DEBRE MARKOS UNIVERSITY

INSTITUTE OF LAND ADMINISTRATION

DEPARTMENT OF LAND ADMINISTRATION SURVEYING

Curriculum for M.Sc. Degree in

Geomatics

July 2023

Debre Markos

Ethiopia

WITH FUNDING FROM
AUSTRIAN DEVELOPMENT COOPERATION
appear
Austrian Partnership Programme in Higher Education and Research for Development

MSc Curriculum of Geomatics

Institute of Land Administration

Department of Land Administration Surveying

Submitted to Debre Markos University

For amendment, discussion, and approval by the senate

1. Executive Summary

Name of the Program: MSc in GEOMATICS

Name of the Degree to be awarded:

In English: Master of Science in GEOMATICS

In Amharic: **የሳይንስ ማስተርስ ዲግሪ በጂኦማቲክስ**

Degree to be awarded by: Institute of Land Administration, Debre Markos University, subject to the approval of the University Senate

Standard period of the program:

Regular: 2 years (four semesters)

Summer: 3 and half years (Six terms)

Extension: 2 and half Years (six winters + Two Summers)

Total Credit Hours: 37

Total number of courses: 11 + Thesis

Commencement of the program: 2016 E.C./2023/24 G.C

Fees/Charges: As per Rules and Regulations of Postgraduate Programs of Debre Markos University

Contents

2. Introduction

Land provides multitude benefits to the society. It is one of the basic assets of the global economy with its particular importance to developing nations. The food to eat, clothes to wear, the houses to live and enjoy our daily lives, the cities and industries flocking, the infrastructure both in urban and rural areas, the utilities, the public facilities, the natural reserves and aesthetical landscapes, the minerals, water bodies, all depend on land. Land can also be commoditized being used as a basic tradable asset depending on the legislation of the nation. It is a liquid asset either by means of mortgage or transactions. It is also the basic means of income for the government by means of land and property taxes which could be fairly executed as a result of real property valuation practices. Besides, it has also a cultural value on which land related disputes cause social disorder and instability even leading to hostility and deadly conflicts by far costing higher value than the land under dispute.

The management of this basic asset of the economy differs from nation to nation. For instance, if we see the land management of most developed nations, it had been formalized starting long years and they have developed a system to generate income by titling of these rights. Their technological advancement in geo-data sciences has been also upgrading from time to time. However, most developing nations, though own enormous assets, they have started formalizing land rights recently even the majorities of them by using traditional measures.

In Ethiopia, the rapidly growing economy and continuous population growth, combined with the inelastic nature of land, have induced a very strong pressure and demand on land, necessitating the involvement of highly qualified land administration experts who can be involved in geo-data collection, analysis and interpretation; teaching, research, and community services at universities and other research institutions; and leading and organising land issues at various levels of the land administration institutions. Though the country has launched formalizing of land rights starting the previous two decades in a cost-effective manner, lack of competent professionals in geo-data sciences has become critical challenge. There are a few numbers of specialists in the profession of geomatics. Upgrading the competence of undergraduate students through implementing a master curriculum on Geomatics to make students fit to spatial and geo-data sciences in the public and private

sector of land administration, as well as for teaching, research and community service at academic institutions is very essential.

The institute also has conducted a need assessment study for the program. According to the result of need assessment study, competence towards geo-data collection, analysis and interpretation has become one of the challenging areas in order to effectively execute land management mandates. Accordingly, there is high interest from professionals employed in land related fields and also from the employer institutions. Besides, as documented in 'Implementation of Academic Geomatics Education in Ethiopia for Supporting Sustainable Development (Edu4Geo2) project' of the institute, gap of competence in spatial data sciences is one area of challenge which should be given due attention by academic programs. Competence in geo-sciences is also demanding issue from the global context since technology towards the discipline is advancing from time to time and accordingly skilled manpower is essential to benefit from these technological advancements. Geo-data is not only essential for land management activities but also it has paramount importance in other activities such as planning, implementation and decision making. However, the lack of well-qualified specialists is becoming a challenge for the proper execution of these duties. Thus, it is timely demanding mandate to produce competent professionals who effectively execute and manage the nationally launched land-related data capturing and processing programs (using ground survey equipment, aerial photography as well as high-resolution satellite imagery). Given the increasing demand for geodata, land governance, and the challenges ahead, master's programme in geomatics is long overdue. Therefore, it is essential to design and develop programs in geomatics/geo-data collection, analysis and interpretation.

Accordingly, the Institute of Land Administration has planned to open MSc program in Geomatics starting October 2023. The specialists of this master program will be employed mainly in Urban and Rural Land Administration Institutions, Geospatial Information Institute, Space Science, in Research Institutions, Universities, Consultancy services, NGOs and the like. In designing the program, curricula of relevant national and international universities has been benchmarked. The MSc program is designed to be completed within two years for regular program, three and half years for summer students and two and half years for evening students. The course breakdown and other contents of the curriculum are presented and annexed in this document.

3. Rationale of the Program

The lack of professionals in geomatics has been discussed in the introduction part based on the results of the need assessment study and referring different published articles, for instance, USAID 2014 study on the professionals' requirement in the land sector of Ethiopia. Accordingly, the rationale of this program is to contribute to the country's sustainable development efforts through creating competence in geo-data sciences which are essential for the effective governance of land and which can also be used as inputs to informed decision making for planning and development.

This MSc program aims to produce responsive professionals with the necessary expertise beyond borders when managing the inbuilt and built environment, developing infrastructures, and using natural and human resources, and develop creative and innovative solutions. It also includes designing and measuring the size of land and buildings i.e., describing, analysing, and understanding the relations between spatial objects and spatial phenomena; and allocations of land parcels, designing and evaluating the effectiveness of methods to avoid conflicts in access to land as well as in reducing land transaction costs. Besides, the technological advancement in Geomatics field is growing faster than ever before about which every professional around the world can witness.

The geomatics program has a holistic approach which is intended to provide students with technical knowledge and skills in the areas of geo-data and spatial sciences, and its application to Land Administration and Management. Hence, there is still a need to work on further specialization in the field of Geomatics to better answer the demand to manage and administer the basic asset of the economy, land, of the country in line with what the time demands, the Institute of Land Administration has found it timely and appropriate to open MSc Degree Program in Geomatics. The aim of the program is to bridge the existing gap in the lack of qualified technical experts in Geomatics in the country. It shall produce skilled and educated man-power having different practical and theoretical knowledge in the field of Geomatics both in rural and urban settings. The graduates from the program will be an input for the government, various education institutions, the private sector and others in their work on the geo-data management and spatial technology aspects of land administration in the

country. The new program includes far more diverse and focused courses that can really meet the new changes of land administration both in urban and rural areas in the country.

In addition, our country has aggressively embarked upon development activities to realize the vision of becoming a middle-income country by the year 2025. As a part and parcel of the growth and transformation plan, Debre Markos University is expected to align itself towards the attainment of this vision by producing sufficient human power with the required level of competencies demanded by the economy. Moreover, requests for increased demand in the field of Geomatics have been on the rise in recent years such as city municipalities in Ethiopia to undertake their day-to-day activities. It is, therefore, with these understandings that the Geomatics program is proposed to be established as a Master of Science under the institute of land administration at Debre Markos University.

4. Program Objectives

The objectives of this MSc program are to:

- ✓ Enable students acquire the required competence in collecting, processing and interpreting geospatial data and to develop their skills in using state of the art satellite, aerial, and ground survey technologies;
- ✓ Fill the knowledge and skill gap towards geospatial sciences and develop necessary competence in the field of geomatics;
- ✓ Design and develop appropriate techniques for the ease and transparent running of land administration in urban, peri-urban and rural areas;
- ✓ Conduct problem solving research in resolving critical challenges in industries, the professions, and the public services;
- ✓ Handle complex challenges by designing technical, socioeconomic, cultural, and environmental solutions,
- ✓ Acquire capabilities to adapt, adjust, and grow independently as well as to compete globally,

5. Profiles

5.1. Graduates Profile

Upon successful completion of the MSc program, the graduates of Geomatics will acquire the necessary knowledge, skills and level of maturity to enable them carrying out various

responsibilities. The students who complete their education in the MSc program in Geomatics have:

Knowledge

- Understand the basic premises and concepts of land administration;
- Solve Geomatics related problems effectively & creatively by using different techniques, skills & modern tools;
- Able to think critically and solve spatial problems efficiently;
- Plan and conduct Geomatics related projects;
- Conduct problem solving research to the thematic areas of spatial, geodesy, cadastral sciences;
- Manage geo-spatial data effectively;
- Familiarity with land administration problems and practices;
- Advise higher officials and policy makers on Geomatics for Land Administration and related issues;
- Advise clients on matters in evolving land administration, geodesy, spatial technology, and land registration;
- Appraise Geomatics for land administration and cadastral system development.

Skills

- Perform and guide cadastral and land information system tasks;
- Apply legal procedures and technical skills for formation and reformation of property units;
- Capture, process and analyse data obtained by UAV and other aerial vehicles;
- Manage and manipulate Continuously Operating Reference Stations (CORS);
- Solve boundary related disputes based on relevant techniques, standards, legislations, and guidelines;
- Conduct and lead spatial part of the land-reform and land development activities;
- Capture and analyse data by using precise ground survey and aerial technologies:
- Download, process and analyse satellite data for spatial planning, change detection, risk assessment and other related activities;
- Manage natural and anthropogenic resources for the sustainable development of the nation;

- Apply entrepreneurial skills for the establishment of private geomatic firms.

Attitudes

- work independently & collaborate with others;
- Intellectual integrity, respect for truth & for the ethics of research & scholarly activities;
- Lead the community and the willingness to accept social & civic responsibilities;
- Respect the values of the other individuals and groups, and an appreciation of human and cultural diversity;
- Politely advice government, NGO or private entities on land and land related issues by supporting geomatics technology;
- Are able to communicate effectively.

5.2. Professional profile

The graduates are prepared to pursue careers as they:

- Collect, analyse and interpret as well as manage and manipulate geo-data for both urban and rural land administration and management; and can contribute for informed decision making, planning and development;
- Conduct geodetic measurements, processing, adjustment, photogrammetric operations, image processing and enhancement, GIS analysis and modelling;
- Are competent enough in satellite data collection, analysis and interpretation both at national and international levels;
- Lead and guide professionals engaged in Geomatics, spatial and cadastral system as well as design and implement the spatial data acquisition and analysis;
- Establish geodetic control points to capture data by aerial vehicles and manipulate it according to its purposes; manipulate and process data from satellite systems and analyse it to fit to purposes; conduct ground surveys by using GNSS equipment, and operate continuously operating stations (CORS);
- Competent enough in spatial part of land development activities and rendering rights-based solutions to the country's development needs;

- Guide the implementation of legal procedures and technical skills for formation and reformation of property units such as subdivision, amalgamation, and partition in urban and rural areas;
- Have competence to critically examine all photogrammetric work steps with regard to potential improvements
- Can conduct applied research and policy analysis on the existing problems and policy matters of Geomatics;
- Instruct students in higher education institutions;
- Consult land-related issue in private, governmental and non-governmental organizations.

6. Target Groups

6.1. Target audiences

The MSc program addresses both national and international applicants who are particularly interested in land issues to development contexts. Candidates to be admitted to this program should have a basic understanding of land administration, geospatial sciences, and information sciences. The required academic background for applicants is:

- A bachelor's degree in one of the following fields: land administration and/or surveying, land use planning, urban and rural development, surveying, geodesy, land valuation/real property valuation, land economics, land development, architecture, civil engineering, environmental engineering, geomatics, geoinformatics, spatial planning, GIS and RS, natural resources management, geography, cadastre and geomatics, or other related fields from recognized university or college.
- Master's degree in the above listed disciplines from recognized university or college

6.2. Program prerequisite

The program is aimed at applicants who are capable of handling complex problems in land matters which usually only tend to have customized and contextually relevant solutions. In addition, applicants should demonstrate good command of the English language, and should have good communication skills.

The procedure for enrolment involves candidates enrolling through DMU's online portal as well as in person application. Written exam (where candidates can physically available); and oral interviews (in cases where candidates are unable to be physically present) will be conducted in person, by telephone or other digital technologies. The results of preliminary assessments and interviews lead to the ranking of candidates to be presented to a selection committee of the institute in the available of the Dean and Program Coordinator. Applicants must also meet other academic and non-academic criteria, as may be laid down by the school of graduate studies of the DMU regarding work experience, recommendation letters, CGPA, etc. It is the committee that determines who is finally accepted or rejected for admission.

6.3. Target Numbers

The number of participants in this master program will be according to the legislation of the university. However, professionals in Geomatics are a few in Ethiopia and to fill this gap, the program tries to admit as many applicants as much as possible.

7. Need Analysis Report

The Institute of Land Administration of Debre Markos University in collaboration with two Austrian Universities has tried to assess the need of specializations in Geomatics. For the sake of this study, a questionnaire was administered to land administration-affiliated institutions. These are Federal Rural Land Administration directorate, Ministry of Infrastructure and Urban Development, Addis Abeba sub-city administration offices, at the regional level; offices of Land Bureau, office of Urban Development and Housing, Municipalities in Amhara National Regional State of Bahir Dar, Awi zone, West Gojam Zone, Jabi-Tenan Woreda, Machakel Woreda, East Gojam zone, Gozamen Woreda and Debre Markos town administration. A total of 120 respondents were selected for the study of which 75% were males while 25% were females. With respect to the educational level, 13.3%, 70% and 16.7% of the respondents were Diploma, bachelor's degree, and master's degree holders, respectively. Therefore, the majority of the experts are bachelor's degree holders.

About 82% of the respondents have basic knowledge about the discipline of Geomatics and about 86% of the respondents agreed that there is a need for launching Geomatics education

program in in Debre Markos University and about (88%) of the respondents have reported that the Geomatics has substantial contribution to sustainable development. About (58%) also strongly agreed for the demand of short-term in-service training in geomatics. Many of the respondents (87%) perceived that the interdisciplinary skills of Geomatics help to minimize cost incurred for different profession. Most of the respondents (91%) also reported that the Geomatics experts available in each institution are a few while the market needs many which support the launching of this program to have additional professionals to the industry. Moreover, (53%) of the respondents have forwarded that the number of Geomatics experts in the concerned institutions is very small which is less than five experts that could not perform the required and demanding duties effectively. Generally, the demand of Geomatics experts in the future is very high.

A plethora of land-related fields were available as an alternative of specialization to experts at different levels. About 84% of the respondents were interested to attend their master's study in Geomatics. The survey result indicates that there is a need of MSc program in Geomatics discipline to upgrade bachelor's degrees to master's degree level. Most of the degree holders in land administration need specialization to effectively execute their duties. It is not only land administration professionals, but also other discipline professionals too require attending MSc degree in Geomatics. For instance, about 76% of the respondents replied that they were interested to attend the MSc program in Geomatics even their first degree is not land related. The respondents were interested not only in long-term courses but also, they strongly need tailor-made-training programs. The result indicated that about 58% of the respondents confirmed the necessity including the continuing education program (CEP). Currently, out of 120 respondents only 35 (29%) were Geomatics professionals in the required field. However, most of the position (71%) is occupied by non-professionals which are not directly related to the field of Geomatics. Finally, according to the need assessment result, opening the master's program in Geomatics is very essential and timely in the Institute of Land Administration.

8. Staff Profile

The MSc program will involve the full time staff from the Institute of Land Administration and guest professors from universities in Austria, especially from the University of Natural Resources and Life Science (BOKU), Vienna and Technical University Vienna (TUW). The implementation of the master course relies heavily on team-teaching. During the first and the

second years of the master program, all classes are held as team-teaching of the project members from all partner institutions. From the third year on, lecturers of DMU will take over and provide classes on their own (in a team-teaching approach). Team-teaching enables lecturers to learn from each other by discussing and applying modern teaching and learning methods. The list of full time and PhD instructors in the Institute of Land Administration of Debre Markos University who will directly involve in this program are indicated in Table 1 below.

Table 1: Staff on duty and PhD study leave (Lecturer and above) in the department of Land Administration and Surveying – Debre Markos University.

No.	Name	Level Of Education	Academic Rank	Field of Specialization
1	Sayeh Kassaw Agegnehu	Ph.D.	Assoc Prof	Land Administration
2	Abebaw Andargie Gedefaw	Ph.D.	Assist Prof	GIS and Remote Sensing for Natural Resource Mgt
3	Ayelech Kidie Mengesha	Ph.D.	Assist Prof	Land scape planning and management
4	Didier Milindi Rugema	Ph.D.	Assist Prof	GI Science for Land Administration and Mgt
5	Worku Nega Adugna	MSc	Assist Prof	Remote Sensing and Geo-informatics
6	Tilahun Dires Azmeraw	MSc	Assist Prof	Real Property Law
7	Takele Abebe Birhanu	MSc	Lecturer	Geodesy and Geomatics
8	Frew Fentahun Eneyew	MSc	Lecturer	Geodesy and Geomatics
9	Nigus Adane Derseh	MSc	Lecturer	Geodesy and Geomatics
10	Abrham Tarekegn Yitayih	MSc	Lecturer	GIS and Remote Sensing
11	Binyam Kebede	BSc	Surveying Lab Assistant	Land Administration and Surveying
12	Biruk Teferea	BSc	Surveying Lab Assistant	Land Administration
13	Gizachew Asefa	MSc	GIS and RS Lab Assistant	GIS and Remote Sensing

9. Resource Available

The institute currently has two well-furnished computer labs (the first one is the GIS and Remote Sensing computer lab) whereas the second is the Photogrammetry computer lab. In both labs, there are 52 high speed computers properly functioning. The necessary software (Erdas Imagine; ArcGIS; Quantum GIS) for data processing are installed in these computers.

There are 15 Total stations, 13 RTK GPS rovers with 6 base GPSs, 15 levelling and 3 Stereo mirrors Monitor 3D PluraView Compact 22" Full HD. Besides, the institute has more than 20 reference hard cover books as well as a lot of digital books for the proposed new MSc curriculum in Geomatics.

10. Course and Module Coding

All Geomatic modules and courses are coded as “GmLA” followed by four digit numbers. In coding the module, the four digits stand for the following:

Four letters from the program name Geomatics for Land Administration are proposed: “Gm” from Geomatics, and “LA” from Land administration, and hence GmLA. Further, M (M stands for Module) followed by four digit numbers shall be added.

A. The first three digit 501 stands for Land administration module.
B. 502stands for Geodesy module,
C. 503 for Spatial technology, and
D. 604 for Research;

The last number shows order of modules within the module category, thus “1” stands for Land Administration module, “2” for Geodesy module, “3” for spatial module and “4” for Research.

In coding the course,

A. The first digit indicates the level of the course in terms of year, i.e., ‘5’ for first year courses, and ‘6’ for second year courses. The two middle digits indicate the module number
B. The last digit stands for the order of the course in the module
C. The letter M (which stands for Module) is removed from course coding.

11. Structure of the module

The regular master program comprises 4 semesters and 37 Cr.hrs. Within the first two semester, students gain knowledge and skills in land administration, in geospatial sciences, and in geodesy and research sciences. In the second year, students focus on writing their thesis.

The program is structured around four types of qualifications.

- ✓ Land Administration and management
- ✓ Geospatial methods and techniques
- ✓ Geodesy concepts and techniques
- ✓ Research methodology

This implies having clusters of modules which deal respectively with land Administration and gender and Land Rights; geospatial science concepts and systems; geodesy concepts and with research skills and tools.

Module 01: Land Administration (GM –M5011)

No	Course code	Course name	Cr. Hrs	Contact hours			ECTS
				L	L/P	HS	
1	GmLA5011	Fundamentals of Land Administration	3	3	0	5	5
2	GmLA5012	Cadaster and Land Registration	3	2	3	5	6
3	GmLA5013	Gender and Land Rights	2	2	0	3	3
			8				**14**

Module 02: Geodesy (GM –M5021)

No	Course code	Course name	Cr.Hrs	Contact hours			ECTS
				L	L/P	HS	
1	GmLA5021	Spatial Statistics and Adjustment Computation	3	2	3	5	6
2	GmLA5022	Satellite and Physical Geodesy	3	2	3	5	7
3	GmLA5023	Reference Systems and Map Projections	3	2	3	4	6
			9				**19**

Module 03: Spatial Technology (GM –M5031)

No	Course code	Course name	Cr. Hrs	Contact hours			ECTS
				L	L/P	HS	

1	GmLA5031	Analysis of Remote Sensing Data	3	2	3	5	6
2	GmLA5032	Applied Photogrammetry	3	2	3	5	7
3	GmLA5033	Advanced GIS	3	2	3	5	7
4	GmLA5034	Spatial Data Analysis and Data Quality	2	1	3	3	4
			11				**23**

Module 04: Research (GM –M6043)

	Course code	**Course name**	**Cr.Hrs**	**Contact hours**			**CP**
				L	**L/P**	**HS**	
1	GmLA5041	Research Methods in Geomatics	3	3	0	5	5
2	GmLA6042	Thesis	6			8	60
			9				**65**

12. Course Breakdown over the Study Years

12.1. Course Breakdown for the Regular Program

Year I Semester I

Course code	Course name	Cr. Hrs	Contact hours			ECTS	Delivery mode	Duration (weeks)
			L	L/P	HS			
GmLA5011	Fundamentals of Land Administration	3	3	0	5	5	Parallel	16
GmLA5033	Advanced GIS	3	2	3	5	7	Parallel	16
GmLA5023	Reference Systems and Map Projections	3	2	3	4	6	Parallel	16
GmLA5021	Spatial Statistics and Adjustment Computation	3	2	3	5	6	Block	8
GmLA5031	Analysis of Remote Sensing Data	3	2	3	5	6	Parallel	16
Total		**15**				**30**		

Year I Semester II

Course code	Course name	Cr.Hrs	Contact hours			ECTS	Delivery mode	Duration (weeks)
			L	L/P	HS			
GmLA5012	Cadaster and Land Registration	3	2	3	5	6	Parallel	16
GmLA5032	Applied Photogrammetry	3	2	3	5	7	Parallel	16
GmLA5022	Satellite and Physical Geodesy	3	2	3	5	7	Block	16
GmLA5013	Gender and Land Rights	2	2	0	3	3	Parallel	16
GmLA5034	Spatial Data Analysis and Data Quality	2	1	3	3	4	Block	8
GmLA5041	Research Methods in Geomatics	3	3	0	5	5	Parallel	16
Total		**16**				**32**		

Year II Semester I

Course code	Course name	Cr.Hrs	Contact hours			ECTS	Delivery mode	Duration (weeks)
			L	L/P	HS			
GmLA6042	Thesis	6				60		16
Total		**6**				**60**		

Year II Semester II

Course code	Course name	Cr.Hrs	Contact hours			ECTS	Delivery mode	Duration (weeks)
			L	L/P	HS			
GmLA6042	Thesis (Ongoing)					60		16

12.2. **Course Breakdown for Summer Program**

Year I Summer I

Course code	Course name	Cr.Hrs	Contact hours			ECTS	Delivery mode	Duration (weeks)
			L	L/P	HS			
GmLA5011	Fundamentals of Land Administration	3	3	0	5	5	Parallel	16
GmLA5033	Advanced GIS	3	2	3	5	7	Parallel	16
GmLA5023	Reference Systems and Map Projections	3	2	3	4	6	Parallel	16
GmLA5013	Gender and Land Rights	2	2	0	3	3	Parallel	16
Total		**11**				**21**		

Year II Summer II

Course code	Course name	Cr. Hrs	Contact hours			ECTS	Delivery mode	Duration (weeks)
			L	L/P	HS			
GmLA5021	Spatial Statistics and Adjustment Computation	3	2	3	5	6	Block	8
GmLA5031	Analysis of Remote Sensing Data	3	2	3	5	6	Parallel	16
GmLA5012	Cadaster and Land Registration	3	2	3	5	6	Parallel	16
GmLA5034	Spatial Data Analysis and Data Quality	2	1	3	3	4	Block	8
		11				**22**		

Year III Summer III

Course code	Course name	Cr.Hrs	Contact hours			ECTS	Delivery mode	Duration (weeks)
			L	L/P	HS			
GmLA5032	Applied Photogrammetry	3	2	3	5	7	Parallel	16
GmLA5022	Satellite and Physical Geodesy	3	2	3	5	7	Block	16
GmLA5041	Research Methods in Geomatics	3	3	0	5	5	Parallel	16
		9				**19**		

Year IV summer IV

Course code	Course name	Cr.Hrs	Contact hours			ECTS	Delivery mode	Duration (weeks)
			L	L/P	HS			
GmLA6042	Thesis	6				60		9 months
		6				**60**		

13. Course Breakdown for Extension Program

Year I Semester I

Course code	Course name	Cr.Hrs	Contact hours			ECTS	Delivery mode	Duration (weeks)
			L	L/P	HS			
GmLA5011	Fundamentals of Land Administration	3	3	0	5	5	Parallel	16
GmLA5033	Advanced GIS	3	2	3	5	7	Parallel	16
GmLA5013	Gender and Land Rights	2	2	0	3	3	Parallel	16
Total		**8**				**15**		

Year I Semester II

Course code	Course name	Cr. Hrs	Contact hours			ECTS	Delivery mode	Duration
			L	L/P	HS			
GmLA5023	Reference Systems and Map Projections	3	2	3	4	6	Parallel	16
GmLA5021	Spatial Statistics and Adjustment Computation	3	2	3	5	6	Block	8
GmLA5031	Analysis of Remote Sensing Data	3	2	3	5	6	Parallel	16
Total		**9**				18		

Year I Summer I

Course code	Course name	Cr.Hrs	Contact hours			ECTS	Delivery mode	Duration (weeks)
			L	L/P	HS			
GmLA5012	Cadaster and Land Registration	3	2	3	5	6	Parallel	16
GmLA5022	Satellite and Physical Geodesy	3	2	3	5	7	Block	16
		6				**13**		

Year II Semester I

Course code	Course name	Cr.Hrs	Contact hours			ECTS	Delivery mode	Duration
			L	L/P	HS			
GmLA5032	Applied Photogrammetry	3	2	3	5	7	Parallel	16
GmLA5034	Spatial Data Analysis and Data Quality	2	1	3	3	4	Block	8
GmLA5041	Research Methods in Geomatics	3	3	0	5	5	Parallel	16
Total		**8**				**16**		

Year II Semester II

Course code	Course name	Cr.Hrs	Contact hours			ECTS	Delivery mode	Duration (weeks)
			L	L/P	HS			
GmLA6042	Thesis	6				60		16
		6				**60**		

Year II Summer II

Course code	Course name	Cr.Hrs	Contact hours			ECTS	Delivery mode	Duration
			L	L/P	HS			
GmLA6042	Thesis (Ongoing)	6				60		16
Total		6				60		

14. Teaching and Assessment Strategies

14.1. Teaching Strategies

Most teaching-learning processes are criticized for the dominant role of the passive strategies. This curriculum has noted the shortcomings of instructor dominated approaches and due attention will be given to make the teaching-learning process active learning. Accordingly, the constructionist theory of education which is a student-centred participatory teaching approach will be employed in the teaching-learning process and this curriculum is designed considering this fact. The modes of teaching include:

- Lecturing
- Seminars
- Lab and field work
- Case study
- Debates
- Book/article review
- Workshops, and
- Exercises and home study

14.2. Assessment Strategies

The methods of assessment and evaluation which will be applied across courses vary depending on the nature of the course and practical conditions. Even though, all courses will have written examination, the assessment and evaluation methods to be used in this program are the following:

❖ **For course work**

- Journal or book chapter review
- Reflection
- Term paper
- Practical exercise (Projects)
- Case studies and analysis report
- Community service/internship report

- Seminar
- Written examination

❖ **For practical courses**
- Class Activity
- Assignment
- Lab and field practice report
- Project presentation and report (practical examination)
- Written examination

❖ **For thesis, seminar, and reports**
- Quality of the paper presented (to be designed according to the university graduate program guidelines).
- Way of presentation
- Defending material presented

15. Rules, Regulation and Requirements

15.1. Admission Requirement

As per the university legislation

15.2. Grading Scale and Grade System

Grading system shall be as per the university legislation.

15.3. Graduation Requirements

Students will be eligible for graduation upon successful completion of all specified module courses and master thesis, which must be written and defended. A minimum CGPA of 3.00, with no more than one "C" grade is required out of the 4.0 scale grading system. The student should also score a minimum of “satisfactory” grade in his/her master’s thesis. In a nutshell, it is according to the legislation of the university.

15.4. Degree Nomenclature

The name of the degree to be awarded to the graduates of MSc Programme is:

in English: “MASTER OF SCIENCE IN GEOMATICS”

in Amharic: “የሳይንስ ማስተርስ ዲግሪ በጂኦማቲክስ”

15.5. Medium of Instruction

All program activities including instruction, presentation, and thesis writing will be conducted in English.

15.6. Duration of the Study

The duration of study for Master of Science in Geomatics (MSc.) is two years for regular, two and half years for the Extension, and three and half years for the summer program. However, in case of academic problems, special issues, or the like the student can extend his/her study to the maximum of two years. Other programs are as per Debre Markos University senate legislation.

15.7. Total Load

The program has 4 modules with total ECTS of 62 + thesis or Cr. Hrs. of 31 + thesis. So, the total load of the program is 31 Cr. Hrs or 62 ECTS Plus thesis. The load of the thesis is 6Cr. Hrs or 60 ECTS.

16. Quality Assurance

Quality of a program depends on the policies and procedures for recruitment of teaching staff, admission requirements, the teaching-learning-research facilities available, policies for determination of academic status, etc. To ensure delivery of the MSc program at the required quality, internal and external quality assurance mechanism will be used. As part of the internal mechanism, evaluation of students based on continuous assessment as well as exams, evaluation of teaching staff, periodic evaluation of the curriculum and assessment of adequacy of teaching facilities will be used. Besides, feedbacks will be obtained from students on regular basis. The external mechanism will include using periodic external assessors (for both course work and MSc thesis) as well as independent assessment of the teaching-learning-research process. The periodic external assessors will evaluate the standards of exams, rigor and currency of text and reference materials, depth of course treatment and coverage, adequacy of teaching facilities, and competence of teaching staff.

17. Annexes

17.1. Module Handbooks

MODULE 01: LAND ADMINISTRATION

Module Guide **Debre Markos University** **Institute of Land Administration Program**	
Module name	**Land administration**
Module Number	**01**
Module Code	GM-MLa5011
Total CrHr	**8**
Total ECTS	**14**
Module Description	This module is dealing with issues of how to administer the management and development of rural and urban land. It also examines the key concepts and theories of land administration, the theoretical and practical aspects of land development and management, and the changing patterns of urban and rural land development. The cadastre and land registration principles and practices are also described in this module. Furthermore the course investigates fundamental issues related to access to land in the statutory and customary land tenure systems.
Module Objectives	At the end of this module, students will be able to: • Comprehend the concepts, basic components and principles of land administration and management • Identify the fundamental issues related to access to land in the statutory and customary land tenure systems. • Recognize the kinds of rights, restrictions and responsibilities with respect to real property • Comprehend how to develop and modify land registration and cadastral systems
Module Competency	Competence of the module are: • Conceptualize the basic components and principles of

	land Administration • Design and develop **l**and registration and cadastral systems

Courses in the Module

	Course code	Course name	Cr.Hrs	Contact hours			CP
				L	L/P	HS	
1	GmLA5011	Fundamentals of Land Administration	3	3	0	5	5
2	GmLA5012	Cadastre and Land Registration	3	2	3	6	6
3	GmLA5013	Gender and Land Rights	2	2	0	5	3
			8				**14**

MODULE 02: GEODESY

Module Guide **Debre Markos University** **Institute of Land Administration Program**	
Module Name	Geodesy
Module Number	**02**
Module Code	GM-M5021
Total CrHr	**9**
Total ECTS	**19**
Module Description	This module attempts to guide and supervise to understand the ground surveying approach for large scale mapping application such as Cadastral, utility mapping etc. Therefore, the main focus will be understanding of ground surveying understanding of errors, their sources, and magnitudes, and adjust their data and the principles of cartography. It also provides students with a wider view of Geodesy and Geoinformatic with the focus on GNSS, satellite system, Static and kinematic measurement systems and tasks. Data processing and signal analysis. Furthermore it examines the concepts and mathematical basis

	for modelling of real, normal and disturbed earth gravity field different types of map projections and computations between geodetic and map projection coordinates.
Module Objectives	At the end of this module, students will be able to: • apply the theory of error propagation and least-square method on adjustment of geodetic observations • understand the effect of errors on geodetic observations • use error ellipses for geodetic network design • have deep understanding of the mathematical and physical foundation for representation and determination of the earth's gravity field • apply proper instruments, measurement and processing methods for different applications • describe the principle of satellite positioning methods, the main components in a satellite navigation system and their functions • Advanced GNSS error models, variance-covariance models • Static and kinematic measuring, Data processing analysis of continuous measurement data (stochastic processes, time series, covariance analysis, Fourier analysis, outline of filter theory), optimization of measurement configurations • Satellite-based Augmented Systems (SBAS) and Concepts of integrity • Precise Point Positioning (PPP): observation equation, analysis concepts

Module Competency	Competence of the module are: • Carry out ground surveying spatial data capturing techniques for large scale mapping • Model and design GNSS data for data processing and signal analysis. • Conduct different geodetic measurements • Carryout full package photogrammetric Aorotriangulation for large scale mapping • Calculate different errors, their sources, and magnitudes, and adjust their data and the principles of geodesy. • Carryout image enhancement and analysis for large scale mapping

Courses in the Module

	Course code	Course name	Cr.Hrs	Contact hours			CP
				L	L/P	HS	
	GmLA5021	Satellite and Physical Geodesy	3	2	3	6	7
	GmLA5022	Reference Systems & Map Projections	3	2	3	4	6
	GmLA5023	Spatial Statistics and Adjustment Computation	3	2	3	6	6
	Total		**9**				**19**

MODULE 03: Spatial Technology

Module Guide **Debre Markos University** **Institute of Land Administration Program**	
Module name	**Spatial Technology**
Module Number	**03**
Module Code	**GM –M5031**
Total CrHr	**11**
Total CP	**24**
Module Description	This module attempts to guide and supervise to the Aerial surveying through photogrammetry, Remote sensing, and other

	contemporary technologies to the identification, analysis, and manipulation of geospatial data and the production of cadastral maps. It also provide students with a wider view of GIS concepts and practices. Furthermore it examines the concepts of spatial databases and modelling and its applications for land administration.
Module Objectives	At the end of this module, students will be able to: • Understand the principles of photogrammetry and other contemporary technologies as aerial surveying for spatial data capturing and processing • Understand the concepts of analytical and digital photogrammetry • Know and conduct aerotriangulation, block diagram, product generation and validation • Understand thermal and hyperspectral sensing, interpretation of thermal imagery, hyperspectral image interpretation and analysis. • Know interferometeric Synthetic Aperture Radar (InSAR) system and Shuttle Radar Topography Mission (SRTM)); LiDAR and application areas of LiDAR remote sensing • Understand Image enhancement techniques, segmentation, thematic image extraction by pattern recognition and artificial intelligence and change detection • Understand signal analysis in remote sensing and conduct analysis practice • Knowadvanced techniques of digital image processing, satellite image distortions, image rectification and restoration (geometric and radiometric correction, noise removal) • Understand architecture and ontology of a GIS • Develop a programme to implement new GIS applications and prototypes • Explain the theory behind the most common algorithms in GI science

	• Plan, design and implement a spatial database/analysis project • Apply Geo-statistical techniques to imperially support the data • Utilize spatial models to make simulations and predictions of real life phenomena • Conceptualize models as representations of real life systems with inputs, outputs, and processes.
Module Competency	Competence of the module are: • apply remote sensing for large scale mapping • Conduct digital image processing, satellite image distortions, image rectification and restoration (geometric and radiometric correction, noise removal) • Apply image enhancement techniques, segmentation, and thematic image extraction by pattern recognition and artificial intelligence • Apply photogrammetry for large scale mapping • Carryout the photogrammetric data processing, product generation and validation • Understand the principles of photogrammetry and other contemporary technologies as aerial surveying for spatial data capturing and processing • Comprehend the concepts of analytical and digital photogrammetry • Conduct aerotriangulation, block diagram, product generation and validation • Carryout and understand thermal and hyperspectral sensing, interpretation of thermal imagery, hyperspectral image interpretation and analysis. • Carryout advanced GIS analysis and modelling • Evaluate spatial data quality and their challenges

Courses in the module

	Course code	Course name	Cr.Hrs	Contact hours			CP
				L	L/P	HS	
1	GmLA 5031	Analysis of Remote Sensing Data	3	2	3	6	6

		GmLA 5032	Applied Photogrammetry	3	2	3	6	7
	2	GmLA 5033	Advanced GIS	3	2	3	7	7
	3	GmLA 5034	Spatial data analysis and data quality	2	1	3	5	4
				11				**24**

MODULE 04: RESEARCH

Module Guide **Debre Markos University** **Institute of Land Administration Program**	
Module name	**Research in Geomatics**
Module Number	**04**
Module Code	**GM-M6043**
CrHr	**9**
Total CP	**65**
Module Description	This module is dealing with the practical works in the area of geomatics for land administration. Furthermore, the practical works mainly focused on ground surveying, photogrammetry, remote sensing and GIS for large scale mapping application. This module is also dealing with issues of how to perform applied research and policy analysis on the existing problems and policy matters of Geomatics for land administration. The modules include a course on how to do qualitative and quantitative research in Geomatics for Land administration. It also incorporates graduate students' proposal development and thesis writing.
Module Objectives	At the end of this module students will be able to: • Develop research proposal • Realize essential methods of data gathering, data summarization and analysis techniques in the areas of Geomatics for land administration • write their thesis
	Competence of the module are: • describe the different research approaches and their ontological and epistemological premises • effectively prepare research design and use appropriate research methods • Develop research proposal and realize essential methods of data gathering, data summarization and analysis techniques in the areas of Geomatics for land administration

	• write their thesis

Courses in the Module

	Course code	Course name	Cr.Hrs	Contact hours			CP
				L	L/P	HS	
1	GM	Research Methods in Geomatics	3	3	0	6	5
2	GM	Thesis	6			8	60
			9				**65**

17.2. Course Guidebooks

Course Guidebook Debre Markos University Institute of Land Administration MSc in Geomatics					
Program	Land Administration & Surveying				
Degree Program	MSc in Geomatics				
Course Title	Fundamentals of Land Administration				
Course Code	GmLA5011				
Course Chair	Name:				
	Office Location:				
	Mobile: e-mail:				
	Consultation Hours:				
Instructor/Tutor	Name:				
	Office Location:				
	Mobile: e-mail:				
	Consultation Hours:				
ECTS Credit (CP)	5				
Contact Hours per Semester	Lectures	L/P	T	HS	Total
	48	0		80	128
Lecture Days, Hours & Room					
Tutorial/Lab Days & Hour					
Target Group	MSc Geomatic students				
Year /Semester	Year I, Semester I				
Status of the Course	Accredited				
Pre-requisites	None				
Course Description	The course fundamentals of Land Administration aim to develop students understanding and appreciation of the key concepts and components and theories of land administration. This course is also designed to introduce and overview the contents of the whole MSc program in land management and administration courses. The course seeks to provide students with a sound understanding of the concepts and major issues of good governance in land administration and challenges facing it both from national and global				

	experience. More specifically, the course provides detailed treatment on the difference between land administration and land management, the benefits of good land administration; features, characteristics and principles of good governance and consequences of weak governance in land administration. This course also aims to introduce the core land administration process such as land tenure, value, use and development. Innovative land administration tools and practices are also part of this course. Finally, the course covers to overview the urban and rural land administration practices and challenges in Ethiopia.
Course Outcomes	• Recap the basic ideology of the discipline of land administration • Recognize the basic principles of land administration • Understand the role of land administration for the sustainable development of the nation • Understand the modern land administration systems • Recognize the basic contents of land administration • Evaluate the contemporary land administration in Ethiopia from the global context
Course Objectives	At the end of the course students will be able to: • Comprehend the evolving forms Man–land relationships; • Understand the broad concept of land administration; • Know the basic components and principles of land administration; • Synthesis the principles of good governance in land administration; • Understand the impacts of weak governance in land administration on societal development; • Summarize the importance of land registration for secure property right; • Examine the existing and emerging land administration tools; • Understand the urban and rural land administration gaps and challenges from the Ethiopian context.
Course Content	**1. Introducing land administration** 1.1.Land 1.2.Array of concepts on land 1.3.Dynamic human-land relationship 1.4.Integrated land administration 1.5.Principles of land administration 1.6.The need for a land administration system 1.7.Benefits of LAS 1.8.Introducing the policy process 1.9.Land policy **2. Land administration processes** 2.1.Importance of land administration processes 2.2.Core land administration processes 2.3.Examples of tenure processes 2.4.Land administration and sustainable development **3. Land tenure and property rights** 3.1.Territoriality 3.2.Land tenure and its development

	3.3.Why land tenure 3.4.Intersecting interests of land tenure 3.5.Property regimes 3.6.Property rights 3.7.Continuum of land rights 3.8.Access to land 3.9.Tenure security 3.10. Land tenure interests 3.11. Land tenure categories in Ethiopia 3.11.1. The Imperial land tenure system 3.11.2. The Derg regime land tenure system 3.11.3. The contemporary land tenure system **4. Modern land administration theory** 4.1.The land management paradigm 4.2.A global land administration perspective 4.3.Cadastre as an engine of LAS 4.4. Land markets 4.4.1. informal and formal markets 4.4.2. pass porting property 4.5.Land valuation and taxation 4.5.1. Basic valuation principles 4.5.2. Basic taxation principles 4.6.Managing the use of land 4.6.1. Land use 4.6.2. Planning control systems 4.6.3. Urban land use planning and regulations 4.6.4. Rural planning and sectoral land use regulations 4.6.5. Integrated land use management 4.6.6. Land development 5. **Land Reform and Land Consolidation** 5.1. Land reform 5.2. Land redistribution 5.3. Land restitution 5.4. Land consolidation 5.5. Approaches of Land Consolidation 5.6. Designing pilot project in land consolidation **6. Governing of the commons** 6.1.Definition of commons 6.2.Classification of goods 6.3.Resource systems and resource units 6.4.Models explaining common pool resources 6.4.1. the tragedy of the commons 6.4.2. The prisoner's dilemma 6.4.3. The logic of collective action 6.5.Contemporary policy prescriptions 6.5.1. Leviathan as the only way 6.5.2. Privatization as the only way 6.5.3. An alternative solution 6.5.4. An empirical alternative

	6.6. Designed principles for the governance of commons (Ostrom) 7. **The Land Administration Tool Box** 7.1. Using Land Administration Tools 7.2. General Land administration Tools 7.3. Professional Land Administration Tools 7.4. Emerging Land Administration Tools 7.4.1. Land Tenure and Gender 7.4.2. Pro-poor land tools 7.4.3. Social Tenure Land Model 8. **Land Administration Practice in Ethiopia** 8.1. Rural Land Administration 8.2. Urban Land Administration
Mode of delivery (Teaching-Learning)	• Brainstorming and experience sharing • Lectures • Group discussions • Reading assignments and presentations • Group and individual book chapter or article review and presentation • Seminars
Mode of Assessment and Evaluation	• Mid exam ---------- 20% • Individual Term Paper ---------- 10% • Group assignment and presentation---------- 20% • Individual Journal or book chapter Review& presentation ---- 10% • Final exam ---------- 40%
Course Policy	It is mandatory to participate in all individual and group activities as well as attending lectures. A Student who attends less than 80% of the lectures is not allowed to sit for final examination. Furthermore, active class participation has substantial value. Criteria for assessing project writing and its presentation • Clarity of presentation • Efforts exhibited to write sound material and make the presentation understandable to the class • Participation of students in asking and answering questions • Adequacy of responses and feed back to the questions raised.
References	Dale. P & McLaughlin J. (1999). Land Administration. Oxford University Press. Dale. P& McLaughlin J. (1988). Land Information Management: An Introduction with special reference to Cadastral problems in third world countries. Oxford University Press. ENEMARK, S. Building Land Information Policies Proceedings of Special Forum on Building Land Information Policies, 26-27October 2004 Aguascalientes, Mexico. ENEMARK, S. The Land Management Paradigm for Sustainable Development In: WILLIAMSON, I., ENEMARK, S. & WALLACE, J., eds. SUSTAINABILITY AND LAND ADMINISTRATION SYSTEMS 9-11 November 2005, 2005 Melbourne, Australia.

	FAO 2007. Good Governance in Land Tenure and Administration: in FAO Land Tenure Studies. FAO, Rome Larsson, G.(2000) Land Registration and Cadastral Systems: Tools for Land Information and Management. 2nd ed. UN-ECE 1996. Land Administration Guidelines. Meeting of officials on land administration, UN Economic Commission for Europe. ECE/HBP/96 Sales No. E.96.II.E.7, 111pp., ISBN 92-1-116644-6 (available at /http://www.unece.org/env/hs/wpla/docs/guidelines/. UN-HABITAT 2012. Handling Land: Innovative tools for land governance and secure tenure, Nairobi, United Nations Human Settlements Programme (UN-Habitat). WILLIAMSON, I., ENEMARK, S., WALLACE, J. & RAJABIFARD, A. 2010. Land Administration for Sustainable Development, Redlands, California, ESRI Press Academics. World Bank & FAO. (2006). Good Governance in Land Administration: Principles and Good Practices. Washington D.C.

Course Guidebook
Debre Markos University
Institute of Land Administration
MSc in Geomatics

Program	Geomatics			
Degree program	MSc in Geomatics			
Module name	Land administration			
Course title	Cadastral survey and land registration			
Course code	GmLA5012			
Credit hours	3			
ECTS Credits	5			
Contact Hours (per semester)	Lecture hours	L/P	HS Hours	Total Hours
	32	48	80	160
Year/semester	Year I, Semester II			
Prerequisite	None			
Status of the course	Compulsory			
Course description	Land registration, cadastral survey and their resulting land information system (LIS) are the main aspects of this course. Land registration system, its components, types of systems, and methods for establishing and maintaining systems are the primary topics on land registration part. Various types of data gathering, data manipulation, map preparation, and cadastral map types are covered in cadastral survey part. Analysis and design of LIS, institutional aspects of the system,			

	strategies of implementing the system and usage of land information are discussed in LIS part. Ground experiences within the local Ethiopian context are discussed with regard to land registration, cadastral survey and LIS.
Learning outcomes	• Define and conceptualize what land registration and cadastre means • Recognize the basic principles of land registration • Categorize between the different types of land registration • Undertake cadastral surveying and produce cadastral maps • Evaluate the different cadastral systems • Analyze the different land information systems
Objectives of the Course	After completing this course, students will be able to: • describe what land registration is and why it is important; • recognize when a country's land registration system is required; • recognize what a land registration system should contain; • equipped with knowledge on establishing and maintaining a land registration system; • recognize various cadastral system types; • be equipped with knowledge on analyzing and designing a contextual cadastral system; • carry out cadastral data collection and analysis; • Produce and maintain cadastral map.
Course contents	1. Introduction to land registration 1.1.The what of land registration 1.2. The why of land registration 2. Principles of land registration 2.1. Land registration principles based on activity 2.2. Land registration principles based on results 3. Classification of land registration 3.1. Title registration versus deeds registration 3.2. Other land registration classifications 4. Establish and maintain a land registration system 4.1. Criteria to consider for establishing a system of land registration 4.2. Adjudication of land interests 4.3. Registration of land interests 4.4. Updating changes in land interests 4.5. Book and computerized land registration system 4.6. Content of land registration 4.7. Legal consequences of land registration 5. Cadastral survey 5.1. Introduction to cadastral surveying 5.1.1. Historical development of cadastre 5.1.2. Types of cadastre 5.1.3. Basic components of cadastre 5.1.4. Cadastre and land matters 5.2. Cadastral surveying procedures 5.2.1. Parameters to be considered in cadastral design

	5.2.2. Cadastral data capturing methods 5.2.3. Data sources for cadastral map preparation 5.2.4. Cadastral map making 5.2.5. Design cadastre projects 5.3. Land property formation and cadastral map updating 5.4. Land property description 6. Land information system 6.1. Land information system analysis and design 6.1.1. Introduction to land information system 6.1.2. System analysis 6.1.3. Domain model of land administration data 6.2. Institutional aspects of land information system 6.2.1. Implementation strategy of land information system 6.2.2. Spatial data infrastructure 6.2.3. Usage of land information 7. Land registration in Ethiopia 7.1.Historical background 7.2. First level land certification 7.3.Second level land certification
Learning methods and activities	• Lectures and reflection on each chapter • Reading assignments and presentations • Individual book chapter or article review and presentation • Group assignment on cadastral project
Mode of Assessment	• Individual assignment (30%) • IAS1 … 10% • IAS2 … 10% • IAS3 … 10% • Group assignment (30%) • GAS1 … 15% • GAS2 … 15% • - Final exam (40%)
Course Policy	It is mandatory to attend lectures as well as to participate in all individual and group activities. A Student who attends less than 80% of the total course activities is not allowed to sit for final examination. Furthermore, active class participation is required.
References	Bezu, S. and S. Holden (2014). "Demand for second-stage land certification in Ethiopia: Evidence from household panel data." Land Use Policy**41**: 193-205. BOGAERTS, T. & ZEVENBERGEN, J. 2001. Cadastral systems – alternatives. *Computers, Environment and Urban Systems*, 25**,** 325-337 Deininger, K., *et al.* (2008). "Rural Land Certification in Ethiopia: Process, Initial Impact, and Implications for Other African Countries." World Development**36**(10): 1786-1812. ENEMARK, S. 2003. Underpinning Sustainable Land Administration Systems for Managing the Urban and Rural Environment. *2nd FIG Regional Conference.* Marrakech, Morocco. ENEMARK, S., MCLAREN, R. & LEMMEN, C. 2016. Fit-For-

Purpose Land Administration: Guiding Principles for Country Implementation. *Report 2 / 2016.* Nairobi: United Nations Human Settlements Programme (UN-Habitat).
FDRE (1995). The Constitution of the Federal Democratic Republic of Ethiopia Proclamation No. 1/1995. Addis Ababa, Federal Negarit Gazeta of the Federal Democratic Republic of Ethiopia (FDRE): 1st Year No. 1, 21st August, 1995.
FDRE (2005). The Federal Democratic Republic of Ethiopia Rural Land Administration and Land Use Proclamation No. 456/2005. Addis Ababa, Federal Negarit Gazeta of the Federal Democratic Republic of Ethiopia (FDRE): 11th Year No. 44, 15th July, 2005.
Hailu, Z. and D. Harris (2014). Rural land registration in Ethiopia increased transparency for 26,000,000 landholders. Annual World Bank Conference on Land and Poverty 2014. Washington, DC.
Hailu, Z. and L. Backstrom (2006). Land Administration in Ethiopia: Model for Establishing Tenure Security in Other Countries. GIM International. Lemmer, the Netherlands, Geomares Publishing.
KAUFMANN, J. & STEUDLER, D. 1998. Cadastre 2014: A Vision for a Future Cadastral System. Copenhagen: International Federation of Surveyors (FIG).
MOLEN, P. V. D. 2002. Land Administration Theory: Thinking in Terms of Migration of Systems. *FIG XXII International Congress.* Washington, DC.
MUCHOMBA, F. M. 2017. Women's Land Tenure Security and Household Human Capital: Evidence from Ethiopia's Land Certification. *World Development,* 98**,** 310-324.
PERSHA, L., GREIF, A. & HUNTINGTON, H. 2017. Assessing the Impact of Second-Level Land Certification in Ethiopia. *Annual World Bank Conference on Land and Poverty 2017.* Washington, DC.
TING, L. & WILLIAMSON, I. P. 1999. Cadastral Trends: A Synthesis. *The Australian Surveyor,* 44**,** 46-54.
UNESC & UNECA 1970. Ethiopia: Cadastral Survey and Registration. *Seminar on Cadastre, .* Addis Ababa, Ethiopia: United Nations Economic and Social Council (UNESC); United Nations Economic Commission for Africa (UNECA).
WILLIAMSON, I. P. & TING, L. 2001. Land administration and cadastral trends - a framework for re-engineering. *Computers, Environment and Urban Systems,* 25**,** 339-366
WILLIAMSON, I. P. 1985. Cadastres and Land Information Systems in Common Law Jurisdictions. *Survey Review,* 28**,** 114-129
WILLIAMSON, I., ENEMARK, S., WALLACE, J. & RAJABIFARD, A. 2010. *Land Administration for Sustainable Development,* Redlands, US, ESRI Press Academic.

	Course Guidebook Debre Markos University Institute of Land Administration MSc in Geomatics
Program	Land Administration & Surveying
Degree Program	MSc in Geomatics
Course Title	Gender and Land Rights
Course Code	GmLA5013
Course Chair	Name:
	Office Location:
	Mobile: e-mail:
	Consultation Hours:
Instructor/Tutor	Name:
	Office Location:
	Mobile: e-mail:
	Consultation Hours:
ECTS Credit	3

Contact Hours per Semester	Lectures	L/P		HS	Total
	32	-		48	80

Lecture Days, Hours & Room	TBA
Tutorial/Lab Days & Hour	TBA
Target Group	MSc Geomatic Students
Year /Semester	Year I / Semester II
Status of the Course	Compulsory
Pre-requisites	No prerequisite
Course Description	The course Gender and Land Rights is designed to equip students with knowledge, skills, and attitudes on gender-related issues and women's land rights. The course deals with the concept of gender, basic definitions of gender and sex; the concept of gender empowerment, policy approaches to women and land rights; gender gap; gender mainstreaming; gender and development; land rights, and women's access to land. Finally, the role of land rights in the planning and implementation of development programs and projects and the framework for gender analysis and planning will be discussed.
Course Outcomes	After the completion of this course, students' knowledge and attitude about gender, gender equality, and women's empowerment will be changed. Students will be able to understand the national and global gender issues; understand the situation of women's access to land and their challenges and constraints; can perform gender analysis tools in their research areas.
Course Objectives	Upon the completion of the course, students will be able to: • Defining Gender and Gender-related concepts • Acquiring knowledge on Gender and Development

	• Understanding international and national instruments that guarantee gender equality • Understanding gender issues regarding land rights in the legal constitutional and regional framework • Performing Gender Analysis and Mainstreaming
Course Content	**1. Defining Gender and Gender Related Concepts** 1.1. Gender and Sex 1.2. Gender Equality and Gender Equity 1.3. Gender Gap, Gender Stereotype, and Discrimination 1.4. Gender Division of Labour 1.4.1. Triple Roles of Gender 1.4.2. Practical & Strategic Gender Needs/ Interests (PGN & SGN) **2. Gender and Development** 2.1. Policy Approaches, Gender and Development to Women 2.1.1. WID: Women in Development Approach/Movement 2.1.2. GAD: Gender and Development Approach/ Movement 2.2. Critical Areas of Concern Intervention for Women in Development Worldwide 2.2.1. Global History of Women's Movement 2.2.2. Gender-Related Problems in Ethiopia **3. Land Rights** 3.1. Why land rights has to be a development issue 3.2. Women's Land Rights 3.3. Enhancing Women's Empowerment and Gender Equality 3.3.1. Concept of Empowerment 3.3.2. Empowerment of Women and their Rights to Access to Land 3.3.3. Economic and Social Empowerment of Women 3.4. Root Causes of Gender Inequality in Access to Land **4. Major Actions of the Government of Ethiopia to Promote Gender Equality** 4.1. International Conventions and Agreements on Women's Rights 4.1.1. Universal Declaration of Human Right in Relation to Gender (UDHR) 4.1.2. Convention on the Elimination of all Forms of discrimination Against Women (CEDAW) 4.1.3. Beijing Platform for Action (BPA) 4.1.4. Millennium Development Goals (MDGs) 4.1.5. Sustainable Development Goals (SDGs) 4.2. National Laws, Policies, and Strategies in Relation to Gender 4.2.1. The Constitution of the Federal Democratic Republic of Ethiopia (FDRE) 4.2.2. Family Law and Criminal (Penal) Code

	4.2.3. Labour law 4.3. Gender Related Policies and Strategies 4.3.1. The National Policy on Ethiopian Women (NPEW) 4.3.2. Plan for Accelerated and Sustained Development to End Poverty 4.3.3. National Action Plan for Gender Equality (NAP-GE) 4.3.4. Ethiopian Women Development and Change Packages (2006) **5. Gender Analysis Framework and Mainstreaming** 5.1. Gender Analysis Frameworks (GAF) 5.2. The Harvard Gender Analytical Framework Moser's Gender Analytical Framework Gender Mainstreaming 5.4.1. Requirements of Gender Mainstreaming 5.4.2. Barriers to Effective Mainstreaming **6. Gender Sensitive Planning, Monitoring and Evaluation** 6.1. Gender Sensitive Planning 6.2. Gender Sensitive Monitoring and Evaluation
Mode of delivery (Teaching-Learning)	• Brainstorming • Lectures • Class works • Group discussions • Assignments • Presentations (in group or individual as convenient)
Mode of Assessment and Evaluation	• Assignments---------- 20% • Book/Article review and presentations ---------- 30% • Written Examination ---------- 50% • Total---------- 100%
Course Policy	It is mandatory to participate in all individual and group activities as well as attending lectures. A Student who attends less than 80% of the lectures is not allowed to sit for final examination. Furthermore, active class participation has substantial value. Criteria for assessing project writing and its presentation Clarity of presentation • Clarity of presentation • Efforts exhibited to write sound material and make the presentation understandable to the class • Participation of students in asking and answering questions • Adequacy of responses and feed back to the questions raised.
References	Amare, A., Gebreegziabher, W., & Markos, G. (2020). Land titling and power building in the three regimes of Ethiopia: The last

empire, the first republic, and the second republic. Journal of Culture, Society and Development, 55, 10–20. https://doi.org/10.7176/JCSD/55-02.
Bayisenge, J. (2018). From male to joint land ownership: Women's experiences of the land tenure reform programme in Rwanda. Journal of Agrarian Changen, 18 (3), 588–605. https://doi.org/10.1111/joac.12257.
Belay, A. A., & Abza, T. G. (2020). Protecting the land rights of women through an inclusive land registration system. African Journal of Land Policy and Geospatial Sciences, 3, 2657–2664.
Bruce, J., 1989, „Homes Divided", World Development, Vol.17, No.7, pp979-991, Pergam on Press Evans, A., 1991, "Gender issues in rural household economics", IDS Bulletin, Vol.22, No.1, Institute of Development Studies, Brighton
Bunch, C., and Carrillo, R., Gender Violence: A Development and Human Rights Issue, Center for Women's Global Leadership.
Deininger, K.; Ali, D.A.; Holden, S.; Zevenbergen, J. Rural Land Certification in Ethiopia: Process, Initial Impact, and Implications for other African Countries. World Dev. 2008, 36, 1786–1812.
Efobi, U. R., Beecroft, I., & Atata, S. N. (2019). Female Access and Rights to Land, and Rural Non-farm Entrepreneurship in Four African Countries. African Development Review, 31(2), 179–189. https://doi.org/10.1111/afdr.v31.210.1111/1467-8268.12376.
Enemark, S.; Williamson, I.; Wallace, J. Building Modern Land Administration Systems in Developed Economies. J. Spat. Sci. 2005, 50, 51–68.
Ganta, B. G. (2019). Access to Rural Land Rights in the Post-1991 Ethiopia: Unconstitutional Policy Shift. Journal of Land and Rural Studies, 7(1), 1–22. https://doi.org/10.1177/2321024918808111.
Hagos, T., Berihun, T., Assefa, A., & Andarge, G. (2016). Women'S Position in Household Decision Making and Violence in Marriage: The Case of North Gondar Zone, Northwest Ethiopia. Journal of Economics and Development Studies, 5(4), 63–70. https://doi.org/10.15640/jeds.v5n2a5.
Heise, L., with Pitanguy, J., and Germain, A., 1994, "Violence Against Women: The hidden health burden," World Bank Discussion Paper, No.255, International Bank for Reconstruction and Development, The World Bank, Washington D.C.
Holden, S.T.; Tilahun, M. Farm Size and Gender Distribution of Land: Evidence from Ethiopian Land Registry Data. *World Dev.* **2020**, *130*, 104926.
Jackson, C., and Pearson, R., (eds.) 1998, Feminist Visions of Development: Gender Analysis and Policy, Routledge, London stergaard, L., 1992, "Gender", in Østergaard, L., (ed),1992,
Johnson, H., 1992, "Women's empowerment and public action: experiences from Latin America" in Wuyts, M., Mackintosh, M., and Hewitt, T., (eds.), 1992, Open University Press, Milton Keynes .

Kang, M., Schwab, B., & Yu, J. (2020). Gender differences in the relationship between land ownership and managerial rights: Implications for intrahousehold farm labor allocation. World Development, 125, 104669. https://doi.org/10.1016/j.worlddev.2019.104669.

Kimmel, S. Michael (2000). The Gendered Society Reader. New York. Oxford University Press,

Kyaw, D.; Routray, J.K. Gender and Rural Poverty in Myanmar: A Micro Level Study in the Dry Zone. *J. Agric. Rural. Dev. Trop. Subtrop.* **2006**, *107*, 103–114.

Lavers, T. Land Registration and Gender Equality in Ethiopia: How State–Society Relations Influence the Enforcement of Institutional Change. *J. Agrar. Chang.* **2017**, *17*, 188–207.

Muchomba, F.M. Women's Land Tenure Security and Household Human Capital: Evidence from Ethiopia's Land Certification. *World Dev.* **2017**, *98*, 310–324.

Mengesha, A.K.; Damyanovic, D.; Mansberger, R.; Agegnehu, S.K.; Stoeglehner, G. Reducing Gender Inequalities through Land Titling? The Case of Gozamin Woreda. World Dev. 2021, 145, 105532. https://doi.org/10.1016/j.worlddev.2021.105532.36.

Mengesha, A.K.; Bauer, T.; Damyanovic, D.; Agegnehu, S.K.; Mansberger, R.; Stoeglehner, G. Gender Analysis of Landholding and Situation of Female-Headed Households after Land Registration: The Case of Machakel Woreda. Land 2022, 11, 1029. https://doi.org/10.3390/land11071029.

Menon, N.; van der Meulen Rodgers, Y.; Nguyen, H. Women's Land Rights and Children's Human Capital in Vietnam. World Dev. 2014, 54, 18–31.

Nussbaum, M., and Glover, J., 1995, Women, Culture and Development: A Study of Human Capabilities, Clarendon Press, Oxford.

Oxaal, Z., 1997, Gender and empowerment: definitions, approaches and implications for policy, BRIDGE Report, No. 40, Institute of Development Studies, Brighton.

Rahmato, D. (2009a). Land rights and tenure security: Rural land registration in Ethiopia. Legalising Land Rights: Local Practices, State Responses and Tenure Security in Africa, Asia and Latin America. Leiden University Press.

Rahmato, D. (2009b). Peasants and agrarian reforms: The unfinished quest for secure land rights in Ethiopia. Legalising Land Rights: Local Practices, State Responses and Tenure Security in Africa. Asia and Latin America. Leiden University Press.

Slavchevska, V.; Doss, C.R.; de la O'Campos, A.P.; Brunelli, C. Beyond Ownership: Women's and Men's Land Rights in Sub-Saharan Africa. Oxf. Dev. Stud. 2021, 49, 2–22.

Wieringa, S., 1994, "Women's interests and empowerment: gender planning reconsidered", Development and Change, Vol.25, No.4.

Williamson, I.; Enemark, S.; Wallace, J.; Rajabifard, A. Land

	Administration for Sustainable Development, 1st ed.; ESRI Press Academic: Redlands, CA, USA, 2010. Yngstrom, I. (2002). Women, wives and land rights in Africa: Situating gender beyond the household in the debate over land policy and changing tenure systems. Oxford Development Studies, 30(1), 21–40. https://doi.org/10.1080/136008101200114886

Course Guidebook Debre Markos University Institute of Land Administration MSc in Geomatics					
Program	Land Administration & Surveying				
Degree Program	MSc in Geomatics				
Course Title	Satellite and physical geodesy				
Course Code	GmLA5022				
Course Chair	Name:				
	Office Location:				
	Mobile: e-mail:				
	Consultation Hours:				
Instructor/Tutor	Name:				
	Office Location:				
	Mobile: e-mail:				
	Consultation Hours:				
ECTS Credit (CP)	3 Cr.Hrs (6 ECTS)				
Contact Hours per Semester	Lectures	L/P	T	HS	Total
	32	48		80	160
Lecture Days, Hours & Room					
Tutorial/Lab Days & Hour					
Target Group					
Year /Semester					
Status of the Course	Accredited				
Pre-requisites					
Course Description	This course introduces students to fundamental theories of physical geodesy, satellite orbit, orbit perturbations, satellite positioning system, and uses various scientific methods and technologies to collect and process gravity and radio signals acquired from navigation satellites to produce accurate and precise geodetic coordinates and geopotential heights that are highly demanding for positioning and civil engineering applications.				
Course Outcomes	After completing the course, students will be able to: • develop strong knowledge base in theories of gravity field, potential theories and satellite positioning system including				

	satellite orbital perturbations, • develop ability to independently undertake field data collection using geodetic quality differential Global Navigation Satellites Systems receivers, • gain essential new skills in processing of gravity data and radio signals acquired from navigation satellites, • acquire experience in undertaking practical geodetic computations, • undertake scientific research under close supervision and guidance, • Strive for new knowledge, skills and professional development.
Course Objectives	• Understand theories of earth's gravity field representation in a form of spherical harmonic function. • Able to understand theories and methods of transforming gravity field to geo-potential field or physical height systems. • Realize concepts of satellite orbit perturbation due to earth's gravity field and be familiar with theories and techniques of recovering gravity from disturbed orbits. • Understand fundamental principles of satellite positioning systems including measurement and data processing. • Formulate and solve some practical geodetic computations.
Course Content	1. **Classical geodesy** 1.1. gravity-equipotential surface and height; Stokes' theorem and leveling; 1.2. gravity modelling**:** normal gravity, Earth Gravity Model 2008 (EGM)08), GRACE and GOCE satellites models, topographic gravity effects: hedgehog algorithm, multipoint, prism, Helmert's condensation of a single layer surface density; laplace's equation; 1.3. applications of spherical harmonics; theory of the level ellipsoid; remove-compute-restore in classical and modern geodesy; Stokes' theory of geoid computation; laplace's equation and Fourier Transform; 2. **Fourier operations** 2.1. Downward continuation from measurement point to ellipsoid (classically the geoid) – normal density, stability. 2.2. Transformation from residual gravity to residual potential; restoring long-wavelength components of topography that is initially removed prior to downward continuation operation so as to create smooth, trend-free residuals. 2.3. Fourier transforms on a region of a spherical Earth – use of map coordinates; 3. **Practical computation of geopotential heights**

	3.1. geopotential number, Dynamic heights H_D, Helmert orthometric heights H_H, normal heights H_N; 3.2. **Special topics:** Vening Meinesz formula, Molodensky's theory of geoid computation. 4. Fundamentals of satellite systems 4.1.1 Satellite orbits, satellite orbit perturbation due to gravitation and non-gravitational forces. 4.1. Concepts and general descriptions of Global Navigation Satellite Systems (GNSS) (GPS, GLONASS, GALILEO, and COMPAS) signal description; 4.2. pseudo-range and carrier phase measurement; 4.3. GNSS error sources and biases; Satellite ephemeris errors, satellite clock errors, ionospheric and atmospheric delays, multipath, cycle slips signal reflection and mitigation techniques, error budgets. 4.4. Static and kinematic positioning Differential GNSS; precision relative measurements; Differential operation, common bias terms.
Mode of delivery (Teaching-Learning)	• Lecture on theoretical aspects of physical and satellite geodesy. • Practical processing and analysis of global gravity data. • Field data measurement of the GNSS data, data processing and interpretation. • Practical exercises – individual or group work based. • Independent reading and computations.
Mode of Assessment and Evaluation	• Practical exercise/project • Written examination
Course Policy	All students are expected to abide by the code of conduct of the university Academic legislation throughout this course. Academic dishonesty, including cheating, fabrication, and plagiarism will not be tolerated and will be reported to concerned bodies for action. Class activities will vary day to day, ranging from lectures to discussions. Students will be active participants in the course. Students are required to do all the assignments and are supposed to accomplish, submit and present it according to the time table indicated. Note on class attendance and participation: You are expected to attend class regularly. Attendance will be taken randomly during the semester to ensure that students are coming to class, and if you miss class repeatedly, your grade will be affected. If you miss more than 20% of the class attendance you will not sit for final exams.
References	Hofmann-Wellenhof B., Lichtenegger H., Wasle H., 2008, GNSS – Global Navigation Satellite Systems: GPS, GLONASS, Galileo, and More. Berlin Springer, p. 516, ISBN: 978-3-211- 73012-6. Bernhard Hofmann-Wellenhof, Helmut Mortiz (2006). Physical geodesy, 2nd edition, Springer Vienna, ISBN: 978-3- 211-33544-

	4. Martin Hotine. (1991). Differential Geodesy, Springer Berlin Heidelberg, 978-3-642-76498-1. Wolfgang Torge (2001). Geodesy: The concepts, 3rd edition, W. de Gruyter, Berlin-New York, ISBN-13: 978- 3110170726 . Petr Vanicek, Edward Krakiwsky (1987). Geodesy: The concepts, 2nd edition, Elsevier Science, ISBN-13: 978- 0444877772 . Günter Seeber (2003). Satellite geodesy, 2nd edition, Walter de Gruyter GmbH & Co. KG,10785 Berlin, ISBN 3-11- 017549-5. Peter J. G. Teunissen, Alfred Kleusberg .(1998). GPS for Geodesy, Springer-Verlag Berlin Heidelberg, ISBN: 978-3-642- 72013-0.

Course Guidebook
Debre Markos University
Institute of Land Administration
MSc in Geomatics

Program	Land Administration & Surveying				
Degree Program	MSc in Geomatics				
Course Title	Reference Systems and Map Projections				
Course Code	GmLA5023				
Course Chair	Name: TBA				
	Office Location:				
	Mobile: TBA e-mail: TBA				
	Consultation Hours: TBA				
Instructor/Tutor	Name:				
	Office Location:				
	Mobile: e-mail:				
	Consultation Hours:				
ECTS Credit (CP)	6				
Contact Hours per Semester	Lectures	L/P	T	HS	Total
	32	38	10	64	144
Lecture Days, Hours & Room	TBA				
Tutorial/Lab Days & Hour	TBA				
Target Group	Geomatics Students				
Year /Semester	1st year 1st semester				
Status of the Course	Compulsory				
Pre-requisites	None				
Course Description	This course is designed to provide students with an in-depth understanding of reference systems and map projections used in geospatial sciences. The course explores the theoretical foundations, mathematical models, and				

	practical applications of different reference systems and map projections used in Ethiopia and worldwide. Students will gain hands-on experience in working with various projection methods and tools in a Geographic Information System (GIS), enabling them to make informed decisions when selecting and applying appropriate map projections for specific spatial analysis tasks.
Course Outcomes	Students will be able to: • Demonstrate a comprehensive understanding of reference systems and their role in cartography and geospatial sciences. • Critically evaluate and select appropriate map projections for different spatial analysis tasks. • Assess the accuracy of coordinates and use them appropriately • Apply mathematical concepts and tools to analyse and manipulate map projections. • Design and create accurate and visually appealing maps using suitable map projections. • Assess and mitigate distortions and errors in map projections through appropriate techniques and strategies. • Utilize GIS software to implement and analyse map projections. • Communicate effectively about reference systems and map projections
Course Objectives	The objectives of the course are to: • Develop a solid theoretical foundation in reference systems and their significance in mapping and geospatial analysis. • Explore different mathematical models used in map projections and understand their underlying principles. • Examine and compare various map projection methods, their characteristics, strengths, and limitations. • Acquire practical skills in selecting, implementing, and evaluating map projections for different mapping tasks. • Understand the impact of distortions in map projections and learn techniques to minimize their effects. • Gain proficiency in using GIS software to work with different map projections and analyse spatial data. • Engage in critical thinking and problem-solving exercises related to reference systems and map projections.
Course Content	1. Introduction to Reference Systems and Coordinate Systems a. Overview and background of reference systems in geospatial sciences b. Coordinates and datum 2. Two- and three-dimensional coordinate systems a. Spherical coordinates b. Cartesian coordinates 3. Geoid a. Description b. Orthometric heights 4. Reference systems a. Geodetic datum b. Transformations c. Vertical datum 5. Mathematical Foundations of Map Projections a. Geometric concepts and coordinate transformations b. Map projection equations and formulas

	c. Map scale and distortion 6. Types and Classification of Map Projections a. Cylindrical, conic, and azimuthal projections b. Equal-area, conformal, and equidistant projections c. Selected map projection methods and their properties d. Registry of reference systems and map projections (EPSG codes) 7. Commonly Used Map Projections and Coordinate Systems a. Overview worldwide b. UTM-System c. Ethiopian systems 8. Global Navigation Satellite Systems (GNSS) a. Overview b. Transformation of GNSS data 9. Error Analysis and Distortion in Map Projections a. Types and sources of distortions b. Methods for quantifying and visualizing distortions c. Strategies for minimizing distortions in specific applications 10. Map Projection Selection and Implementation a. Factors influencing map projection choice b. Selecting appropriate map projections for specific tasks 11. Implementation of map projections using GIS software (QGIS, ArcGIS Pro) a. Geographic coordinate systems b. Projected coordinate systems c. Transformations 12. Practical Applications and Case Studies a. Cartographic design considerations b. Thematic mapping and visualization techniques c. Analysis of spatial data in different map projections
Mode of delivery (Teaching-Learning)	• Lectures • Practical (computer lab) • Group discussions • Reading assignments and presentations
Mode of Assessment and Evaluation	• Open book tests (multiple choice) • Project work (Exercises using a GIS) • Final exam (written format) Will be implemented based on the University legislation and the nature of the course
Course Policy	• In any assessment, each student must honestly disclose all help received and sources used. • In an oral assessment, each student must be able to present the entire assignment and solution and answer questions about it.

References	Bugayevskiy L.M. and Snyder J. (1995): Map Projections - A Reference Manual. Taylor&Francis. Grafarend, E.W. and Krumm F.W. (2006): Map Projections – Cartographic Information Systems. Springer. Iliffe, J. and Lott R. (2008): Datums and Map Projections for Remote Sensing, GIS and Surveying. 2nd edition. Whittles Publishing. Maling, D.H. (1992): Coordinate Systems and Map Projections. Pergamon Press. Snyder, J. P. and M. P. Voxland (1989): Album of Map Projection, US Geological Survey, Professional Paper 1453. http://pubs.usgs.gov/pp/1453/report.pdf Usery E.L, Finn M.P. and Mugnier C. (2009): Coordinate Systems and Map Projections. In: Manual of Geographic Information Systems (pp.87 - 112). https://www.researchgate.net/publication/236028762_Chapter_8_-_Coordinate_Systems_and_Map_Projections

Course Guidebook
Debre Markos University
Institute of Land Administration
MSc in Geomatics

Program	Land Administration & Surveying				
Degree Program	MSc in Geomatics				
Course Title	Spatial Statistics and Adjustment Computation				
Course Code	TBA				
Course Chair	Name:				
	Office Location:				
	Mobile: TBA e-mail: TBA				
	Consultation Hours: TBA				
Instructor/Tutor	Name:				
	Office Location: DMU / TUW, Vienna				
	Mobile: TBA e-mail: TBA				
	Consultation Hours: TBA				
ECTS Credit	6				
Contact Hours per Semester	Lectures	L/P	T	HS	Total
	32	48		80	160
Lecture Days, Hours & Room	TBA				
Tutorial/Lab Days & Hour	TBA				
Target Group	Master				
Year /Semester	1 / 1				
Status of the Course	TBA				

Pre-requisites	None
Course Description	The course explains the mathematical and statistical concepts to develop and understand the least squares approach for parameter estimation and spatial statistical concepts. Step by step, starting with the mathematical concepts, the course explains the theories. Each step is carried out using simple examples to understand the mathematical processes. In the end, the participants will be able to perform an adjustment of observations based on the least squares approach. Specific attention is given to the statistical background.
Course Outcomes	After successful completion of the course, students are able to • explain statistical parameters, • name the properties of normal distribution, • present the concepts of error propagation, • discuss the least squares method, • describe the method for statistical tests, • explicate statistical errors, • calculate statistical parameters, • determine the effect of measurement uncertainties in calculations, • solve overdetermined systems of equations using the least squares method, • calculate spatial statistical parameters, and • perform simple statistical tests.
Course Objectives	• Communicate in-depth knowledge on parameter estimation using the least squares approach • Improving the skills on the evaluation of geodetic observations • Acquire basic experience in the interpretation of calculation results
Course Content	1. Introduction 1.1.The basic problem 1.2.Why statistics 2. Review of mathematics 2.1.Linear algebra 2.2.Matrix calculus 2.3.Differential calculus 2.4.Optimization 3. Descriptive Statistics 3.1.Explorative data analysis 3.2.Statistical parameters 4. Probability distributions 4.1.Random sample 4.2.Probability theory 4.3.Distribution of random variables 4.4.Some important probability distributions 5. Random vectors 1.1.Terminology 1.2.Correlation, autocorrelation, cross-correlation 1.3.Error Propagation

	6. Adjustment computation 6.1.The least squares method 6.2.Standard approaches 6.3.Stochastical model a priori 6.4.Stochastical model a posteriori 6.5.The functional model 7. Test statistics 7.1.Random sample distribution 7.2.Confidence regions for parameters 7.3.Some statistical tests 8. Spatial Interpolation 8.1.Delauney triangulation and Thiessen polygons 8.2.Linear interpolation and natural neighbour interpolation 8.3.Spline interpolation 8.4.Inverse distance weighted interpolation 8.5.Kriging
Mode of delivery (Teaching-Learning)	Knowledge, skills, and competences are delivered to students through various teaching concepts: Frontal presentation of theory, solution of practical examples shown, similar practical examples solved in homework and discussed during the classes
Mode of Assessment and Evaluation	Class activities (answering questions, quizzes, asking questions) Handed in homework Final exam (written format)
Course Policy	Implemented based on the university's legislation
References	Bronson, Richard, Costa, Gabriel B. & Saccoman,m John T. (2014) Linear Algebra – Algorithms, Applications, and Techniqes, 3rd edition, Elsevier. Ghilani, Charles D. (2010) Adjustment Computations, 5th edition, John Wiley & Sons. Lawson, Charles L. & Hanson, Richard J. (1974) Solving Least Squares Problems. Prentice Hall.

Course Guidebook Debre Markos University Institute of Land Administration MSc in Geomatics	
Program	Land Administration & Surveying
Degree Program	MSc in Geomatics
Course Title	Analysis of Remote Sensing Data
Course Code	GmLA5031
Course Chair	Name:
	Office Location:

<table>
<tr><td></td><td colspan="5">Mobile: e-mail:</td></tr>
<tr><td></td><td colspan="5">Consultation Hours:</td></tr>
<tr><td rowspan="4">Instructor/Tutor</td><td colspan="5">Name:</td></tr>
<tr><td colspan="5">Office Location:</td></tr>
<tr><td colspan="5">Mobile: e-mail:</td></tr>
<tr><td colspan="5">Consultation Hours:</td></tr>
<tr><td>ECTS Credit (CP)</td><td colspan="5">6</td></tr>
<tr><td rowspan="2">Contact Hours per Semester</td><td>Lectures</td><td>L/P</td><td>T</td><td>HS</td><td>Total</td></tr>
<tr><td>32</td><td>48</td><td></td><td>80</td><td>160</td></tr>
<tr><td>Lecture Days, Hours & Room</td><td colspan="5"></td></tr>
<tr><td>Tutorial/Lab Days & Hour</td><td colspan="5"></td></tr>
<tr><td>Target Group</td><td colspan="5">Geomatics Students</td></tr>
<tr><td>Year /Semester</td><td colspan="5">1st year - 1st semester</td></tr>
<tr><td>Status of the Course</td><td colspan="5">Compulsory</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">None</td></tr>
<tr><td>Course Description</td><td colspan="5">This course gives inside knowledge of concepts, theories, and applications of remote sensing classification analysis. It covers the mathematical realization of the main feature extraction techniques (i.e., spectral and spatial filters) and the principal algorithms for supervised and unsupervised classification. All steps of a classification process from the very beginning until the final product will be carried out in theory and practice: downloading the satellite data, getting the ground truth based on visualization, splitting into training and test data subsets, training the algorithms, predicting a final map and assess the results. This course will use open-source software such as QGIS and open-access data from the Copernicus program.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">• Explain the differences in the electromagnetic spectrums for several land cover classes.
• Organize a workflow for a specific classification process.
• Describe spatial, spectral, and morphological filters.
• Explain the different subsets of data in the classification process.
• Discuss characteristics of unsupervised and supervised classification.
• Explain the parameters of the decision tree classifier.
• Describe the process of cross-validation.
• Compare the results between random forest and k-means.
• Explain the parameters of the random forest classifier.
• Illustrate the benefits and shortages of structures and types of DTMs.
• Calculate land cover classification and interpret its accuracy.
• Identify the input data requested for producing orthophotos.
• Explain the differences between general band combination and false colour composition.</td></tr>
</table>

	• Download satellite images from the web pages. • Identify suitable images for the classification process. • Summarize the content of a scientific paper and discuss the findings and the scientific approach.
Course Objectives	• Giving in-depth knowledge of remote sensing data analysis, processing, and algorithms. • Improving skills and competencies through hands-on completion of an entire remote sensing classification process. • Acquiring the ability to critically examine all remote sensing classification work steps with regard to potential improvements. • Learning the ability to assess and evaluate the quality of classification results/products/maps.
Course Content	**1. Fundamentals of Remote Sensing** **1.1.**Concepts of remote sensing. **1.2.**Types of remote sensing. **1.3.**Optical remote sensing. **1.4.**Microwave remote sensing: 1.4.1. Synthetic Aperture Radar (SAR) processing and interpretation. 1.4.2. Interferometric Synthetic Aperture Radar (INSAR) processing and interpretation. 1.4.3. Thermal remote sensing. 1.4.4. Hyperspectral Sensing. 1.4.5. Thermal vs hyperspectral remote sensing. **2. Remote sensing data** **2.1.**Spatial data sources. **2.2.**Characteristics of digital Image data. **2.3.**Digital data acquisition. **2.4.**Digital Image Data formats. **2.5.**Satellite Data products: 2.5.1. Practical session: Download data. 2.5.2. Select suitable images. 2.5.3. Visualization and regionalization. **3. Feature extraction** **3.1.**Textures. **3.2.**Spatial filters. **3.3.**Morphological filters. **3.4.**Spectral information: Vegetation Indices. **4. Remote sensing data processing and analysis** **4.1.**Remote Sensing Data Pre-processing . **4.2.**Image Enhancement and Analysis. **4.3.**Overview of classification: **4.4.**Spectrum for different classes. **4.5.**Data structure: input and output. **4.6.**Classification process: train, test, cross-validation. **4.7.**Assessment. **4.8.**Unsupervised classification.

	4.8.1. Theoretical session: Introduction to unsupervised classification. 4.8.2. K-means algorithm. 4.8.3. Practical sessions: QGIS segmentation. 4.9.Supervised classification 4.9.1. Theoretical session: Introduction to supervised classification. 4.9.2. Decision Tree algorithm. 4.9.3. Random Forest algorithm. 4.9.4. Practical sessions: QGIS classification. **5. Change Detection** **5.1.**Nature of Change Detection. Practical session: Change Detection.
Mode of delivery (Teaching-Learning)	Knowledge, skills, and competencies are delivered to students by applying a bundle of modern teaching and learning methods. The course will be given in two parts: 1. The first part of the course is given in general introduction focused on remote sensing classification. 1.1. For each step, the theory regarding the methodology, the mathematical realization, and the evaluation of the results are delivered in a face-to-face approach. 1.2. A deepening of knowledge is achieved by individual or group discussions between students in quizzes. 1.3. All steps are also performed practically by the students under the guidance of the course instructor. 2. In the second part, the course chair will hand over scientific papers on a remote sensing image classification topic to each student. The students have to review this paper and elaborate on a review report.
Mode of Assessment and Evaluation	Continue evaluation based on the following: 1. Class activities (quizzes, collaboration) 2. Results (technical reports) of exercises carried out during the course. 3. Paper reviews
Course Policy	Will be implemented based on the University legislation and the nature of the course
References	G. Camps-Valls, D. Tuia, L. Gomez-Chova, S. Jimenez, J. Malo, 2011: Remote Sensing Image Processing. Synthesis lectures on image, video and multimedia processing. William K Pratt, 2007: Digital Image Processing. Wiley. John A. Richards, 2013: Remote Sensing Digital Image Analysis. Springer Berlin, Heidelberg. Principles of Remote Sensing, ITC Educational Textbook Series 2 Publisher: University of Twente Faculty of Geo-Information and

	Earth Observation (ITC), Editors: Tempfli K, G.C. Huurneman, W.H. Bakker, and L.L.F. Janssen

Course Guidebook Debre Markos University Institute of Land Administration MSc in Geomatics					
Program	Land Administration & Surveying				
Degree Program	MSc in Geomatics				
Course Title	Applied Photogrammetry				
Course Code	GmLA5032				
Course Chair	Name:				
	Office Location:				
	Mobile: e-mail:				
	Consultation Hours:				
Instructor/Tutor	Name:				
	Office Location:				
	Mobile: e-mail:				
	Consultation Hours:				
ECTS Credit (CP)	7				
Contact Hours per Semester	Lectures	L/P	T	HS	Total
	32	48	0	80	160
Lecture Days, Hours & Room	TBA				
Tutorial/Lab Days & Hour	TBA				
Target Group	Geomatics Students				
Year /Semester	1st year, 2nd semester				
Status of the Course	Compulsory				
Pre-requisites	None				
Course Description	This course gives inside knowledge to concepts, theories and applications of photogrammetry. It covers the mathematical realisation of the optical and geometric photogrammetric projection as well as the principal algorithms for the generation of Digital Surface Models (matching algorithms) and orthophoto resampling. All steps of a photogrammetric workflow from the very beginning until the final product will be carried out in theory and in practice: planning of a photo flight, operating a photo flight with Unmanned Aerial Vehicles (UAV, drones), control point measurements, orientation of				

	photographs / aerotriangulation, 3-dimensional digitizing, generation of Digital Surface Model, resampling of orthophotos and creating an orthophoto mosaic. Special attention is paid to the optimal planning of all photogrammetric processes with regard to achieve specified quality criteria as well as to the assessment of accuracies of the photogrammetric products. Different concepts of existing software packages (ERDAS IMAGINE and AgiSoft Metashape) are discussed.
Course Objectives	• Imparting in-depth knowledge of photogrammetric procedures and algorithms. • Improving skills and competencies through hands-on completion of an entire photogrammetric workflow. • Acquiring the ability to critically examine all photogrammetric work steps with regard to potential improvements. • Learning the ability to assess and evaluate the quality of photogrammetric products.
Learning Outcomes	• Explain the geometrical concept of photogrammetry. • Organise a workflow for a specific photogrammetric project. • Describe spatial, radiometric, spectral and temporal resolution of photogrammetric sensors. • Explain the parameters of the Interior orientation. • Outline elementary digital image processing operations and identify their applicability in a photogrammetric workflow. • Discuss characteristics of reference and projection systems applied in Ethiopia. • Explain the parameters of the Exterior orientation. • Describe the process of aerotriangulation and interpret results achieved. • Compare the most commonly used image matching methods. • Describe the concept of stereoscopic measurements. • Illustrate the benefits and shortages of structures and types of DTMs. • Calculate Digital Surface Models and interpret their accuracy. • Identify the input data requested for producing orthophotos. • Discuss the quality of orthophotos. • Explain all parameters required for operating a UAV photo flight. • Plan a UAV photo flight for a specific project and justify the selected mission parameters. • Determine the parameters of Interior Orientation for a non-photogrammetric camera. • Carry out a photogrammetric project (orientation, 3D-measurements, DSM-generation, orthophoto resampling) and judge accuracies achieved. • Summarize the content of a scientific paper and discuss the

	findings and the scientific approach
Course Content	1. Introduction to photogrammetry 1.1. Definition of photogrammetry 1.2. A brief history of photogrammetry 1.3. Geometrical Concept of Photogrammetry 1.4. Photogrammetric Workflow 2. Photogrammetric sensors and platforms 2.1. Fundamentals of lens design 2.2. Photogrammetric cameras 2.3. Characteristics of camera sensors 2.4. Resolution of sensors 2.5. Photogrammetric platforms (aerial, UAV, terrestrial) 2.6. Image coordinate systems 2.7. Camera geometry / Interior orientation 2.8. Calibration of camera sensor 3. Digital Image Processing 3.1. Properties of images 3.2. Elementary image processing operations 3.3. Filtering 3.4. Image enhancement and restauration 3.5. Image resampling 3.6. Image data structures 3.7. Image compression / image pyramids 3.8. Image segmentation 4. Spatial Assignment of Images to the Object Coordinate System 4.1. Geodetic coordinate systems 4.2. Collinearity equations 4.3. Exterior orientation (incl. relative and absolute orientation) 4.4. Aerotriangulation 4.5. Structure by Motion 4.6. Exploitation of GNSS/IMU Data 5. Automation in Photogrammetry 5.1. Epipolar geometry and normalized images 5.2. Image matching methods (intensity-based matching, feature-based matching, relational matching, template matching) 5.3. Automatic feature extraction 6. 3D-Mapping 6.1. Stereoscopic depth perception 6.2. Stereoscopic viewing 6.3. Stereoscopic measurements (principle of floating mark) 6.4. Automated feature measurements 7. DSM Generation 7.1. Concepts of digital elevation models 7.2. Features representing elevation models 7.3. Advantages and limits of DSM

	8. Orthophoto Production 8.1. Requirements 8.2. Advantages and limits of orthophotos 8.3. True orthophotos 8.4. Orthophoto mosaics 8.5. Quality Aspects in Photogrammetry and Quality Assessment of Photogrammetric Products 9. Project and Mission Planning 9.1. Project definition 9.2. Project design 9.3. Flight mission planning 9.4. Operating a photo flight 10. Digital Photogrammetric Workstations
Mode of delivery (Teaching-Learning)	Knowledge, skills, and competences are delivered to students by applying a bundle of modern teaching and learning methods. The course will be given in three parts: 1. The first part of the course is given in a project-based approach according to a typical photogrammetric work-flow. 1.1. For each step, the theory regarding the methodology, the mathematical realization and the evaluation of the results is delivered in a face-to-face-approach, supported by videos. 1.2. A deepening of knowledge is achieved by group discussions between students (World Café approach) and quizzes. 1.3. All steps are also performed practically by the students under the guidance of the course instructor. The acquired knowledge is continuously repeated by Open Book Tests. 2. In the second part of the course, the students have to carry out photogrammetric case studies by their own. 2.1. Project data will be provided by the course chair. 2.2. In the computer lab, students carry out the projects using the installed photogrammetric software. The projects will be elaborated in group work (two or three students per group). An instructor supervises and supports the students during the practical work. 2.3. In homework, the student groups will finalise the project work by elaborating technical reports for each project. 3. In a third part the course chair will hand over scientific papers on a photogrammetric topic to each of the students. The students have to review this paper and to elaborate a review report.
Mode of Assessment and Evaluation	• Class activities (quizzes, world' cafes, collaboration) • Results (technical reports, DSMs, orthophotos, maps) of projects carried out during the course (group work) • Open book tests (multiple choice) • Paper reviews • Final exam (written format)

Course Policy	All students are expected to abide by the code of conduct of the university Academic legislation throughout this course. Academic dishonesty, including cheating, fabrication, and plagiarism will not be tolerated and will be reported to concerned bodies for action. Class activities will vary day to day, ranging from lectures to discussions. Students will be active participants in the course. You need to ask questions and raise issues. You are required to do all the assignments you are supposed to accomplish, submit and present it according to the time table indicated. All issues discussed in class or derived from other sources may be the subject of assignment or final exam question items. Please follow the instructions indicated in the content of your course guidebook to complete all the assignments provided whether they are to be performed individually or in group. Note on class attendance and participation: You are expected to attend class regularly. Attendance will be taken randomly during the semester to ensure that students are coming to class, and if you miss class repeatedly, your grade will be affected. If you miss more than 20% of the class attendance you will not sit for final exams. Please try to be on time for class.
Ethical approach	All members of a group are responsible for the group's work. In any assessment, each student must honestly disclose all help received and sources used. In an oral assessment, each student must be able to present the entire assignment and solution and answer questions about it.
References	Falkner E., Morgan D. (2002). Aerial Mapping – Methods and Applications. ISBN 1-56670-557-6. DRC Press LLC. Lewis Publishers. Foerstner W., Wrobel B. (2016). Photogrammetric Computer Vision. https://doi.org/10.1007/978-3-319-11550-4. Springer Cham. ISBN 978-3-319-11549-8. Springer International Publishing Switzerland. Jensen J. R. (2006). Remote Sensing of Environment: An Earth Resource Perspective (2nd Edition) Prentice Hall, ISBN-10: 0131889508, ISBN-13: 978 0131889507. Jin S., Cardellach E., Xie, F. (2013). GNSS Remote Sensing - Theory, Methods and Applications, Publisher: Springer ISBN, Edition Number 1, 978-94-007-7481, -0 volume 19. Linder W. Digital Photogrammetry (2018), A Practical Course, ISBN978-3-662-57063-0, Publisher: Springer Berlin, Heidelberg, Edition Number 4 McGlone C. (Editor), Mikhail E.M. (Editor), Bethel J.S. (Editor), Mullen R. (2004). Manual of Photogrammetry, 5th edition, American Society of Photogrammetry. Mikhail E. M., Bethel, McGlone J.C. (2001). Introduction to Modern Photogrammetry. Wiley, John & Sons. ISBN-10: 1570830711 Niedzielski T. (Editor). Applications of Unmanned Aerial Vehicles in Geoscience ISBN: 978-3-030-03171-8; Edition: 1st; Birkhäuser Cham.

	Schenk T. (1999). Digital Photogrammetry; Terra Science, Laurelville. Vermeer M., Ayehu G.T. (2021): Digital Aerial Mapping – A Hands-On-Course; https://swadhin.org.in/ebooks/digital-aerial-mapping-%E2%80%94-a-hands-on-course. Wolf P.R., Dewitt E.B.A., Wilkinson B.E. (2014), Elements of Photogrammetry - With Applications in GIS, 4th edition, ISBN: 978-0-07-176111-6. McGraw-Hill Education.

Course Guidebook
Debre Markos University
Institute of Land Administration
MSc in Geomatics

Program	Land Administration & Surveying			
Degree Program	MSc in Geomatics			
Module Name	Spatial Technology			
Course Title	Advanced GIS			
Course Code	MGLa5033			
Course Chair	Name:			
	Office location:			
	Mobile: e-mail:			
	Consultation Hours:			
Instructor / Tutor	Name			
	Office location:			
	Mobile: e-mail:			
	Consultation Hours:			
ECTS credit (CP)	7			
Contact hours (per semester)	Lecture hours	L/P hours	HS hours	Total hours
	32	48	80	160
Lecture days, hours, and Room				
Target Group	Geomatics Students			
Year / semester	1st year 1st semester			
Prerequisite	None			
Status of the Course	Compulsory			
Course Description	Over the past years, researchers and professionals have increasingly turned to GIS for acquiring, processing, analyzing, and mapping land, environmental and socio-economic data. This course covers advanced topics in understanding and using GIS. Advanced GIS will cover a wide			

	range of spatial modelling applications using raster analysis and least cost path analysis. The focus will be on both vector- and raster-based modeling. Also give illustration to data manipulation and analysis, topology creation and data query, digital terrain modeling, and network analysis. Finally introduced to Web based GIS. This course is application-orientated, particularly in fields such as land administration and governance, this course has lecture and lab components. Students are also expected to strengthen their GIS skills through hands-on labs, exercises, and course projects. Putting these two aspects together, students of this course should measure their accomplishments in terms of an overall growth and maturity in modeling/analytical skills and problem-solving abilities using GIS.
Learning Outcomes	• Explain the concepts and types of modeling. • Describe the way why modelling used in GIS applications. • Explain model components. • Discuss how design, create, edit, document, and distribute of a model. • Explain the data manipulation language. • Describe raster and vector data manipulation and Analysis. • Explain topological relationships and errors. • Illustrate terrain features and Digital Elevation Models. • Modelling road, hydrology, and facility networks. • Explain Spatial Decision Support System. • Download online data. • Explaining GIS project management tools and techniques. • Summarize the content of a scientific paper and discuss the findings and the scientific approach.
Objectives of the Course	• Describe how GIS practitioners typically use GIS as a tool for analysis and the display of quantitative data to solve problems. • Use and understand Network Analyst. • Understand the key stages and distinct challenges in the creation, use and maintenance of a GIS, paying particular attention to the unique structure of spatial information (topology), the issues associated with its storage, the role of metadata and the quality of data. • Understand and appreciate the scope and usefulness of GIS for real world applications. • Recognise and describe the ethical responsibilities of the communication of geographic information. • Demonstrate an understanding of spatial information by identifying and applying appropriate GIS techniques to the solution of practical applications. • Describe the fundamental building blocks (data models, spatial analysis methods, and so on) used in geographic information technologies and spatial models. • Utilize spatial models to make suitability analysis for different land administration and land resource management purposes.

	• Critically evaluate the types of models that will be required to effectively manage land and other resources, • Design and implement GIS projects.
Course Contents	1. Modelling 1.1. Concepts and types of Modelling 1.2. Why Modelling 1.3. Domains of Spatial Model 1.4. Model components 1.5. Designing, Creating, Editing, Documenting, and Distributing of a Model 2. Data Manipulation and Analysis 2.1. Data Manipulation Language 2.2. Uses of data Manipulation 2.3. Raster data Manipulation and Analysis 2.3.1. Single layer Analysis 2.3.2. Multiple layer Analysis 2.4.Vector data Manipulation and Analysis 2.4.1. Overlay techniques. 2.4.2. Buffering 3. Topology Creation and Data Query 3.1. Concepts in Topology 3.2. Topological Relationships 3.3. Topological Errors 3.4. Data Query 4. Terrain Analysis 4.1. Terrain Features 4.2. Digital Elevation Models 4.3. Slope, Aspect and Hill shade Analysis 4.4. Image Dripping 4.5. 3D Analysis and Visualization 5. Networks and Network Analysis 5.1. What is Network? 5.2. Uses of Network Analysis 5.3. Network Data set 5.4. Types of Networks and their Character 5.4.1. Road Network 5.4.2. Hydrological Network 5.4.3. Facility Networks 6. Spatial Decision Support System 6.1. What are Spatial Decisions? 6.2. Types of Spatial Decisions 6.3. Spatial Decision-Making Problems 7. Web based GIS 7.1. Advantages of online GIS 7.2. Online Data Sources 7.3. Web Mapping and Map Sharing 7.4. GIS Community 8. GIS Project Management

	8.1. GIS Strategy and Project Management 8.2. GIS Project Management Tools and Techniques 8.3. GIS Facilities 8.4. Ethical Issues for GIS Professionals
Teaching Learning Methods and Activities	• Lectures • Project work • Laboratory practical work • Group discussion • Presentation • Field observation • Case study • Reading assignment
Mode of Assessment	• Individual Lab work 1 ----10% • Individual Lab work 2…...10% • Individual Lab work 3 ----10% • Group Lab work 1…….20% • Group Lab work 2…….15% • Written examination…… 35%
Course Policy	It is mandatory to participate in all individual and group activities as well as attending lectures. A Student who attends less than 80% of the lectures is not allowed to sit for final examination. Furthermore, active class participation has substantial value. Criteria for assessing project writing and its presentation Clarity of presentation: ✓ Clarity of presentation ✓ Efforts exhibited to write sound material and make the presentation understandable to the class. ✓ Participation of students in asking and answering questions ✓ Adequacy of responses and feed back to the questions raised.
References	Worboys, M. F., and M. Duckham, 2004. GIS: A Computing Perspective, 2nd edition. Taylor & Francis. Abolghasem S., 2009, Ontology-based and User-centric Spatial Modeling in GIS: Basics, Concepts, Methods, Applications. Longley, P.A., Goodchild, M.F., Maguire, D.J. &Rhind, D.W. 2011, Geographic Information Systems and Science, 3rdedn, Wiley, London. Otto Huisman, Rolf A. de By (eds.) (2009) Principles of Geographic Information Systems An introductory textbook. ITC, Enschede, The Netherlands Gottfried Konecny (2003) Geoinformation; Remote sensing, photogrammetry, and geographic information systems ITC Educational textbook series (2010), GI Science and Earth Observation: a process-based approach. Jim Arlow and IL A Neustadt (2002) UML and the Unified Process: Practical object-oriented analysis and design. ISBN 0-201-77060-1, Addison Welsey publisher

	Paul Bolstad (2006), GIS Fundamentals: A first text on Geographic Information Systems. Peter F. Dale and Johan D. McLaghlin (1988) Land Information Management: an introduction with special reference to cadastral problems in third world countries. ISBN 0-19-858409-9 pbk, Oxford University press. Peter F. Dale and Johan D. McLaghlin (1999) Land Administration: Spatial Information and Geostatics Series. ISBN 0-19-823390-6, Oxford University press.

Course Guidebook
Debre Markos University
Institute of Land Administration
MSc in Geomatics

Program	Land Administration & Surveying				
Degree Program	MSc in Geomatics				
Course Title	Spatial data analysis and data quality				
Course Code	GmLA5034				
Course Chair	Name:				
	Office Location:				
	Mobile: TBA e-mail: TBA				
	Consultation Hours: TBA				
Instructor/Tutor	Name:				
	Office Location:				
	Mobile: TBA e-mail: TBA				
	Consultation Hours: TBA				
ECTS Credit (CP)	4				
Contact Hours per Semester	Lectures	L/P	T	HS	Total
	16	48		48	112
Lecture Days, Hours & Room	TBA				
Tutorial/Lab Days & Hour	TBA				
Target Group	Master				
Year /Semester	1st year 2nd semester				
Status of the Course	Compulsory				
Pre-requisites	None				
Course Description	The course explains the application of spatial data analysis using a concrete situation, i.e. disaster management. Starting with this picture in mind, various methods on data analysis are explained and tested: Simulation, point pattern analysis, and machine learning. In addition, the quality of spatial data is discussed because their inevitable limitations will affect the results of all analysis and awareness of these limitations is essential for good governance. The course explains the theories and provides guidance to perform the required steps.				

Course Outcomes	After successful completion of the course, students are able to • describe the phases for disaster management and apply relevant GIS functionalities • carry out geo-simulations • analyse point patterns and integrate the results into decision-making processes • describe multi-criteria decision analysis as well as to carry out a site selection using GIS functionalities • list and explain common methods of machine learning and apply them to geodata • list and explain aspects of spatial data quality • explain challenges in the use of spatial data quality
Course Objectives	• Design well-formed database models, using appropriate design techniques, and be able to implement such designs using relational database software • Use SQL to establish and retrieve databases • Use ArcGIS based spatial databases to create and populate geodatabases • Critically assess the limitations of conventional database structures as a means of storing spatial data • Critically assess current advances in database design for geographical applications
Course Content	1. Disaster management 1.1. What is disaster management? 1.2. Disaster Management and GIS 1.3. Being prepared: Essential layers 1.4. Response Phase 1.5. Recovery phase 1.6. Use case L'Aquila, Italy (2009) 2. Geosimulation 2.1. Introduction 2.2. Modelling process 2.3. Automata 2.4. Multi-agent systems 2.5. Examples 3. Spatial data quality 3.1. Reasons for quality limitation 3.2. Data quality vs. Uncertainty 3.3. Aspects of data quality 3.4. Data quality standards 3.5. Challenges for spatial data quality 4. Point pattern analysis 4.1. Descriptive statistics 4.2. Spatial distribution 4.3. Hot spot analysis 4.4. Regression analysis 4.5. Graphical data representation

	5. Geospatial Machine Learning 5.1. Introduction 5.2. Training, Testing, Prediction 5.3. Workflow for Knowledge detection in ML 5.4. Deep Learning 5.5. Association analysis
Mode of delivery (Teaching-Learning)	Knowledge, skills, and competences are delivered to students through various teaching concepts: Frontal presentation of theory, solving practical examples in group work and alone, group discussions
Mode of Assessment and Evaluation	Class activities (answering questions, quizzes, asking questions) Handed in homework Final exam (written format)
Course Policy	Implemented based on the university's legislation
References	Benenson, Itzhak & Torrens, Paul (2004) Geosimulation : Automata based Modeling of Urban Phenomena Bivand , R. S., Pebesma , E. J., Gomez Rubio, V., & Pebesma , E. J. (Applied spatial data analysis with R (Vol. 747248717). New York: Springer Goodfellow, Ian, Bengio , Yoshua, & Courville, Aaron (2016). Deep learning. MIT press. Tomaszewski, Brian (2014) Geographic Information Systems (GIS) for Disaster Management

Course Guidebook
Debre Markos University
Institute of Land Administration
MSc in Geomatics

Program	Land Administration & Surveying
Degree Program	MSc in Geomatics
Module Name	Research
Course Title	Research Methods in Geomatics
Course Code	GmLA5041
Course Chair	Name
	Office location:
	Mobile: e-mail:
	Consultation Hours:
Instructor / Tutor	Name
	Office location:
	Mobile: e-mail:
	Consultation Hours:

<table>
<tr><td>ECTS credit (CP)</td><td colspan="4">5</td></tr>
<tr><td rowspan="2">Contact hours (per semester)</td><td>Lecture hours</td><td>L/P hours</td><td>HS hours</td><td>Total hours</td></tr>
<tr><td>48</td><td>0</td><td>80</td><td>128</td></tr>
<tr><td>Lecture days, hours and Room</td><td colspan="4">TBA</td></tr>
<tr><td>Target Group</td><td colspan="4">Geomatics Students</td></tr>
<tr><td>Year / semester</td><td colspan="4">Year I, Semester II</td></tr>
<tr><td>Prerequisite</td><td colspan="4">None</td></tr>
<tr><td>Status of the Course</td><td colspan="4">Compulsory</td></tr>
<tr><td>Course Description</td><td colspan="4">The aim of this course is to develop students' knowledge, skill and understanding on quantitative and qualitative research methods. It offers basic concepts of research, types of research and the importance of the research. It will also introduce concept of research problem and problem identification techniques. The course describes theoretical underpinnings of research and the philosophical foundation of quantitative and qualitative research paradigm. Intellectual and methodological debates among research paradigm will be discussed. The course equips students with the skill to review both theoretical and empirical literature that allow them to prepare research proposal, conduct research and prepare research reports. In addition, issues of designing different data collection techniques, managing data and analyzing data are core to this course. Students will be equipped with knowledge and skill to conduct original research work in their field of study</td></tr>
<tr><td>Learning Outcomes</td><td colspan="4">At the end of this course the students are able to:
Define research and understand different types of research.
Describe and compare different research paradigm based on their methodological strength and weakness.
Select and apply research paradigm in problems in their field of study.
Understand concepts, functions, evolution and designing qualitative research.
Compare qualitative and quantitative research.
Critical review relevant literature in their field of study.
Explain the relationship between theory and research process and the role of theory in guiding practical research.
Construct an effective data collection tool for both qualitative and qualitative research.
Interpret results obtained using a statistical package, as well as critique results reported in professional journals by other researchers.
Independently conduct research project and produce report.</td></tr>
<tr><td>Objectives of the Course</td><td colspan="4">Analyse contemporary development issues.
Discovery development problems and define it for identification of</td></tr>
</table>

	solutions. • Discuss on general approaches/methods of development research. • Independently develop research proposal. • Apply i) survey research methods (sampling design and sampling procedures, errors in survey research, questionnaire design, participatory approach to research, personal interviews) ii) Experimentation; and iii) case studies, • Understand concepts, functions, evolution and designing qualitative research. • Compare qualitative and quantitative research. • Recognize techniques of qualitative research.
Course Contents	1. **Definition and Concept of Research** 1.1 Definition and objectives of research? 1.2 Important characteristics scientific method 1.3 Types/ classification of research 1.4 Research methods versus methodology 1.5 Foundations of qualitative and quantitative research methods 1.6 When do we use qualitative and quantitative methods? 1.7 Comparing qualitative and quantitative methods 1.8 Combining qualitative and quantitative methods 1.9 Ethical issues in research 1.10 Codes of ethics applicable at each stage of the research goal 2. **Defining the research problem** 2.1.What is research problem 2.2.Selecting the problem 2.3.Necessity of defining the problem. 2.4.Techniques involved in defining a problem. 3. **Designing Research proposal** **3.1.** Background of the Study 3.2.Statement of the Problem 3.3.Objectives of the Study 3.4.Research Questions and Hypotheses 3.5.Significance of the Study 3.6.Delimitations and Limitations of the Study **3.7.**Review of literature 3.8.Research Methods/Methodology 3.9.Logistics 4. **Sampling design and Questionnaire** 4.1.Census and Sample Survey 4.2.Implication of a sample design 4.3.Steps in sample design 4.4.Criteria of selecting a sampling procedure 4.5.Characteristics of a good sample design 4.6.Types of sample designs 4.7.How to select a random sample? 4.8.Questionnaire design 5. **Methods of data collections**

	5.1.Collection of primary data 5.1.1. Observation method 5.1.2. Interview method 5.1.3. Focus Group Discussion 5.1.4. Collection of data through questionnaire 5.1.5. Collection of through schedule 5.1.6. Difference between questionnaire and schedule 5.2.Collection of secondary data 5.3.Selection of appropriate method for data collection 5.4.Case study method **5.5.**Ethnographic Studies 5.6.Phenomenological Studies 5.7.Historiography and Oral Tradition 6. **Data analysis** 6.1.Qualitative analysis 6.1.1. Coding techniques 6.1.2. Content analysis 6.1.3. Measurement and coding 6.2.Quantitative analysis 6.2.1. Descriptive statistics 6.2.2. Data preparation 6.2.3. Data entry 6.2.4. Vicariate analysis 6.2.5. Inferential statistics 6.2.6. Multivariate analysis 6.2.6.1.Multiple regression analysis 6.2.6.2.Logistic regressions analysis 6.2.6.3.Discriminate analysis 6.2.6.4.Factor analysis 6.2.6.5.Limited dependent variable models (logit, probit, LPM and Tobit models) 6.2.6.6.Impact analysis models (before and after, propensity score matching (PSM), difference indifferences (DD), regression discontinuity design (RDD), and instrumental variables (IV), Endogenous switching probit model (ESP) 7. **Research Report Writing** 7.1.Identifying the purpose of the writing: arranging the noodles 7.2.Delineating a supportive structure: visual signals for the reader 7.2.1. The Abstract 7.2.2. The Introduction 7.2.3. Literature Review 7.2.4. Methodology 7.2.5. Findings or Results 7.2.6. Discussion 7.2.7. Conclusion and Recommendation 7.2.8. References, Notes, and Appendices 7.2.9. Practicing Citation on Freely Available Software's 7.2.10. Presenting research material

Teaching Learning Methods and Activities	Series of lectures, reflection on chapters, reading assignment and chapter presentation, proposal writing and its presentation in the class and homemade assignments and presentations.
Mode of Assessment	• Reading assignments and Journal Review -------20% • Proposal writing and presentation ---------- 40% • Final Examination ---------- 40%
Course Policy	It is mandatory to participate in all individual and group activities as well as attending lectures. A Student who attends less than 80% of the lectures is not allowed to sit for final examination. Furthermore, active class participation has substantial value. Criteria for assessing assignments and presentation of proposals. Clarity of presentation • Efforts exhibited to prepare sound material and make the presentation understandable to the class. • Participation of students in asking and answering questions • Adequacy of responses and feed back to the questions raised.
References	Alan Bryman and Duncan Cramer () Quantitative data Analysis with SPSS 12 and 13, A Guide for Social Scientists. Babbie, E., 1992. The practice of Social Research, 6thedn. Wadsworth publishing, Belmont, California. CRESWELL, J. W. 2014. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, Los Angeles, SAGE Publications, Inc. Babbie, E., 1973. Survey Research Methods. Wadsworth publishing, Belmont, California. Bernard, H.R., 1994. Research Methods in Anthropology: Qualitative and Quantitativeapproaches, 2ndedn. SAGE publications, London. (Selected sections). Brown RA, Swanson-Beck J., 1993. Medical Statistics on Personal Computers, 2nd edn. London: BMJ Publishing Group. Flowerdew, R., Martin, D., Eds., 1997. Methods in Human Geography: A Guide forstudents doing a Research Project. Longman. Hammond, R., Mccullagh, P., 1978. Quantitative Techniques in Geography: AnIntroduction. Second Ed. Clrendon press, Oxford Mikkelsen, B. 1995. Methods for Development works and Research: A guide forpractitioners, SAGE publications, New Delhi. Zikmund, W.G., 2000. Business Research Methods. Sixth Ed. The Dryden presses. Pal, S. K., 1982. Statistical Techniques: A Basic Approach to Geography. Tata McGrawHill. New Delhi. Berg, Bruce l. (2001) Qualitative research Methods for the Social

sciences. 4th Ed., California state university, long beach, United State of America, 2001.
Daniel Muijs (2005) Doing quantitative research in education with SPSS.
Gujarati (2003) Basic Econometrics. 4th Ed.
Maddala (1992) Introduction to Econometrics. 2nd Ed.
Murphy, E, et al (1998) Qualitative research methods in health technology assessment: a review of the literature. The Basingstoke Press, Basingstoke, UK.
Natasha Mack Cynthia Woodsong (2005). Qualitative Research Methods: A data collectors Field Guide.
Ritchie, Jane and Lewis, Jane (Editors) (2003) Qualitative Research Practice: A guide for social science students and researchers. Sage publications, London.
Silverman, David and Marvasti, Amir (2008). Doing qualitative research: a comprehensive guide. Sage publications Inc., India.
C.R. Kothari (1990). Research methodology, methods, and techniques. Second revised edition. Published by New Age International (P) Ltd., Publishers

Course Guidebook
Debre Markos University
Institute of Land Administration
MSc in Geomatics

Program	Land Administration & Surveying			
Degree Program	MSc in Geomatics			
Module Name	Research			
Course Title	Thesis			
Course Code	GmLA6042			
Course Chair	Name			
	Office location:			
	Mobile: e-mail:			
	Consultation Hours:			
Instructor / Tutor	Name			
	Office location:			
	Mobile: e-mail:			
	Consultation Hours:			
ECTS credit (CP)	60			
Contact hours (per semester)	Lecture hours	L/P hours	HS hours	Total hours
	0	0		2160
Lecture days, hours and Room	TBA			
Target Group	Geomatics Students			
Year / semester	Year II, Semester I & II			
Prerequisite	None			

Status of the Course	Compulsory
Course Description	In the course 'MSc Thesis' students are developing their research proposal. The research proposal development includes title, introduction, statement of the problem, aims and objectives, research questions/hypotheses, methodology/methods, definitions, delimitation, limitations, and significance, time planning and review of literature. Students are also required to write their thesis. Thesis writing includes the introductory part (title, statement of the problem, objectives, etc), data collection, data summarization, data analysis, presenting the findings of the study, summary, conclusion, recommendations, list of references and appendices.