STUDENTS ARE EXPECTED TO

Learn the basic concepts of spatial planning.

Know the effective factors and processes and methods used in urban planning.

REQUIRED STUDENT RESOURCES

References:

1. Faludi, A. (2000). The performance of spatial planning. Planning practice and Research, 15(4), 299-318.
2. Morphet, J. (2010). Effective practice in spatial planning. Routledge.
3. Dühr, S., Colomb, C., & Nadin, V. (2010). European spatial planning and territorial cooperation. Routledge.

Web links:-

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	An overview on basic concepts: spatial planning, relationship between spatial planning and geomatic engineering, and regional planning
2	Factors influencing spatial planning such as environmental, economic, social and cultural, political and security parameters
3	Basics of physical designs: land-use maps, Determining the hierarchy of service distribution, Determining the rules and regulations
4	Spatial structure analysis: spatial structure patterns, analyzing factors on spatial structure, analyzing spatial structure problems
5	An overview of spatial planning from the perspective of the Management and Planning Organization
6	Spatial planning models (what if/ RIKS)
7	Spatial planning and GIS
8	Passive Defense and spatial planning

EVALUATION PROCEDURES AND GRADING CRITERIA

Classroom activities and projects	5 points
Mid-Term Exam	5 points
Final Exam	10 Points
Total Points	20 points

Multi Criteria Decision Making

BASIC INFORMATION

Place in Curriculum, title and semester: Elective, Multi Criteria Decision Making, S5

Number of credits: 2

COURSE PREREQUISITES

Geospatial Information Systems

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Jamshid Maleki

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Phone number: +983137935294

Homepage: https://cet.ui.ac.ir/~j.maleki

Email address: j.maleki@cet.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Guided learning	Laboratory	Problem Solving	Theory
1/3 h	---	---	2 h

COURSE OBJECTIVES

The purpose of this course is to make the ability to prepare a variety of vector and raster maps on paper and digital with existing standards and experience with the principles and concepts of spatial information management.

The purpose of this course is to introduce students to the multi-criteria decision making (MCDM) methods in crisp and fuzzy environments and its' applications in different geospatial problems.

Required Student Resources

Textbooks and References:

1. M. J. Asgharpour, Multi-Criteria Decision Making, University of Tehran Press, Ninth Edition, 2011, (In Persian)

Student's field visit:

At least one of the organizations in charge of preparing the map, such as:

- National cartographic center

- Cadastre Organization

- Isfahan Municipality Information and Communication Technology (ICT) Organization

Course Schedule/Outline/Calendar of Events

Topic	Week
Introducing and explaining two main categories of multi-criteria decision making models (MCDM) called multi-objective decision making models (MODM) and multi-attribute decision making models (MADM).	1
Investigation of multi-objective decision making methods including weighted sum and pareto based methods.	2
Investigation of linear programming methods, goal programming, interactive programming.	3
An overview of various multi-attribute decision making methods and explaining the necessity of them.	4
Investigating various normalization techniques	5
Investigation and explanation of various methods for evaluating the weights of attributes, including entropy and eigenvector techniques.	6
Investigation of compensatory models such as SAW, TOPSIS, AHP and ANP	7
Investigation of widely used and well-known models such as TOPSIS, AHP and ANP in group decision making.	8
Introducing optimization methods	9

Evaluation Procedures and Grading Criteria

Assignments	6 points
Mid-Term Exam	6 points

Final Exam	8 points
Total Points	20 points

Precise Industrial Surveying

BASIC INFORMATION

Place in Curriculum, title and semester: Elective, Precise industrial surveying, S3

Number of credits: 3

COURSE PREREQUISITES

Geodetic Surveying And Control Networks Analysis

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Hamid Mehrabi

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

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Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	1 h	2h	1/3 h

COURSE OBJECTIVES

The purpose of this course is to acquaint students with the methods of precise site surveying in local and regional scale and its primary and partial differences with geodetic surveying topics.

REQUIRED STUDENT RESOURCES

References:

1. M. A. R. Cooper, “Control Surveys in Civil Engineering”, Collins Professional and Technical Books, 1987.
2. E. W. Grafarend and F. Sanso, “Optimization and Design of Geodetic Networks”, Springer-Verlag, 1985.
3. A. Johnson, “Plane and Geodetic Surveying: The Management of Control Networks”, Spon Press, 2004.
4. S. Kuang, “Geodetic Network Analysis and Optimal Design”, Sams Publications, 1996.
5. U.S. Army Corps of Engineers, “Geodetic and Control Surveying”, University Press of the Pacific, 2004

web linkes:-

Student's field trip:

Visiting is necessary along with the approval of the specialized council of the department.

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Importance of precise industrial and site surveying (microgeodesy).
2	Review and completion of required topics including deformation analysis, statistical tests, geodetic surveying, and an introduction to robust estimators such as L1 norm.
3	Establishment of geodetic networks: network design considering various criteria including network sensitivity to deformation, design and structure of points, methods of observations, quality control criteria in geodetic networks, accuracy criteria (error ellipses and covariance matrices), reliability and geometric strength criteria for network sensitivity analysis, and cost criteria for a network.
4	Special issues in industrial and site surveying including precise installation and setup of equipment, necessary standards for measurements, precise surveying equipment (precision levels and industrial total stations), integration of different types of observations in geodetic networks, calibration and testing of instruments, use of GPS for deformation monitoring.
5	Displacement and deformation in geodetic networks including the detection of stable points in geodetic networks, compatibility test of observations in different epochs, stability test of network points, overall stability test of the network for identifying unstable points, minimization of the L1 norm vector displacement, simultaneous deformation at different epochs, methods for calculating absolute displacement and displacement ellipses, determination of height displacements: precise leveling, radar interferometry method.

6	Relative displacement and concept of strain in geodetic networks, comparison of deformation and absolute displacement, Delaunay triangulation for strain parameter calculations, computation of strain matrices, and invariant descriptors of strain.
7	Principles of precise measurement and modeling in inverse engineering: close-range photogrammetry, 3D scanners for point measurement, measurement with various targets, concepts of point cloud processing.

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	2 points
Comprehensive Assignment	3 points (at max)
Mid-Term Exam	7 points
Final Exam	8 points
Total Points	20 points

New Instruments and Software in Geomatics

Basic Information

Place in Curriculum, title and semester: Elective, New Instruments and Software in Geomatics, S6

Number of credits: 2

Course prerequisites

Digital cartography

Course co-requisites

Teachers

The person in charge: Dr. Mehdi Momeni

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone Number: +983137935288

Homepage: https://eng.ui.ac.ir/~momeni

Email Address: momeni@surv.ui.ac.ir

Other instructors: -

Weekly hours

Theory	Problem Solving	Laboratory	Guided learning
2	-	1 h	1/3 h

Course Objectives

Become familiar with the new instruments and software in geomatics

Get basic skills with their professional instruments and software in geomatics

Required Student Resources

References:

1. Johnson, “Plane and Geodetic Surveying: The Management of Control Networks”, Spoon Press, 2004.
2. E. D. Kaplan and C. Hegarty, “Understanding GPS: Principles and Applications”, 2nd Edition, Artech House Publishers, 2005.
3. P.R. Wolf and B.A. Dewitt, “Elements of Photogrammetry with Applications in GIS”, 4th Edition, McGraw-Hill, 2014.
4. T.M. Lillesand and R.W. Kiefer, “Remote Sensing and Image Interpretation”, 6th Edition, John Wiley and Sons, 2008.

Web links:

https://leica-geosystems.com/

https://www.trimble.com/

Student's field trip:

Visiting the surveying instrument exhibitions or the laboratory of one of the reputable and active companies will be programmed in the semester along with the approval of the specialized council of the department.

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Introduction (the historical progress of surveying instruments and software in the ground surveying and cartography, GIS, remote sensing, photogrammetry and GPS)
2	New professional software: Civil3D and programming in Autocad and ArcGIS
3	Instruments and software of cartography (scanners, plotters, digitizers, R2V software, automatic mapping, I/O formats), Lab. 1
4	Instruments and software of ground surveying (general total stations, digital and industrial theodolites, general specifications, usage, I/O formats, project design based on the new instruments, new software), Lab. 2
5	Remote sensing and image processing software, Lab. 3
6	GPS instruments and software (history, specifications, types, usage), Lab. 4
7	Precession surveying instruments (history, specifications, types, usage), Lab.5
8	Environmental sensors (types, usage, processing software in GIS)

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments 4 points

Comprehensive Assignment	8 points
Mid-Term Exam	- points
Final Exam	8 points
Total Points	20 points

Urban Planning

BASIC INFORMATION

Place in Curriculum, title and semester: Elective, Urban planning, S6

Number of credits: 2

COURSE PREREQUISITES

Geospatial Information System (GIS)

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Mina Moradizadeh

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone number: +983137935312

Homepage: https://eng.ui.ac.ir/~m.moradizadeh

Email address: m.moradizadeh@eng.ui.ac.ir

Other instructors: -

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	-	-	-

COURSE OBJECTIVES

The purpose of this course is to familiarize students with the basic concepts of urban management and planning, as well as to study the effective factors, processes and methods used in urban planning.

Students are expected to:

5. Be familiar with the basic concepts of urban management and planning

6. Know definition of the city and theories of city construction
7. Be familiar with the basic concepts of planning
8. Get sufficient knowledge in concepts and goals of urban land use planning
9. Know the different types of urban planning plans

Acquire some skills in performing urban planning projects using GIS

REQUIRED STUDENT RESOURCES

Textbooks:

1. Shie, E., "An introduction to urban basics", University of Science and Technology, 2000.
2. Ziyari, K., “Urban land use planning, University of Tehran, 2009.

References:

1. Poormohammadi, M.R., “Urban land use planning”, Samt Press, 2009.

Shie, E., “Urban planning workshop”, University of Science and Technology, 2009.

Web linkes: ---

Student's field trip: ---

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	An overview of city concepts: Definition of city and urban development
2	Factors of city expansion, problems of urbanization in the present era, a review of theories of city construction, various urban development plans
3	An overview of planning concepts: definition of planning, types of planning in terms of time, levels of planning
4	An overview of planning theories (rational, incremental, idealistic and methodological)
5	Overview of urban planning concepts: definition of urban planning, objectives of urban planning and different aspects of urban planning
6	The relationship between urban planning and geomatics engineering
7	Urban land use planning: definition of urban land use planning, different levels of urban land use planning, objectives of urban land use planning
8	Classification of urban uses, evaluation of urban uses, urban land use planning process
9	Standards of urban land use planning, prediction models and methods in urban land use

	planning, studies and measures required in urban land use planning
10	Types of urban planning plans: urban comprehensive plans, detailed plans, guide plans
11	Other designs and products of various urban planning studies
12	Urban planning and GIS: optimal criteria in urban planning, optimal criteria in locating urban functions
13	Types of factor maps, methods of preparing different types of factor maps, weighting methods of different types of factor maps, methods of combining different types of factor maps
14	Carrying out related projects

EVALUATION PROCEDURES AND GRADING CRITERIA

Assignments	2 points
Comprehensive Assignment	3 points (at max)
Mid-Term Exam	7 points
Final Exam	8 points
Total Points	20 points

Special Studies

BASIC INFORMATION

Place in Curriculum, title and semester: Elective, SPECIAL STUDIES, S7

Number of credits: 2

COURSE PREREQUISITES

Basics of photogrammetry, basics of geodesy

COURSE CO-REQUISITES

TEACHERS

The person in charge: Dr. Ali Abzal

Office location: Department of Geomatics Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Isfahan, 81746-73441, Iran

Phone number: +983137935275

Homepage: https://cet.ui.ac.ir/~a.abzal

Email address: a.abzal@cet.ui.ac.ir

Other instructors:

This course can be held like a workshop.

WEEKLY HOURS

Guided learning	Laboratory	Problem Solving	Theory
1 h	-	1 h	2 h

COURSE OBJECTIVES

The purpose of this course is to familiar students with the latest scientific and technological achievements in a specialized field of surveying engineering. The presentation of this course will be held based on the students' request and the diagnosis and decision of the specialized group of surveying engineering.

REQUIRED STUDENT RESOURCES

References:

1. It will be introduced by the professor according to the specialized field

Web links:

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Classroom activities and projects	10 points
Final Exam	10 Points
Total Points	20 points