Lessons Learned Manual: Applying Geospatial and Engineering Technology (AGET)

October 1, 2022

H. Jeff Turk,

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EXECUTIVE SUMMARY

The National Science Foundation (NSF) awarded a three-year, $609,739 Advanced Technological Education program grant (#1700568) to the University of North Georgia Applying Geospatial and Engineering Technology (AGET) project. The materials included in this lessons learned manual are provided by AGET team members at the conclusion of the project to share suggestions and recommendations with the broader educational community. This document may be of particular interest to educational departments that are initiating or reformatting geomatics and geospatial programs. Creation of this manual required AGET team members to examine and classify lessons learned (Figure 1) through analysis of the project goals, process, and outcomes.

The document includes a summary of the AGET project background including the process of forming the Executive Advisory Board. In addition, a diagram of the curriculum structure is provided to demonstrate use of modular and stackable credentials. Semi-structured interviews were used to identify and classify lessons learned and results from these semi-structured interviews with AGET team members and project collaborators are provided. Lastly, teaching resources include samples of course syllabi, surveying and geomatics educational materials, and GIS lab exercises.

Figure 1: Lessons learned manual goals

AGET MASTER CONTACT LIST

Name	Role	Email
H. Jeff Turk	PI	Jeff.Turk@ung.edu
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Sudhanshu Panda	Co-PI	Sudhanshu.Panda@ung.edu
Yu Sun	Co-PI	ysun@ung.edu
Blake Urbach	External Reviewer	blake@ppeonline.net
Steven Hooks	Surveying Instructor	Steven.Hooks@ung.edu
Jacob McDonald	Surveying Instructor	Jacob.McDonald@ung.edu

AGET PROJECT BACKGROUND

Application of geospatial technology (GST) is a proven methodology for environmental management decision support and is extensively utilized in a broad range of technical occupations. GST encompasses a combination of robust technological approaches including Geographic Information Systems (GIS), Remote Sensing (RS), Global Navigation Satellite Systems (GNSS), and Information Technology (IT) (Panda, 2015). The sophisticated and diverse technical methods included in GST are useful in environmental management to examine not only everything on the surface of the earth, but also atmospheric and lithospheric geophysical processes. In addition, environmental management also considers human behavior and ways of living. The enormity of GST applications improves the efficacy, precision, and efficiency of environmental management decision-making throughout the world. The advent of GST and its prudent and smart usage is evidenced by the enhanced quality of efficient problem solving in the field of engineering (Huang et al., 2020; Jackson, 2020; Panda et al., 2019; Shah and Wani, 2015; Kawasaki et al., 2013; Nugent et al., 2010).

The Lewis. F. Rogers Institute for Environmental & Spatial Analysis (IESA) at the University of North Georgia (UNG) aspired to use the true potential of GST to advance environmental and engineering decision support in and around the metro-Atlanta region of Georgia, USA. To accomplish this goal, IESA secured grant funding from the National Science Foundation (NSF) Advanced Technological Education (ATE) program in 2017 (NSF Award #1700568). The Applying Geospatial and Engineering Technology (AGET) grant prepares highly-skilled technicians to enter the workforce through new curriculum development, workforce training, and dissemination of innovative educational resources. The AGET project was also developed to address the construction industry bounce-back following the long recession that had decimated the construction sector. It is to be noted that during the recession and decade-long recovery time period (years 2007 – 2017), the ever-growing GST sector grew by leaps and bounds with significant advancements in new and efficient technology such as LiDAR, GNSS-supported land surveying, ultra-high spatial & spectral imaging using unmanned aerial systems (UAS), robotics applications in surveying, and substantial improvements in GIS and image processing (Ghilani,

2018). As one of the unique and premier geospatial technology undergraduate degree programs in the country, IESA was well-equipped with knowledge of this GST growth and its application.

To provide GST skills and knowledge to the metro-Atlanta workforce, IESA created two new academic programs – a Land Surveying Technician Certificate and Associate degree in Environmental, Earth & World Studies, and Spatial Science & Engineering. These programs were intentionally designed to allow immediate employment upon completion and meet a state shortage for professional land surveyors. In addition, the programs were designed to be "stackable credentials" to more easily enable students to acquire multiple degrees and qualifications over time. These career pathways increased the engineering and science workforce through seamless transition from high schools and technical colleges to associate degrees (Figure 2), with an emphasis on underrepresented groups. Project based information, processes, methodologies, and outcomes were disseminated directly to local area high schools, University colleagues, and the broader public. Presentations at regional and national conferences helped share project findings with the educational and academic community. In addition, new GIS lab exercises were created and shared with educators through faculty training workshops.

The AGET project was guided by faculty and staff with over 100 years combined faculty experience in geospatial technologies & engineering, environmental science, environmental studies, and geography. The project team was led by Dr. Jeff Turk and supported by Drs. Sudhanshu Panda, Yu Sun, and Amber Ignatius along with Mr. Zac Miller. In addition to teaching and academic expertise, the AGET team specializes in real-world problem solving using GST, applied field research, engineering, and hands-on application.

Through the introduction of certificate and degree programs in 2017, IESA has already prepared workforce Surveying Technicians, Construction Management Technicians, Infrastructure Design Technicians, Forestry Technicians, Environmental Technicians, and Geoscience Technicians. New courses include Surveying I (ENVE 2221K), Surveying II (ENVE 2222K), and Legal Aspects of Surveying (ENVE 3465). All of these courses utilize GST within the curriculum while emphasizing applied methods and professional training in preparation for state certification. In addition, other new courses such as Physical Environmental Science (ENVS 2111K) and Environmental Management & Sustainability (ENVS 2112K) also contribute to the

new Associate degree. The various AGET Technician Career Pathways (Figure 2) has come to fruition after three years of AGET grant project implementation at UNG.

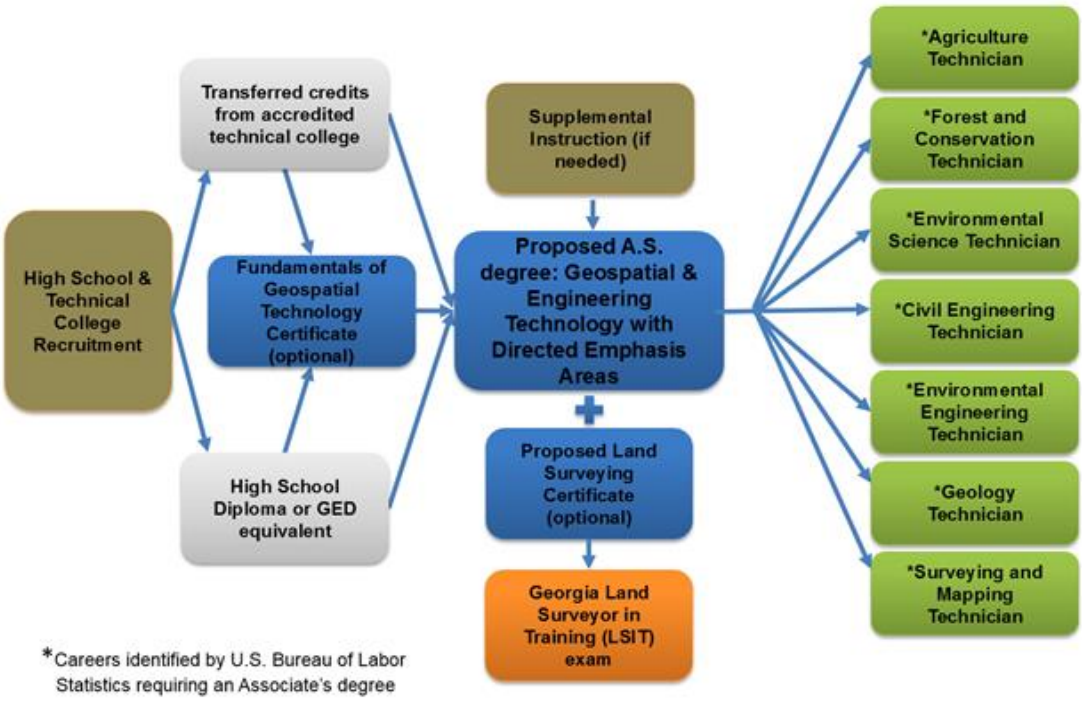


Figure 2: AGET Technician Career Pathways.

* A.S. Geospatial Engineering Technology has changed to Environmental, Earth & World Studies, and Spatial Science & Engineering

The new certificate and degree program are designed to support regional industry needs and address the requirements of relevant stakeholders. The curriculum was planned and put together with extensive guidance from a well-crafted Executive Advisory Board (EAB) drawn from various professional fields: Data Management Solutions for Agriculture, City Water Resources Utility Database Management and AMI Analysis, Georgia Department of Natural Resources, Geomatics, Surveying, Planning, and Consulting, Stream Restoration and Land Surveying, Georgia Forest Management, Watershed Management, Power Companies, and many others. The Executive Advisory Board also provided opportunities for internships and direct connections between our students and industry professionals.

Examples of the positive and constructive criticism from the Executive Advisory Board are cited below. These comments from professionals were carefully considered and actively guided the AGET project teams to effectively address concerns:

q Steven Hooks (Engineering 303, LLC Stream Restoration & Land Surveying) commented, "*The course information you sent is in line with what I hoped for. It definitely hits the 'high points' as well as the more technical details. I am happy to see that it includes topics from significant figures, kinematic GPS, through mapping and GIS*."

q Christopher Semerjian (Georgia Department of Natural Resources) commented, "*I wanted to respond to the meeting and the materials that you sent. I greatly appreciate you asking me to participate. I think the concept of what you are doing with the "geoengineering" degrees are great and true to the original intent of the Institute*."

q Mark Chastain (Chastain & Associates, P.C., Surveying, Planning & Consulting) commented during the Industry Advisory Board meeting "*This AGET initiative would certainly meet the demands of now booming surveying industry in Atlanta and Georgia along with other parts of the United States*."

q Jeff Simmons (Platinum Geomatics) suggested during the Executive Advisory Board meeting, "*Expertise in LiDAR, UAV, and other advanced geospatial engineering & technology skills of IESA would innovate the way of surveying and the construction management field*."

The Executive Advisory Board also guided design of curriculum prerequisites based on their knowledge of needed skills and state requirements for the Georgia Land Surveyor Examination. For example, through consistent board meeting discussions each semester, the AGET team determined the Land Surveying Technician Certificate should offer an optional Engineering Hydrology course to maintain opportunities for students interested in additional hydrology training.

Success of the AGET project was significantly attributed to recruiting efforts. AGET PIs and other supporting personnel at the Institute conducted recruiting visits to minority-majority high schools in the area including Clarke Central High School, East Hall High School, Gainesville High School, Johnson High School, West Hall High School, and other schools in the region. High quality and inspiring recruitment materials were developed in collaboration with IESA, UNG Enrollment Services, and the UNG Financial Aid Office. In addition, the team helped disseminate information at local events, produced brochures, featured the new programs on the Financial Aid and UNG websites, and created an AGET project website to disseminate materials (http://www.visualecogeo.com/iesa-ate) (Figures 3-4). Importantly, the project team also developed articulation agreements to provide current high school students an opportunity to take associate and baccalaureate level courses through UNG's Dual Enrollment Program.

Figure 3: Drs. Sun and Panda demoing the Robotics Total Station to High School students

Figure 4: Drs. Panda and Sun teaching a workshop to High School students in their lab about the application of GST in environmental management.

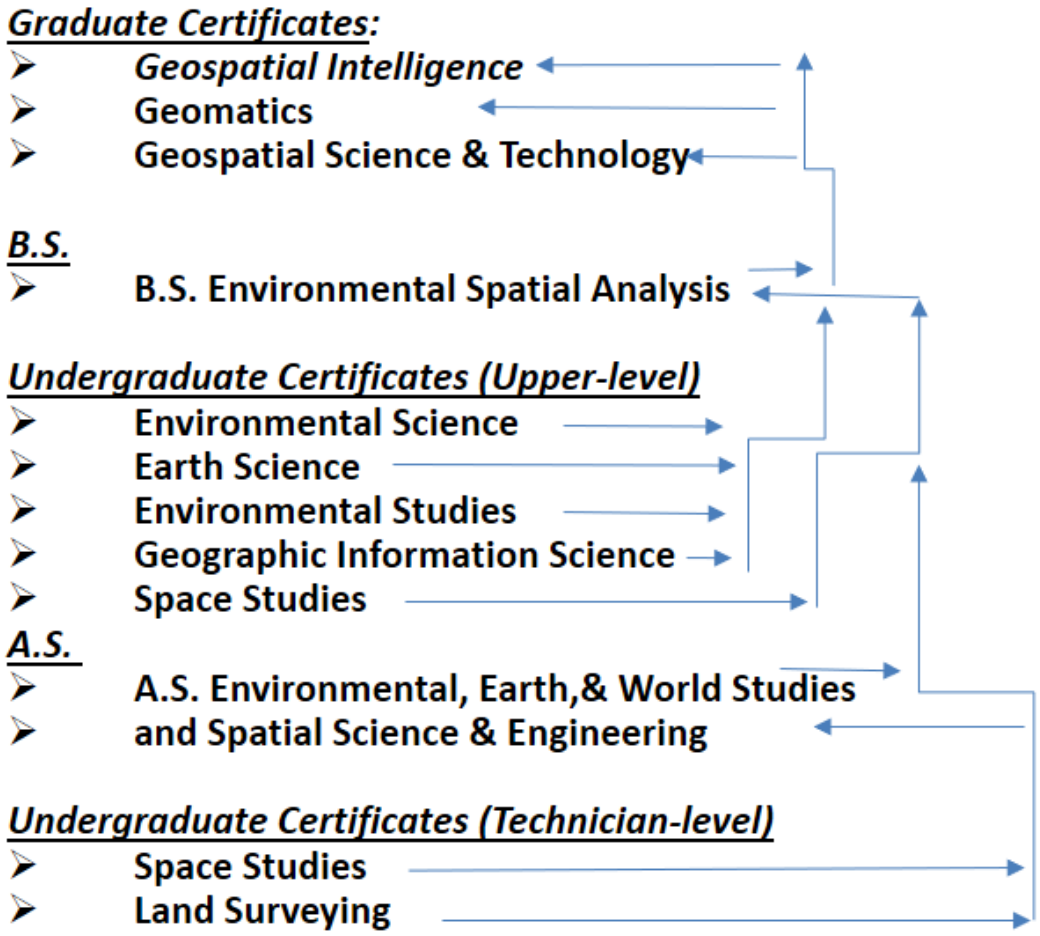
External evaluation was a critical component of the AGET educational project and a significant tool in its success. AGET project evaluation activities were ongoing throughout the performance period to ensure the program served its constituents' needs and continually improved the effectiveness of technician education. Documenting accomplishments and disseminating evaluation findings served the geospatial, engineering, and technologies education communities

through transparency. External evaluation was conducted in a timely manner twice each year and included suggestions to the project approach based on findings.

Project evaluation of activities and outcomes included: i) curriculum development and design, ii) collaboration with industry partners and the K-12 community, iii) establishment of articulation agreements and experiential opportunities, and iv) student scholarship and workforce readiness. Early in the execution of the project, a total of 39 students were enrolled and graduated in the Certificate courses by fall 2019 with 8% minority students and a 77:23 male and female student ratio. The Land Surveying Education Evaluation Policy (2018) was also an essential reference for the ongoing refining and development of the AGET program.

To conclude, implementation of AGET initiative successfully fulfilled project goals at IESA, UNG. Project success was contingent on the guidance of project PI Dr. Turk and the sincere dissemination effort conducted by the investigator team, Drs. Panda, Sun, and Ignatius. Project success was realized by a persistent and focused team effort that implemented and realized AGET project goals through the early development of curricular materials and approval of courses and programs. This allowed the project team to then focus on program refinement, recruiting and actualization of project results. Visits to local high schools and early colleges increased awareness about the Environmental Spatial Analysis (ESA) bachelors program and the newly created associate and certificate programs. Project effectiveness was evaluated each year through interviews and progress analysis by Ms. Blake Urbach and was communicated to the funding agency on a regular basis by the project PI. IESA, UNG has seen an uptick in student enrollment in the newly created associate and certificate programs and in the ESA, B.S. degree as a whole. IESA's ESA degree caters towards non-traditional students because of the focus on GST supported environmental management professional teaching and learning. In addition, we observed more 'direct from high school' students signed up in the ESA program after AGET project implementation. We also observed a change in diversity in the student's intake in the program with respect to women and minorities. According to Ms. Blake, our in-house project evaluation expert, the AGET project successfully achieved the proposal goals. The project team is planning to apply for another NSF grant to expand the program success. It is to be noted that the 2020 COVID-19 epidemic created some hick-ups in our project dissemination endeavor, but we received no-cost extensions from the funding agency to complete dissemination activities.

AGET "STACKABLE" CURRICULUM STRUCTURE



AGET COLLABORATOR ROLES

Semi-structured interviews were conducted throughout the summer of 2022.

PROJECT COLLABORATOR ROLE	DATE OF INTERVIEW
H. Jeff Turk, Ph.D. – Dr. Turk is PI on the AGET project. Turk is the Dean of the Institute for Environmental & Spatial Analysis. Turk has served as the IESA Director and Dean for several years and as a professor of engineering at the Gainesville campus where he began the campus's engineering program. His academic interests include the design and management of environmental systems. https://ung.edu/institute-environmental-spatial-analysis/faculty-staff-bio/jeff-turk.php	June 22, 2022
Amber R. Ignatius, Ph.D. - Dr. Ignatius is a Co-PI on the AGET project. Ignatius is a geographer and geospatial scientist specializing in water resources. Her research uses remote sensing, geographic information systems, and environmental modeling approaches to assess human impact on environment. http://www.visualecogeo.com	August 1, 2022
Sudhanshu Panda, Ph.D. - Dr. Panda is a Co-PI on the AGET project. Panda is an engineer specializing in geospatial science and engineering with applications toward environmental and agricultural modeling. https://ung.edu/institute-environmental-spatial-analysis/faculty-staff-bio/sudhanshu-panda.php	
Yu Sun, Ph.D. - Dr. Sun is a Co-PI on the AGET project. Yu Sun specializes in environmental geography and geospatial science & technology. His research mainly focuses on human-environmental interactions, watershed modeling/management, land use/cover change, and human population dynamics.	July 8, 2022 11:00am EST

https://ung.edu/institute-environmental-spatial-analysis/faculty-staff-bio/yu-sun.php	
Blake Urbach, M.S. - Urbach served as an external reviewer on the AGET project. Urbach is the Principal Consultant at Preferred Program Evaluations. Urbach has conducted program evaluations and social science research for over 18 years. https://www.ppeonline.net	July 12, 2022 1:00pm EST
Steven Hooks, M.S. - Hooks helped design and teach the Surveying curriculum for the AGET project and served on the Executive Advisory Board. Hooks is a professional Georgia Land Surveyor and teaches Surveying 1, Surveying 2, and Professional Practice of Land Surveying. https://ung.edu/institute-environmental-spatial-analysis/faculty-staff-bio/steven-hooks.php	August 5, 2022 11:00am EST
Jacob McDonald, Ph.D. - Dr. McDonald helped design and teach the Surveying curriculum for the AGET project. McDonald is a geographer, soil scientist, and geomorphologist who uses GIS and field surveys to conduct research, provide technical assistance, and create educational opportunities. https://ung.edu/institute-environmental-spatial-analysis/faculty-staff-bio/jacob-mcdonald.php	July 14, 2022 2:30pm EST

LESSONS LEARNED INTERVIEW RESULTS

Each project collaborator reflected on their own experiences as part of the AGET project. Interviewees were specifically asked to consider five questions about the project during semi-structured interviews. A summary of responses in included below.

AGET GOALS

What were your goals at the outset of this project? Did outcomes align with these goals?	Respondent
Initial personal goals for the project focused on bringing surveying and additional environmental science coursework into our programs. Surveying seemed to be a natural fit for what we were already doing in the Institute. Adding surveying courses and a new surveying faculty member would expand and complement the Institute's programs and faculty. A second important project goal was to emphasize student recruitment, enrollment and retention in our programs. Yes, these goals were achieved. We have a new full-time surveying faculty member, new courses, a certificate, and new students. IESA is one of three entities at UNG that has shown growth over the last three years. We believe this is primarily a result of students associated with programs developed for the AGET project. In addition, we were able to purchase significant and important new equipment including new state-of-the-art Surveying Total Stations. Also, we were able to leverage salary savings toward the purchase of new UASs and other relevant geospatial equipment and technology.	H. Jeff Turk
The initial project goal was to create new learning opportunities in surveying and geospatial sciences. We sought to expand access to education in geomatics and GIS technologies to create job opportunities and help our local community. At the beginning of the project, my personal goals were focused on the geospatial education component of the grant. I aimed to create geospatial learning materials to reach a broader group of students within our university including non-majors. Another goal was to reach-out to high school, under-represented, and non-traditional students to increase geospatial awareness.	Amber R. Ignatius

Project outcomes aligned with initial goals as we successfully created new certificate programs and courses. Development of modular GIS learning materials helped us meet learning goals by incorporating GIS exercises into a variety of classes. In the future, it would help to find additional strategies to reach out to underserved individuals within our community.	
The followings are the objectives of this project and we achieved all our goals perfectly and beyond including the following. Curriculum Development: Both an Associate of Science with Geospatial Engineering Technology with directed emphasis areas and a Certificate in Land Surveying using an Executive Advisory Board (EAB) to strengthen the development and implementation process were created. Workforce Development: The project has increased and enhanced the geospatial and engineering technician workforce while increasing opportunities for underrepresented groups. A seamless transition from high schools and technical colleges to associate degrees and certificate programs was facilitated through articulation and dual enrollment programs. Typical graduates from the two newly created programs quickly found employment opportunities. These new programs helped our traditional IESA B.S. degree students obtain additional skills which allowed for additional opportunities after graduation. The EAB formed to assist in the implementation of the new programs while assisting in employment options. Dissemination: Products and processes were disseminated through professional conferences, professional publications, and presentations at local high schools. The project team continues the process of publishing processes and outcomes through various professional outlets.	Sudhanshu Panda
The main project goals were encapsulated in the project objectives and so it's best not to repeat that here. However, it is important to note that at the outset of the project, the team wanted to directly focus on educational opportunities related to career development. Our intentions were to encourage the study of geospatial engineering and provide that expertise within our local area. In addition, we wanted to build up the land surveying certificate to address the shortage of workers in that field. We have achieved most of the goals despite COVID interruptions. The land surveying certificate, faculty hiring, and new course development were all achieved. Unfortunately, the ability to visit local high schools became impossible during the COVID pandemic. However, conference dissemination and virtual outreach was successful.	Yu Sun

The project goals were directly tied to the approved NSF proposal. As an external reviewer, personal goals were based on assessing activities for evaluation and focusing on the deliverables to be produced. Based on sources such as the industry partners and student survey, project findings, recommendations, next steps, and strategies to be implemented were identified. These goals were captured in the project outcomes.	Blake Urbach
As a member of the Executive Advisory Board and a part-time Lecturer for the Surveying Certificate, a personal goal was to contribute long-term experience in the field of surveying to the project. Before the AGET project, there was already concern among many industry professionals that the field needed to develop new professionals with technical expertise. The need for more advanced technical education was often discussed at professional conferences and seminars. The project goals were implemented in classroom by creating a curriculum which included theory and advanced technical training alongside real-world applications. Goals included student graduates successfully pursuing productive technical careers. This would be exemplified by a student becoming an LSIT (Land Surveyor In Training) journeyman or taking the professional license exam.	Steven Hooks
As a faculty contributor to the project, goals were for students to become familiar with equipment in the surveying and GNSS courses. Another goal was to have students write SOPs to prove they could teach how to use equipment. Most students succeeded in this goal and the SOP help them in their job after graduation.	Jacob McDonald

AGET PROCESS

Which processes worked well? Which could be built on in the future?	Respondent
The original process was to prioritize getting courses and programs approved by the University. Approval required development of syllabi, course	H. Jeff Turk

descriptions, and the certificate program structure. We then needed approval from IESA faculty, the Provost Council, and lastly the Academic Affairs Committee within the University. Once the effort was approved by the University, we focused on implementing courses and programs. We initially had difficulty hiring a full-time surveying faculty. As an alternative, professional surveyors were hired part-time to teach classes. In addition, current IESA faculty with surveying experience were asked to support the classes. For example, one of our Assistant Professors with research-based surveying experience completed our Surveying Certificate under direction of professional surveyors serving as part-time faculty. With this gained educational expertise and prior experience, the Assistant Professor now helps support the certificate program by occasionally teaching some of the classes needed to support these programs. Eventually, we were given financial support from the University to hire a full-time surveying lecturer and have been able to secure a hire. An Executive Advisory Board made up of industry professionals helped guide the programs development. For example, one of the individuals on our Advisory Board was also on the State License Board for engineering and surveying. He provided significant guidance about how to best customize and structure our program to optimally serve students. The Executive Advisory Board was quite important in defining, implementing and promoting the newly created programs. Marketing the program was another important part of the process. We included descriptions of our program in Surveying and Mapping Society of Georgia (SAMSOG) newsletters and other outreach materials. We were very fortunate because there was already preexisting demand for these classes in the state of Georgia. The initiative now focuses on the sustainability of the program. With the hiring of a full-time faculty member, many of these responsibilities can be turned over to that individual. The program has reached a sustainability point where it is robust and resilient and we look forward to future growth.	
One of the most effective aspects of project implementation was inclusion of faculty from different focus areas. The grant team incorporated engineers, surveyors, and geographers. I believe the diverse expertise on the grant team helped us reach out to a broader and more diverse group of students and be more creative in how we approached the project design and subsequent dissemination. Another successful process was the Executive Advisory Board. Professional input helped our surveying certificate gain legitimacy within the professional	Amber R. Ignatius

field and was vital for success of the program. The collaboration with industry also helped students network and find jobs after graduation. In the future, we need to expand our Executive Advisory Board to have specializations beyond surveying.	
Curriculum Development process worked very well. EAB set-up and their support for the success of the new curriculum was excellent. Our Dissemination effort was successful but could have been better as the pandemic often impeded these activities. Workforce Development objective was achieved better than expected. As mentioned, the EAB was a significant supporting force and the GET courses were needed in industry and graduates typically found employment immediately and in engineering and surveying companies. The students are well respected in their respective companies, where they work now. Recent economic growth and booming real-estate market were perhaps also drivers of our success. We may also have to measure this workforce development process and our graduates' employability skills in a struggling economy.	Sudhanshu Panda
One process which worked well was having regular meetings every few weeks. Meeting very frequently immediately at the project outset was important and kept the project momentum. In addition, regularly meeting with outside evaluator was helpful. Designing the land surveying certificate and geomatics program was very efficient a result of these regular meetings and communication among collaborators. In the future, the outside evaluator will not be needed as frequently but would still be a strong asset for future assessment. Lastly, the certificate program has grown to become an important focus of our Institute and will continue to be built-on in the future.	Yu Sun
What worked particularly well was having a clear understanding of key players from the outset. This included the institution and external partners such as business/industry. The clear guidance regarding expectations of roles helped achieve success. Given the number of grants evaluated, it is evident that having clearly-defined roles helps everyone keep on track along the way. A very clear timeline of implementation was also important. The timeline for specific goals and activities kept the project on-track as the three years for the grant goes quite quickly. To avoid burn-out, the team also worked to make	Blake Urbach

sure that sustainability and flexibility were on the radar from the get-go. For example, when facing COVID the faculty shifted to an online learning environment and were able to adjust to the inability to come to campus. The team was also thoughtful about having assessment remain a continual part of conversation front-and-center. Which components are successful and what do we want to continue post-funding? How are finding going to be constructively used to improve pedagogy? Lastly, it was important that project PI Dr. Turk used the NSF funding to leverage additional funding dollars from sources such as surveying industry support.	
In terms of project implementation, the use of field-based technical education is working nicely in courses when teaching concepts such as data collection and instrument use. In addition, the process of course design has used numerous UNG resources such as the UNG library system and reaching out to other faculty. The faculty collaboration has been hugely helpful.	Steven Hooks
Hiring a professional surveyor to teach courses allowed the grant team to accomplish several project goals such as curriculum design and certificate implementation. Attending SAMSOG and giving a presentation helped tremendously with recruitment. Networking within the professional community was also an essential part of the process.	Jacob McDonald

AGET RESOURCES

Does IESA need any additional resources to continue/complete the project in the future?	Respondent
Currently, IESA's AGET project is in a very resilient position. We have a new full-time surveying faculty member, state-of-the-art equipment, several full-time faculty with surveying expertise, and access to part-time faculty to support the courses and programs. In the future, staying up-to-date with developing technology in the field will be a challenge. Receiving University support to keep our equipment up-to-date will be important going forward.	H. Jeff Turk

The highly competitive field of surveying and financial opportunities in the private sector also creates some concern and uncertainty regarding faculty retention.	
In the future, IESA will continuously require funding to purchase equipment. In addition, the University should allow academic units to rent equipment using student lab fees so that our Institute always has the newest materials available for learning. Our Institute also requires consistency in terms of personnel. Equitable faculty salary and hiring practices are essential to maintain a strong program over time. At the state funding level, hiring freezes and state budget constraints have a negative impact on the longevity of University and all projects.	Amber R. Ignatius
Yes, IESA may need an additional full-time survey/engineering faculty to support expanded curricula created through and as a byproduct of project initiatives. Additional faculty would complement other faculty within IESA and further the expansion of the AGET programs. Additional funding for developing subsequent workshops for high school students and high school faculty would benefit the sustainability of project goal by increasing students' interest and likely enrollment in project programs This will further enhance and meet workforce needs in the state of Georgia.	Sudhanshu Panda
Currently, we are in a post-pandemic period. In the future, if things return to normal we will need to do more dissemination to local high schools. We need to work out more than face-to-face outreach. In the future, perhaps use more video and other methods online.	Yu Sun
Yes, operational costs, equipment updates, and software agreements will need to be sustained through division budget or other sources.	Blake Urbach
In many ways, IESA is at an advantage. The new building provides plenty of space for classrooms and labs. In addition, equipment is currently very high-quality. In the future, equipment costs will be a consideration due to the 3-5 year obsolescence or potential that class sizes could grow tremendously.	Steven Hooks
Yes, funding to support equipment maintenance and purchase of new equipment would help the project in the future. If the certificate program expands to offer two sections of each course each semester, two additional robotic total stations would be vital.	Jacob McDonald

AGET FUTURE

Do you anticipate any issues based on current project status?	Respondent
There is an opportunity for further integration of skills associated with GIS, CAD and Surveying and it likely that blending and growth in this area will accelerate. However, potential issues involve a changing economic situation. For example, one issue may include reaching a point where the building industry collapses due to changing economic climate; such as the global recession, which began in 2008.	H. Jeff Turk
The project is running very well at this point in time. We currently have strong faculty and full-time lectures real world experience. In the future, a shifting economic situation might change the demand for surveying and could impact the popularity of the certificate program.	Amber R. Ignatius
No, with no-cost extension of the project, we continued and achieve all our objectives proposed through the project. We continue to work with regional schools, their faculties, and students in recruiting for our programs.	Sudhanshu Panda
Everything seems good so far and goals are achieved and successful. Hiring faculty members for land surveying was an important achievement. We did lose a faculty with expertise in UAV/drone and will need to re-hire to support this sector.	Yu Sun
In the future, the project will need to keep fresh/current curriculum and maintain their industry-informed approach. The hands-on piece for students and connections with industry will need to be maintained. Students should have the ability to work with industry and faculty need continued professional development, as well.	Blake Urbach
Given the current world economy and educational funding situation at the state level, there is some concern about maintaining faculty within the Institute. Faculty shortages could result from competitive private sector opportunities.	Steven Hooks

Curriculum needs to be more integrated so that surveying students are encouraged to take advantage of other courses more effectively. Faculty could work together more.	
A strong group of students remains interested in the program, and I do not anticipate any future issues. Only a potential economic change could affect students.	Jacob McDonald

AGET ACHIEVEMENTS

What has been the most significant achievement?	Respondent
The outcome of the program was holistic one involving a convergence of multiple achievements including new course and program development related to surveying, development and implementation of new environmental science courses, an augmented CAD course, development and dissemination of new GIS lab exercises, recruiting new students, acquiring new equipment, developing an advisory board with industry connections, and finally the acquisition of a new faculty line to support the new programs.	H. Jeff Turk
The most significant achievement of the project has been creation of a new certificate program and new courses. In the short project period we have already recruited students and are successfully supporting graduates from the program. We also shared methods within the brother educational community through conference presentations and faculty training session. This has fostered additional opportunities for collaboration within our University system and with other regional universities. The inclusion of student leaders in the project was also a highlight.	Amber R. Ignatius
EAB creation, successful development of both curricula, helping the graduating students obtaining employment in quality companies are the biggest achievements of this project. Demonstrating our newly developed technology in local schools was also very significant but it could have been much better if were in a normal time without COVID derailing our efforts.	Sudhanshu Panda

All outcomes are successful but the creating of the entire geomatics/land surveying certificate, attracting students, and getting curriculum approved is largest accomplishment.	Yu Sun
The biggest accomplishment was creating something entirely new from scratch, going through all of the approval processes, and getting students to enroll. This is a substantial achievement. Any time you have a three-year project where you create something from the ground up with approval channels/marketing/garnering interest (current students/new students/workers/etc.) is a huge undertaking and accomplishment.	Blake Urbach
The surveying certificate program is increasingly able to generate students with a well-rounded education, licensure, and career advancement. Students are seeking referrals and forms to help with long-term career goals. In addition, the caliber of students is improving over time. Current students are work-ready, competent, and serious about the program. This speaks to the strong reputation of our courses.	Steven Hooks
One important achievement from the project is being able to show our students throughout IESA all of the different equipment. The knowledge has moved beyond just surveying students to include non-majors, as well.	Jacob McDonald

AGET CURRICULUM MATERIALS

ENVE 2221K - SURVEYING I

SAMPLE SYLLABUS:

UNG | UNIVERSITY of NORTH GEORGIA™

Lewis F. Rogers Institute for Environmental and Spatial Analysis

ENVE 2221K
Surveying 1 – Summer 2021

I. GENERAL INFORMATION

Instructor's name	Doug Sherrill
Office Room Number	Gainesville Campus, Science 241
Cell Phone **Office Phone**	706-525-9496 for emergencies only, please email.
Email address	doug.sherrill@ung.edu
Office hours	TBA
Hybrid Online	D2L

II. TEXT AND OTHER MATERIALS

Text: Elementary Surveying, 15th Edition. Ghilani, Charles D.
ISBN 13:978-0-13-460465-7

Other Materials: Field notebook (provided), scientific calculator, sunscreen, Engineering scale, & Protractor

III. COURSE DESCRIPTION

This course focuses on the basic principles of plane land surveying. Topics include the history, equipment, field methods, and calculations used in plane land surveying. Students will gain valuable field experience in surveying techniques including the measurement of angles, distances, and elevations using a total station and level. Other topics include: elementary traverse computations, metrics of error, accuracy, and precision, coordinate geometry, areal measurements, and the principles of global navigation satellite systems (GNSS).

IV. COURSE OBJECTIVES (EXPECTED OUTCOMES)

Upon completion of this course, students should be able to:

- Create and interpret legible surveying field notes
- Define and explain common surveying terms and concepts
- Compute horizontal and vertical measurement accuracies
- Understand leveling procedures and calculations
- Explain and demonstrate procedures for electronic distance measurement (EDM)
- Performs calculations involving horizontal angles, distances, azimuths, and bearings
- Operate a total station and measure horizontal and vertical angles
- Show understanding of elementary traverse computations
- Calculate areal measurements from field observations
- Understand the principles and basic equipment used in global navigation satellite systems (GNSS)

1

V. COURSE CALENDAR (subject to revision at the discretion of the instructor)

Week	Week of	Hour 1	Hour 2	Hour 3 & Lab	Reading
1		Introduction, Syllabus & Expectations	Ch 1 - Introduction to Survey & Geomatics	Units, Pacing, Compass	Ch 1
2		Ch 2- Units, Significant Figures, Rounding	Ch 2 - Field Notes	Notes & Sketches, Bldgs	Ch 2
3		Ch 3 -Errors	Ch 3 - Cont'd	Error Computation & Closure	Ch 3
4		Ch 4 - Leveling I	Ch 4 - Leveling II	Levels I Lab	Ch 4
5		Ch 5 - Leveling Field Procedures	Ch 5 - Cont'd	Quiz 1 & Levels II Lab	Ch 5
6		Ch 6 - Distance Measurements I & II	Ch 6 - Distance Measurements III	Layout and Traverse	Ch 6
7		Ch 7 - Angles, Azimuth, & Bearings	Ch 8 - Total Stations I	Angles, Slopes, etc. Angle Balance	Ch 7 & Ch 8, part I
8		Review, Follow-up	Traverse Set up	Exam 1	Study
9		Ch 8 - Total Stations II	Ch 9 - Traversing	Total Station Traverse	Ch 8, part II & Ch 9
10		Ch 10 - Traverse Computations	Ch 10 - Cont'd	Total Station Traverse Reduction	Ch 10
11		Ch 10	Ch 10	COGO Lab - Manual	
12		Ch 10 - COGO	Ch 11 - Intro	Quiz 2	Ch 11
13		Ch 11	Ch 12- Area	Exam 2 & COGO Lab 2 - Software	Ch 12

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14		Ch 12 - Area	Ch 13 - GNSS Intro	GNSS Lab	Ch 13
15		Ch 14 - Static GNSS	CH 14 - Cont'd	Review	Ch 14
	May	FINALS WEEK!			

SEE https://ung.edu/academics/academic-calendars/index.php for other important dates

VI. COURSE GRADING

Item	Weight
Homework	30%
Quizzes (2)	10%
Exams (2)	10%
Labs	30%
Review Attendance	5%
Final	15%

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VII. COURSE POLICIES

Attendance Policy: Punctuality and attendance are expected. It is the student's responsibility to promptly make up missed work. Tests or quizzes missed without written documentation of an emergency will result in a zero grade. Emergencies are deaths, severe illnesses, or accidents. Emergencies do not include vacations, work, or your own lack of preparation and planning.

Final Exam: It is your responsibility to be aware of the date and time of the final exam for the class and plan accordingly. See https://ung.edu/academic-affairs/final-exam-schedules.php

Homework Submittal Information

- All Review & Follow-up sessions are mandatory.
- Please complete weekly readings by Wednesday.
- Homework due on Fridays. Time and submittal method will be announced in class.
- Please name homework as follows: LASTNAME_Initial-HW#.pdf. (i.e., Hooks_S-HW1.pdf).

Supplemental Syllabus: See https://ung.edu/academic-affairs/policies-and-guidelines/supplemental-syllabus.php

ENVE 2222K – SURVEYING II

SAMPLE SYLLABUS:

UNG | UNIVERSITY of NORTH GEORGIA

Lewis F. Rogers Institute for Environmental and Spatial Analysis

ENVE 2222K

Surveying 2 – Spring 2019

I. GENERAL INFORMATION

Instructor's name	Steven Hooks
Office Room Number	Gainesville Campus, Science 241
Cell Phone Office Phone	912-674-8296 for emergencies only, please email.
Email address	steven.hooks@ung.edu
Office hours	F 1p-2p & 5p-6p
Meeting Room	Online & Fridays 2p-5p -- Science 257

II. TEXT AND OTHER MATERIALS

Text: Elementary Surveying, 15th Edition. Ghilani, Charles D.
ISBN 13:978-0-13-460465-7
YOU MUST BE ABLE TO ACCESS SUPPLEMENTAL MATERIALS ONLINE INCLUDING VIDEOS AND WOLFPACK

Other Materials: Field notebook (provided), scientific calculator, sunscreen, Engineering scale, & Protractor

III. COURSE DESCRIPTION

This course covers basic construction and route surveying concepts and computations, including horizontal and vertical curves and volumetric measurements. Emphasis is placed on automated data collection methods using total stations and GNSS equipment. Students will also be introduced to adjustments by least squares, basic photogrammetric methods and geographic information systems (GIS).

IV. COURSE OBJECTIVES (EXPECTED OUTCOMES)

Upon completion of this course, students should be able to:

- Define and explain common surveying terms and concepts
- Perform and draw a basic mapping survey
- Compute horizontal and vertical curves
- Perform a basic least squares adjustment
- Assist with the performance of a boundary survey
- Discuss the Public Lands Survey System (PLSS)
- Operate a total station and measure horizontal and vertical angles
- Perform some 'stake out' functions and calculate elementary construction layout
- Recognize methods for performing volumetric calculations and compute simple volumes.
- Exhibit familiarity with terms and concepts of geographic information systems (GIS)

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V. COURSE CALENDAR (subject to revision at the discretion of the instructor)
There will be assignments and quizzes posted in each module.

Module	Week of	Online content description	Lab	Reading
1	7-Jan	Introduction, Syllabus & Expectations	Lab Expectations, Safety, Equipment handling	Ch 15
2	14-Jan	Kinematic GNSS - Ch 15	Kinematic GNSS Lab - Field	Ch 16
3	21-Jan	Least Squares - Ch 16	Least Squares Lab - Inside	Ch 17
4	28-Jan	Mapping Surveys - Ch 17	Mapping/Topo Lab - Field	Ch 18
5	4-Feb	Mapping - Ch 18	Mapping/Topo - Inside	Ch 19
6	11-Feb	Control Surveys - Ch 19	Control Survey - Field	Ch 20
7	18-Feb	Projections & State Plane - Ch 20	Reduction/Conversion - Inside	Ch 21
8	25-Feb	Boundary Surveys - Ch 21	Boundary Data - Field	Ch 22
9	4-Mar	PLSS - Ch 22	EXAM	Ch 23
	11-Mar	SPRING	BREAK	
10	18-Mar	Construction Surveys	Staking - Field	Ch 24
11	25-Mar	Horizontal Curves - Ch 24	Curves & Stationing - Inside	Ch 25
12	1-Apr	Vertical Curves - Ch 25	Topo/Scan - Field	Ch 26
13	8-Apr	Volumes - Ch 26	Volume Calcs- Inside	Ch 27
14	15-Apr	Photogrammetry - Ch 27	UAS or Scan - Field	Ch 28
15	22-Apr	GIS Intro - Ch 28	REVIEW	
16	29-Apr	FINALS	WEEK!	

SEE https://ung.edu/academics/academic-calendars/index.php for other important dates

VI. COURSE GRADING

The grades tool in D2L will be utilized to keep a record of your grade. You may review your progress at any time. The breakdown of each of the components of the grading is as follows:

Item	Weight	
Attendance, Participation & Discussions	20%	This includes assignments that must be submitted via d2L each week.
Quizzes	15%	
Exam	15%	
Labs	30%	
Review Attendance	5%	
Final	15%	
	100%	

VII. COURSE POLICIES

Attendance Policy: Punctuality and attendance are expected for the online component and labs. It is the student's responsibility to promptly make up excused missed work. Tests or quizzes missed without written documentation of an emergency will result in a zero grade. Emergencies are deaths, severe illnesses, or accidents. Emergencies do not include vacations, work, or your own lack of preparation and planning.

Final Exam: It is your responsibility to be aware of the date and time of the final exam for the class and plan accordingly. See https://ung.edu/academic-affairs/final-exam-schedules.php

Homework and assignment Submittal Information

- All Review & Follow-up sessions are mandatory.
- Please submit all assignments typed and as a single PDF file using d2l. If work can be handwritten, it will be noted in the instructions. Otherwise, ten points will be deducted for failure to submit single, typed files.
- Late assignments will not be graded.
- **The Mandatory Attendance Quiz and the Required Introduction Discussion** must be completed within the first week of the semester for online classes. Students who do not complete these two items will be reported to the Registrar for non-attendance and may be dropped from the course.
- Please complete weekly readings by Friday. As indicated by the reading schedule, it is expected that you read the material the week prior to the online presentation. There will be assessments included in the online materials.
- Discussions are how attendance and participation are monitored in online classes. You may work ahead and complete discussions early, but you may not complete discussions late. Reminders for due dates for discussion posts are in the course calendar and discussions will disappear when no longer available.
- Calendar is subject to change. Please check D2L and your UNG email for due dates and announcements regarding class changes.
- UNG has an app you can download to your smart device and access D2L to complete assignments and discussions on the go. I do not recommend taking quizzes or exams on your smart device due to screen size.

VIII. SUPPLEMENTAL SYLLABUS

VIII. Supplemental Syllabus: See https://ung.edu/academic-affairs/policies-and-guidelines/supplemental-syllabus.php

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ENVE 3465 – LEGAL ASPECTS OF SURVEYING

SAMPLE SYLLABUS:

UNG | UNIVERSITY of NORTH GEORGIA

Lewis F. Rogers Institute for Environmental and Spatial Analysis

ENVE 3465
Legal Aspects of Surveying
Fall 2019

I. GENERAL INFORMATION

Instructor's name	Doug Sherrill
Office Room Number	241
Cell Phone Office Phone	706-525-9496
Email address	doug.sherrill@ung.edu
Office hours	3:00-5:30 TR
Meeting Room	262/257

II. TEXT AND OTHER MATERIALS

Text:

Evidence and Procedures for Boundary Location, 6th Edition. Robillard, W., Wilson, D. and Brown, C.
ISBN 978-0-470-40478-2

Other Materials: Graph paper/notebook, scientific calculator

III. COURSE DESCRIPTION

This introductory course covers land surveyor ethics and professional responsibility, the creation of Georgia property statutes, real property law, real and record evidence, records research, conveyances, recording systems, the public domain, eminent domain, legal aspects of boundary establishment, unwritten title, easements, prescription, water boundaries and surveying plans.

IV. COURSE OBJECTIVES (EXPECTED OUTCOMES)

"A good decision is based on knowledge and not numbers." Plato

Upon completion of this course, students should be able to:

- Define and discuss the History of Land Surveying
- Define and discuss the Boundary Survey
- Understand Types of Evidence
- Understand the Value and Priorities of Evidence
- Understand how to Record and Preserve Evidence
- Prepare research for completing a Boundary Survey
- Determine the Procedures for Preparing and Completing a Boundary Survey
- Define Land Ownership and Title
- Read and Write Legal Descriptions

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- Read and interpret Right-of-way plans
- Define and Determine Various Types of Easements
- Define and Understand Various Errors and their Causes
- Understand, Define and Recognize Professional Liability
- Discuss and interpret various case law regarding Boundary Issues
- Understand the relationship between the Surveyor and the Law
- Define and understand the laws of Georgia as it relates to Surveying

As a result of your experiences at the University of North Georgia, and this class, students will be able to:

- Demonstrate effective reading comprehension and writing, exploring the implications of ideas.
- Demonstrate the problem-solving ability to apply mathematical methods to comprehend, interpret, and communicate quantitative information.
- Analyze political, cultural, or socioeconomic interactions among people or organizations of the world.
- Analyze forms of expression that reflect individual, social, and cultural values.
- Apply principles of scientific method and mathematical techniques to the analysis of the natural or physical world.
- Analyze the complexity of human behavior as a function of the commonality and diversity within or between groups.
- Analyze the interaction between culture and history or politics in the United States.
- Identify, analyze, evaluate and synthesize information to make inferences, support ideas, or solve problems.

Outline of the Course – Topics Overview

I. The Nature of Evidence – Chapter 2
II. The Evidence of Words – Chapter 3
III. Evidence and Technology – Chapter 4
IV. Species of Evidence Chapter 5
    a. Plat of Survey
    b. Monuments
V. Measurements as Evidence – Chapter 6
VI. Plats as Evidence – Chapter 7
VII. Evidence of Water Boundaries – Chapter 8
VIII. History as Evidence – Chapter 9
IX. Preserving Evidence – Chapter 10
X. Procedures for Locating Boundaries – Chapter 11
XI. Original Surveys – Chapter 12
XII. Unwritten Rights – Chapter 13
XIII. Land Title – Chapter 14
XIV. The Deed – Chapter 15
XV. The Professional Surveyor
    a. Liability – Chapter 16
    b. Stature – Chapter 17
    c. Qualifications – Chapter 18
    d. Relationship to the Courts – Chapter 19

V. COURSE CALENDAR (*subject to revision at the discretion of the instructor)

Week	Dates	Day 1	Day 2
1/2	Aug 20/ Aug 22 Aug 27/ Aug 29	Syllabus / Introductions	Ch. 1 – History of Boundaries History Continued
2	Sept 3/ Sept 5	Ch. 2 – The Nature of Evidence	Ch. 2 – The Nature of Evidence
Discussion Board 1 – The Nature of Evidence – Due Sunday Sept 8 by Midnight			
3	Sept 10/ Sept 12	Ch. 3 – The Evidence of Words	Ch. 3 – The Evidence of Words
Quiz 1 – Vocabulary			
4	Sept 17 / Sept 19	Ch. 4/5 - Tech/Species of Evidence	Ch. 4/5 – Tech/Species of Evidence
Discussion Board 2 – Species of Evidence – Due by Sunday Sept 22 Midnight			
5	Sept 24 / Sept 26	Ch. 6 – Measurements as Evidence	Ch. 6 – Measurements as Evidence
Discussion Board 3 – Measurements as Evidence – Due by Sunday Sept 29 Midnight			
6	Oct 1 / Oct 3	Ch. 7 – Plats as Evidence	Ch. 7 – Plats as Evidence
7	Oct 8 / Oct 10	Library Research	Library Research
Discussion Board 4 – Plats as Evidence – Due by Sunday Oct 13 Midnight			
8	Oct 15 / Oct 17	Ch. 8/9 Water boundaries/History as Evidence	Ch. 9 – History as Evidence
Quiz 2 – Vocabulary			
9	Oct 22 / Oct 24	Ch. 10 – Preserving Evidence	Ch. 10 – Preserving Evidence
Paper 1 Due Sunday by Midnight – The History of Surveying			
10	Oct 29 / Oct 31	Ch. 11 – Procedures for Locating Boundaries	Ch. 11 Procedures for Locating Boundaries
11	Nov 5 / Nov 7	Ch. 12 – Original Surveys	Ch. 12 – Original Surveys
Quiz 3 - Vocabulary			
12	Nov 12 / Nov 14	Ch. 13 – Unwritten Rights	Ch. 13 – Unwritten Rights
Discussion Board 5 – Procedures for Locating Boundaries – Due by Sunday Nov 17 Midnight			
13	Nov 19 / Nov 21	Ch. 14/15 – Land Title/The Deed	Ch. 15 – The Deed
Quiz 4 - Vocabulary			
14	**Nov 26 / Nov 28**	**FALL BREAK**	**FALL BREAK**
Paper 2 – Case Law Paper - Due by Sunday Midnight – December 1			
15	Dec 3 / Dec 5	Ch. 16/17 – Liability and Stature	Ch. 18/19 – Qualifications/Relationship to law
16	**Dec 12**		**Final Exam**

Important dates

Refer to this link (https://ung.edu/academics/academic-calendars/index.php) for other important dates

Final Exam will be held on THURSDAY DECEMBER 12 from 5:30 – 7:30 PM.

There will be no change or alternative date for this exam so be present.

VI. COURSE GRADING

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*You are solely responsible for the grade that you earn in this class.

Assessment of Student Outcomes

I will assess outcomes through the evaluation of 4 quizzes, 5 Discussion Boards, 2 papers, class participation and the final exam.

Category Assessment	Points Each	Total Points Possible
Attendance/Participation	100 pts	100
Quizzes (4)	25 pts	100
Discussion Board (5)	50 pts	250
Paper 1	100 pts	100
Paper 2	100 pts	100
Final Exam	100 pts	100
Total Course Pts		800

VII. COURSE POLICIES

- **Attendance Policy: REGULAR CLASS ATTENDANCE IS MANDATORY**. 5 points will be deducted for each absence from the attendance category. The responsibility of promptly making up work missed because of absences rests entirely with the student. In addition, if you are late for class, you will more than likely find yourself unable to catch up, so be in class on time. **Any assignment/discussion/paper missed or late without written documentation of an emergency will result in a zero**. Emergencies are deaths, or severe illnesses or accidents. Emergencies are ***NOT*** family vacations, work, your own lack of preparation and planning

- **Dropping the Class:** If you need or want to drop the class either prior to midterm or after midterm, it is your responsibility to fill out the appropriate form (s). Failure to do so will result in an F for the course.

- **Withdrawals:** Withdrawal from the class will not necessarily result in a grade of "W". Factors such as absences, grades, attendance, etc., are taken into consideration and if merited, a "WF" may be awarded.

- **Academic Honesty:** All students are responsible for maintaining the highest standards of honesty and integrity in every phase of their academic careers. The penalties for academic dishonesty are severe and ignorance is not an acceptable defense.

- **Extra Credit:** I do not give students extra credit outside of the class assignments.

- **Final Exam:** It is your responsibility to be aware of the date and time of the final exam for the class and plan accordingly. I will not make accommodations for students to take the exam at any time other than the exam time scheduled by UNG.

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ENVS 2111K – Physical Environmental Science

SAMPLE SYLLABUS:

Institute of Environmental Spatial Analysis
ENVS 2111K
Physical Environmental Science 1

I. GENERAL INFORMATION

Instructor's name	
Office Room Number	
Office Phone **Cell Phone**	
Email address	
Office hours	

II. TEXT AND OTHER MATERIALS

1) **Required**: Miller, G. T., & Spoolman, S., *Environmental Science*, 16th Edition, Cengage Learning.
2) Introduction to Hydrology (Fifth Edition), by W. Viessman, Jr. and G. L. Lewis (ISBN: 0-67-399337-x) - OPTIONAL
3) Hillel, D. (2012). *Soil and water: physical principles and processes*. Elsevier. (ISBN: 9780323156707) - **Optional**
4) Materials: USB Storage Drive; a three ring binder for Laboratory Reports; a field logbook

III. COURSE DESCRIPTION

This course will focus on a fundamental understanding of water resources, soil science and basic environmental chemistry. Science concepts including the physical, chemical, and biological properties of soil and water will be instructed. Water resources, water properties and basic soil science topics including soil formation and morphology, weathering, soil texture and structure, soil classification, soil quality and pollution, soil chemical and biological properties, monitoring and remediation methods will be addressed. Introductory hydrology including the hydrologic cycle, hydrologic budget, watershed dynamics, and coastal waters will be instructed. Students will be introduced to surface and subsurface hydrology, soil water interactions, saturated and unsaturated flows in soils, soil erosion, and soil and water conservation.

IV. COURSE OBJECTIVES, EXPECTED OUTCOMES, ASSESSMENT

The mission of University of North Georgia is to further the well-being of students by providing a culture of academic excellence in a student-focused environment that includes quality education, service, inquiry and creativity. This is accomplished through broad access to comprehensive academic and co-curricular programs that develop students into leaders for a diverse and global society.

This course contributes to this mission by:

- providing a course as part of a UNG degree program or transfer program
- enhancing the science and technological skills of the student
- providing students the opportunity to participate effectively in groups engaged in the identification, exploration, and solution of scientific problems
- developing student knowledge of systematic methods of inquiry and applying those principles and procedures to investigate scientific problems.

Individual Course Objectives:

Objective 1: Understand basic scientific knowledge of water and soil properties, resources and conservation.
Objective 2: Understand the hydrologic cycle, surface, subsurface and coastal hydrology.
Objective 3: Understand fundamental environmental chemistry including soil, water and air quality issues and the impact on humans and the natural world.

Expected Student Outcomes. The student will:

- Demonstrate knowledge of basic soil, water and hydrologic science.
- Demonstrate basic knowledge of conservation, environmental chemistry and pollution.
- Perform hands-on environmental laboratory and field assignments.
- Develop the ability to work individually and when applicable as a team to analyze water, soil and hydrologic phenomenon.

Assessment of Student Outcomes

Expected outcomes will be assessed though evaluations of class and lab assignments, tests and quizzes. Each student will develop laboratory reports related to lecture topics. Students will develop a semester (class project) report/project//presentation on a topic related to the course.

V. COURSE CALENDAR

Week	Lecture	Practical	Evaluation Item/Objective
Week 1 Objective 1	WATER: ✓ Water's Importance and Unique Physical Properties ✓ The Water Cycle ✓ Water Resources ▪ Use, Supply, and Renewal	USGS Video on Water to review (https://www.usgs.gov/media/videos/drought-drinking-water-and-natural-environments)	Assignment/Report
Week 2 Objective 1	WATER: ✓ Water's Chemistry ✓ Water Conservation	Field Lab to collect water samples. Test samples	Field Lab/Report
Week 3 Objective 1	HYDROLOGY: ✓ Surface Water ▪ Watersheds/Drainage Basins ▪ Surface Runoff, Wetlands, Streams, Lakes, Ice Caps ▪ Flooding	Georgia HUC (Hydrologic Unit Code) based drainage basin analysis through the use of maps.	**Quiz # 1** Assignment/Report
Week 4 Objective 1	HYDROLOGY: ✓ Groundwater ▪ Zone of Saturation, Water-table, Aquifers	Field Lab to investigate campus ground water wells, review water table in different topography, soil type, and land uses.	Field Lab
Week 5 Objective 1	HYDROLOGY: ✓ Saline Water ▪ Oceans, Global Warming, Sea-level Rise ▪ Bays and Estuaries etc., Salt Water Intrusion	DEMO exercises on sea level rise.	Assignment/Report

Week 6 Objective 1	HYDROLOGY: ✓ Hydrology & Human Constructions ▪ Flooding, Coastal Erosion, Mitigation		**Quiz # 2**
Week 7	**Course Review & MID-TERM**		
Week 8 Objective 2	SOIL: ✓ Geologic Processes ✓ The Rock Cycle, Mineral and Soil Resources ▪ Soil Formation ✓ Environmental Effects of Mining and Extracting Mineral Resources ▪ Renewable versus Nonrenewable Mineral Resources	Review and analysis of STATSGO and SSURGO data using maps.	Assignment/Report
Week 9 Objective 2	SOIL: ✓ The Base of Life ▪ Composition ▪ Properties: Physical, Biological, Chemical ▪ Constituents and Classification ✓ Soil Erosion and Degradation	Use the Web Soil Survey web site to examine personal property soil type and make an online map.	Assignment/Report
Week 10 Objective 2	SOIL: ✓ Soil Erosion and Degradation		**Quiz # 3**
Week 11 Objective 2	SOIL: ✓ Soil Conservation and Erosion Control	Field visit to examine campus soil and water conservation projects.	Field Lab/Report
Week 12 Objective 3	AIR CONTAMINATION: ✓ The Atmosphere ✓ Outdoor Air Pollution ▪ Pollutants, Smog, Acid Deposition ✓ Indoor Air Pollution	Review and report on air-quality issues (https://www.epa.gov/ air-quality--data-and-tools)	**Quiz # 4** Assignment/Report
Week 13 Objective 3	WATER CONTAMINATION: ✓ Pollution of Streams, Lakes and Oceans ✓ Groundwater Contamination	Review and report on water quality real-time data collected by USGS (National Water Information System - https://waterdata.usgs.gov/nwis)	Assignment/Report
Week 14 Objective 3	SOIL CONTAMINATION: ✓ Soil Pollution ✓ Effects of Pollution on Organisms and the Environment ✓ Mitigating Pollution	Research on Soil Contamination in Georgia.	**Quiz # 5** Assignment/Report
Week	**Course Project Presentations**		

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Final Exam Week	**FINAL**

VI. COURSE GRADING

Item	**Marks (weightage)**
Quizzes	15%
Mid Term Exam	15%
Final Exam	20%
Lab Assignments	30%
Class Project	15%
Class Participation & Interaction	5%
Total	**100%**

Students will create a lab portfolio that contains the answers to lab questions and one layout from each unit. These will be due the day of the practice test for each unit. Students will be given due dates for all assignments in class and lab. Late assignments will result in a 15 point deduction per class day. Once papers are returned to the rest of the class, however, no late work will be accepted. Projects may not be turned in late, without prior permission of instructor.

Important Dates: http://ung.edu/academics/academic-calendar.php

Final Exam Schedule: http://ung.edu/academic-affairs/final-exam-schedules.php

VII. Additional Information

ACADEMIC SUCCESS PLAN PROGRAM
UNG has implemented an Academic Success Plan Program to identify and provide assistance to at-risk students. Refer you to your campus Academic Advising Center for the development of strategies that will enhance your academic success. You will be expected to take advantage of advising and other campus resources to achieve your academic goals.

STUDENTS WITH DISABILITIES
University of North Georgia is committed to equal access to its programs, services, and activities, and welcomes otherwise qualified students with disabilities. Students who require accommodations and services must register with Disability Services and submit supporting documentation. Disability Services provides accommodation memos for eligible students to give to their instructors. Students are responsible for making arrangements with instructors, and must give reasonable prior notice of the need for accommodation.

Contact Information for Disability Services:

- Gainesville Campus: Carolyn Swindle, Assistant Director, carolyn.swindle@ung.edu, Dunlap-Mathis Building, Room 107, 678-717-3855

ENVS 2112K – ENVIRONMENTAL MANAGEMENT & SUSTAINABILITY

SAMPLE SYLLABUS:

UNG | UNIVERSITY of NORTH GEORGIA

Institute of Environmental & Spatial Analysis
ENVS 2112K
Environmental Management & Sustainability

I. GENERAL INFORMATION

Instructor	
Office Room Number	
Office Phone **Cell Phone**	
Email	
Office Hours	

II. TEXT AND OTHER MATERIALS

- **Required:** Miller, G. T., & Spoolman, S., Environmental Science. 16th edition, Cengage Learning.
- Environmental Land Use Planning and Management, by John Randolph; ISBN # 1559639482; 9781559639484 - **Optional**
- Materials: USB storage drive, a three ring binder for laboratory reports and a field logbook.

III. COURSE DESCRIPTION

This course will focus on fundamental scientific understanding and importance of sustainability, resource degradation, land-use types, environmental science, and procedures necessary for sustainable land-use and management. Topics include mountain, prairie, coastal, desert, and wetland ecosystems etc., ecological integrity, land-use attribute quantification, land use forecasting, soil and hydrologic map understanding for scientific management and decision support, simulations of water, land-use and soil parameters for suitable and sustainable development. Students will consider sustainability, planning, and land use analysis and planning as a systematic scientific assessment of physical, social and economic factors.

IV. COURSE OBJECTIVES, EXPECTED OUTCOMES, ASSESSMENT

The mission of University of North Georgia is to further the well-being of students by providing a culture of academic excellence in a student-focused environment that includes quality education, service, inquiry and creativity. This is accomplished through broad access to comprehensive academic and co-curricular programs that develop students into leaders for a diverse and global society.

This course contributes to this mission by:

- providing a course as part of a UNG degree program or transfer program
- enhancing the science and technological skills of the student
- providing students the opportunity to participate effectively in groups engaged in the identification, exploration, and solution of scientific problems
- developing student knowledge of systematic methods of inquiry and applying those principles and procedures to investigate scientific problems.

Individual Course Objectives:

Objective 1: Understand the earth ecosystems and their management through studies of biomes, land use changes, and human impacts on ecosystems
Objective 2: Understand basic environmental science of land use, land cover characteristics of the earth, impacts of land use changes, sustainability of earth's environmental resources for better management decisions
Objective 2: Understand the impact of human development on environmental sustainability and develop skills to create decision support of sustainable environmental management practices within a changing global climate.

Expected Student Outcomes. The student will:

- Demonstrate knowledge of environmental science and the earth ecosystems
- Analyze, compare and cognize environmental management and sustainability through acquired knowledge of land use conservation and management
- Perform hands-on environmental laboratory and field assignments
- Describe scientifically the impact of human development on the natural world
- Develop the ability to work individually and when applicable as a team to develop environmental planning and land use analysis, conservation, and ecosystems management knowledge.

Assessment of Student Outcomes

Expected outcomes will be assessed though evaluations of class and lab assignments, tests and quizzes. Each student will develop laboratory reports related to lecture topics. Students will develop a semester (class project) report/project//presentation on a topic related to the course.

V. COURSE CALENDAR

Week	Lecture	Lab	Evaluation Item
Week 1 (Objective 1)	ECOSYSTEMS MANAGEMENT: ✓ Biomes ▪ Types ▪ Climate and Plant Life		
Week 2 (Objective 1)	ECOSYSTEMS MANAGEMENT: ✓ Human Impacts on Ecosystems ▪ Population Distribution & Urban Growth ▪ Urban Resource and Environmental Problems ▪ Transportation & Urban Development	Investigate the global population increase and distribution and the subsequent land use degradation using maps and their interpretation.	Assignment/Report
Week 3 (Objective 2)	LANDUSE, CONSERVATION & ENVIRONMENTAL MANAGEMENT: ✓ Land use/Land cover basics ✓ Importance of land use in environmental management		**Quiz # 1**
Week 4 (Objective 2)	LANDUSE, CONSERVATION & ENVIRONMENTAL MANAGEMENT:	Download NLCD data and analyze.	Assignment/Report

	✓National Land Cover Dataset (NLCD) ✓State land use characterization ✓Levels of Land use classes		
Week 5 (Objective 2)	LANDUSE, CONSERVATION & ENVIRONMENTAL MANAGEMENT: ✓Landuse change analysis and impact on earth sustainability	Perform land use change analysis.	Assignment/Report
Week 6 (Objective 2)	LANDUSE, CONSERVATION & ENVIRONMENTAL MANAGEMENT: ✓Sustaining Ecosystems ✓Biodiversity & Ecological Integrity ✓Managing & Sustaining Forest, Rangelands & Wilderness ✓Resources & Management ✓Public Lands		**Quiz # 2**
Week 7 (Objective 2)	LANDUSE, CONSERVATION & ENVIRONMENTAL MANAGEMENT: ✓Sustaining Agriculture ✓Public Lands	Explain crop production in Georgia using the (https://nassgeodata.gmu.edu/CropScape/) CROPSCAPE site.	Assignment/Report
Week 8 (Objective 3)	ENVIRONMENTAL PLANNING: ✓What is environmental planning ✓Approaches to planning ✓Planning process ✓Land-use and soil conservation planning for environmental management	Exercise on environmental planning.	Assignment/Report
Week 9	**Review for Midterm & Midterm**		
Week 10 (Objective 3)	WORLDVIEWS, MANAGEMENT ETHICS AND SUSTAINABILITY: ✓Environmental Management Worldviews ✓Life-centered and Earth-centered Views	Exercise: Worldview Assessment.	Assignment/Report
Week 11 (Objective 3)	WORLDVIEWS, MANAGEMENT ETHICS AND SUSTAINABILITY: ✓ Living Sustainably ▪ Environmental & Resource Problems ▪ Is our Current Path Sustainable? ▪ Matter & Energy Laws ▪ Systems and Models of Systems ▪ Life & Earth's Life-support Systems	Review of U.S. Clean Water Act (https://www.epa.gov/laws-regulations/summary-clean-water-act)	Assignment/Report
Week 12 (Objective 3)	ENVIRONMENTAL MANAGEMENT POLITICAL & ECONOMIC SCIENCE: ✓ Economic Systems & Environmental	Review an article related to Environmental Science that is affected by policy and politics. Develop a summary	**Quiz # 3** Course Project Assignment and

	Problems ✓ Growth & Costs ✓ Politics & Environmental Policy ✓ Risk Assessment	report.	Development
Week 13 (Objective 3)	ENVIRONMENTAL IMPACT ANALYSIS: ✓ Land management ✓ Deforestation ✓ Urban Sprawl	Field Lab: Green Hydrologic Structures.	Field Lab Assignment/Report
Week 14 (Objective 3)	ENVIRONMENTAL MANAGEMENT DECISION SUPPORT SYSTEM DEVELOPMENT		Quiz # 4
Week 15	**Course Project Presentations**		
Final Exam Week	**FINAL**		

Note: This syllabus may be adjusted if deemed necessary by the instructor. For example, the course calendar and lecture topics are subject to change with notice. It is your responsibility to remain informed of any adjustments made regarding work in this course.

VI. COURSE GRADING AND IMPORTANT DATES

Quizzes	15%
Mid Term Exam	15%
Final Exam	20%
Lab Assignments	30%
Class Project	15%
Class Participation & Interaction	5%
Total	**100%**

Important Dates: http://ung.edu/academics/academic-calendar.php

Final Exam Schedule: http://ung.edu/academic-affairs/final-exam-schedules.php

VII. Additional Information

ACADEMIC SUCCESS PLAN PROGRAM
UNG has implemented an Academic Success Plan Program to identify and provide assistance to at-risk students. Refer you to your campus Academic Advising Center for the development of strategies that will enhance your academic success. You will be expected to take advantage of advising and other campus resources to achieve your academic goals.

STUDENTS WITH DISABILITIES

University of North Georgia is committed to equal access to its programs, services, and activities, and welcomes otherwise qualified students with disabilities. Students who require accommodations and services must register with Disability Services and submit supporting documentation. Disability Services provides accommodation memos for eligible students to give to their instructors. Students are responsible for making arrangements with instructors, and must give reasonable prior notice of the need for accommodation.

Contact Information for Disability Services:

- Gainesville Campus: Carolyn Swindle, Assistant Director, carolyn.swindle@ung.edu, Dunlap-Mathis Building, Room 107, 678-717-3855
- Dahlonega Campus: Thomas McCoy, Assistant Director, thomas.mccoy@ung.edu, Stewart Student Success Center, Room 313, 706-867-2782
- Oconee Campus: Erin Williams, Assistant Director, erin.williams@ung.edu, Administration Building, Room 112, 706-310-6202
- Cumming Instructional Site: Nicola Dovey, Director nicola.dovery@ung.edu or Beth Bellamy, Test Facilitator, beth.bellamy@ung.edu 678-717-3855. (For on-site assistance, contact Rebecca Rose, Head Librarian, rebecca.rose@ung.edu, Library University Center 400, 470239-3119.

ACADEMIC INTEGRITY POLICY
Student Code of Conduct: Please review the Student Code of Conduct found here: http://ung.edu/student-affairs/student-code-of-conduct.php

Plagiarism and Turnitin.com: Students agree that by taking this course all required papers may be subject to submission for textual similarity review to Turnitin.com for the detection of plagiarism. All submitted papers will be included as source documents in the Turnitin.com reference database solely for the purpose of detecting plagiarism of such papers. Use of the Turnitin.com service is subject to the Terms and Conditions of Use posted on the Turnitin.com site.

Copyright: Both Federal and State laws forbid the unlawful duplication of copyrighted computer software or other reproductions of copyrighted material. In accordance with these policies, University of North Georgia expressly forbids the copying of such materials supplied by or used in the College. Unlawful duplication of copyrighted materials by a user may result in disciplinary action by the College under the Student Code of Conduct (Non-Academic Infractions--Prohibitions, Theft), and/or possible criminal action by the owner of the copyright.

DISRUPTIVE BEHAVIOR POLICY
Students who exhibit behaviors that are considered to obstruct or disrupt the class or its learning activities are subject to sanctions under the Board of Regents Policy on Disruptive Behavior. Behaviors which may be considered to be inappropriate in this classroom includes, but is not limited to, sleeping, coming in late, talking out of turn, inappropriate use of laptops or mobile devices, verbal behavior that is disrespectful of other students or the faculty member, or other behaviors that may be disruptive. Students who exhibit such behavior may be temporarily dismissed from the class by the instructor and will be subject to disciplinary procedures outlined in the Student Handbook.

CLASS EVALUATIONS
Class evaluations at UNG are conducted online. Evaluation of the class is considered a component of the course and students will not be permitted to access their course grade until the evaluation has been completed. The evaluations will be accessible beginning one week prior to Final Exam week.

ACADEMIC EXCHANGE
Universities welcome diversity, free speech and the free exchange of ideas. Discussion should be held in an environment characterized by openness, tolerance of differences and civility. The values of an

intellectual community are trust, honesty, free inquiry, open debate, respect for diversity, and respect for others' convictions. Further, the intellectual community always seeks to foster the virtues and characteristics of intelligence, curiosity, discipline, creativity, integrity, clear expression and the desire to learn from others. It is these that must guide our work and exchanges in this class. These principles are delineated further in the ACE Statement on Academic Rights and Responsibilities.

If these values and principles are breached, students have the right and responsibility to discuss their concerns with the course instructor and, as needed, the department head. Usually, the concerns are addressed at this level, but sometimes the department head may refer students to another resource. In the event that either the student or the instructor is not satisfied after discussion with each other, he/she may take his/her concerns in writing to the Associate Provost for Academic Administration.

INCLEMENT WEATHER
TV and radio stations will announce if the college is closed. Information on closing will also be available on our Web site http://www.ung.edu. Students, faculty and staff who have registered under Blackboard Connect Emergency Notification System will receive information not only about college and individual campus closures but also about the status of college and campus hours, including late openings.

Blackboard Connect Emergency Notification System

Emergency situations - from natural disasters to health scares to the threats of violence - require that our campus community be fully prepared and informed. Accordingly, University of North Georgia has implemented the Blackboard Connect service to enhance university communication and emergency preparedness. The Blackboard Connect system is a communication service that enables key administrators and Public Safety personnel to quickly provide all students, faculty, and staff with personalized voice and text messages.

All UNG emails are added into the system automatically. In addition, you may enter a phone number so that emergency announcements can be sent to you via voice and text message. To do this, go to our Banner self-service environment; click on the tab labeled "Personal Information"; then, click on the tab named "Enter Emergency Contacts for Blackboard Connect." Here you can update your information for the Blackboard system.

If you have questions, please contact Public Safety at 706-864-1500 or send an e-mail to emeralert@ung.edu.

SMOKING POLICY
UNG is a tobacco-free environment. Tobacco use is prohibited on campus—both indoors and outdoors—does not allow the use of any tobacco products in the buildings or on the grounds of the institution. At Dahlonega, there are a few designated smoking areas located outdoors in the periphery of the campus.

COURSE GRADES AND WITHDRAWAL PROCESS
Grades: A, B, C, D, F, W, WF, MW – Should this date be listed at the end of this section?

Incomplete grades (I) - This grade indicates that a student was doing satisfactory work but, for non-academic reasons beyond her/his control, was unable to meet the full requirements of the course. For undergraduate programs, if an I is not satisfactorily removed after one semester (excluding summer), the symbol of I will be changed to the grade of F by the appropriate official. For graduate programs, if an I is not satisfactorily removed after two semester (excluding summer), the symbol of I will be changed to the grade of F by the appropriate official. Under special circumstances, this period of time can be increased with the approval of the department head and the dean.

IP (In Progress) - This grade is appropriate for thesis hours, project courses, Learning Support and English as a Second Language (ESL) courses. It is not appropriate for traditional credit courses. If an IP grade isn't satisfactorily removed after 3 semesters, the symbol of IP will be changed to the grade of F by the appropriate official. Under special circumstances, this period of time can be increased with the approval of the dean. However, students who receive a grade of IP in a learning support course or an ESL will retain this grade due to the nature of the course.

K - This symbol indicates that a student was given credit for the course via a credit by examination program.

MW – Withdrawal for military exigencies

CR – Credit (for Military experience)

NR - This symbol indicates that the grade was not reported by the instructor.

S- This symbol indicates that a student completed the course with satisfactory work.

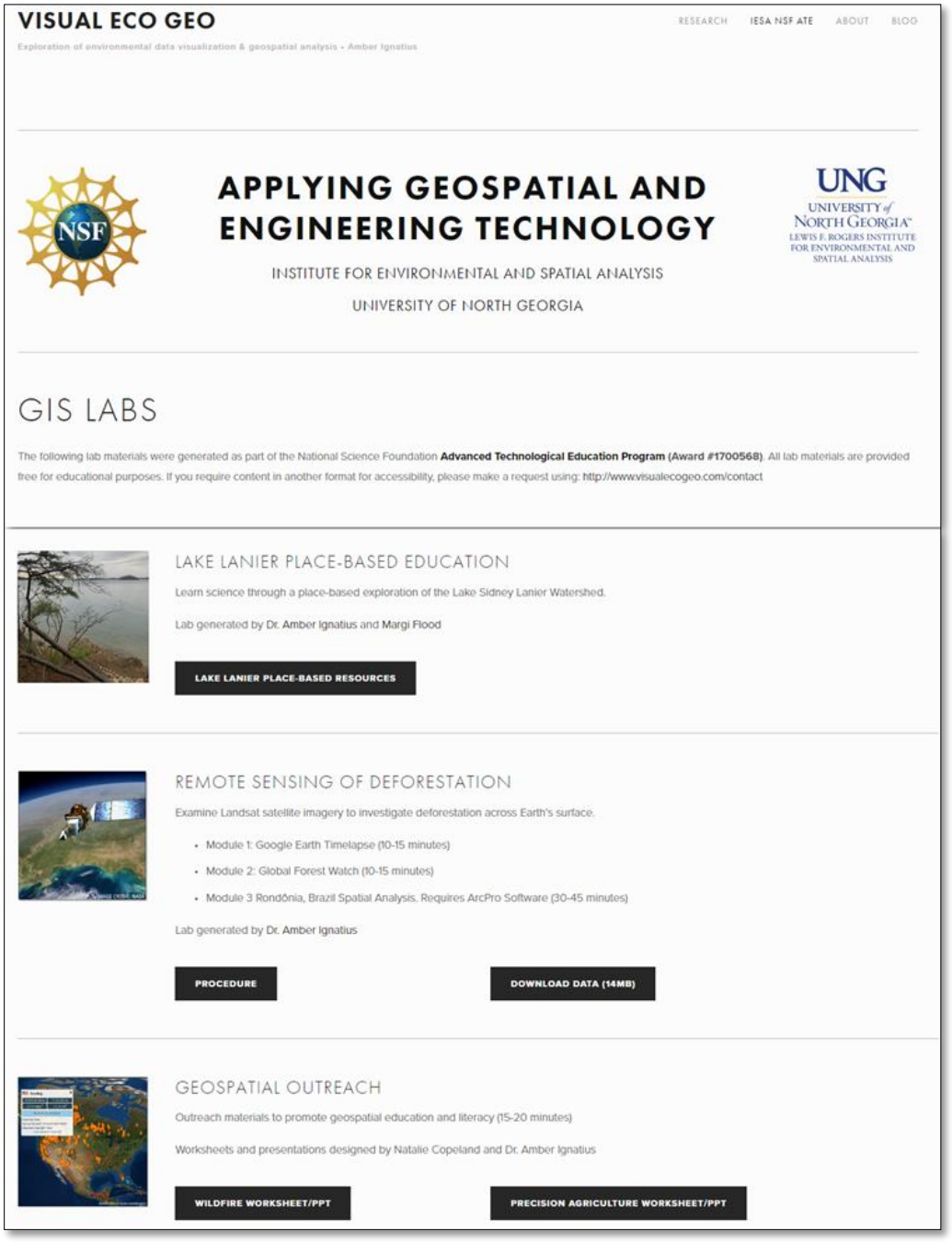
U- This symbol indicates that a student did not complete the course with satisfactory work.

V - This symbol indicates that a student was given permission to audit the course. Students may not transfer from audit to credit status or vice versa. If an audit student withdraws from a course prior to the end of the term, a "W" will be assigned as the grade rather than a grade of "V." An audit student who is dropped by the instructor for excessive absences will be assigned a grade of "W."

W or WF – A W grade indicates that a student was permitted to withdraw from without academic penalty. Students may withdraw from courses prior to the midterm and receive a grade of W. Withdrawals without penalty will not be permitted after the midpoint of the total grading period except in cases of hardship as determined by the appropriate official. If a student withdraws before the deadline, the grade of W will be given. The grade of WF is for students who withdraw after the deadline for the term or commit academic integrity violations.

AGET LAB MATERIALS

Numerous lab exercises are available at our AGET project website: http://www.visualecogeo.com/iesa-ate#/gis-labs/



HALL COUNTY LAND COVER CHANGE

Conduct Land Cover change study of Hall County using the National land Cover (NLCD) dataset of 1974 and 2011.

Requires ArcMap Software. (1hr 50 minutes)

Lab generated by Dr. Sudhanshu Panda

PROCEDURE DOWNLOAD DATA (3MB)

GA COUGAR HABITAT SUITABILITY

Identify locations suitable for cougar habitat using spatial analysis and GIS.

Requires ArcMap Software. (1hr 50 minutes)

Lab generated by Dr. Sudhanshu Panda

PROCEDURE DOWNLOAD DATA (3MB)

SOCIAL SCIENCE GIS

Analyze spatial distribution of demographic data, explore population data, and examine change over time.

- Module 1: Spatial Distribution Analysis (15 minutes)
- Module 2: Demographic Analysis (15 minutes)
- Module 3: Change Detection (15 minutes)

Lab generated by Dr. Yu Sun

PROCEDURE

DRASTIC GROUNDWATER MODEL

Determine spatial vulnerability of groundwater contamination to provide decision support on land zoning in the City of Gainesville, GA.

(1hr 50 minutes)

Lab generated by Dr. Sudhanshu Panda

PROCEDURE DOWNLOAD DATA

ENVE 2221K – SURVEYING I

SAMPLE LAB:

ENVE2221K – Fall 2021

Lab 9 – Collecting Traverse Data

Instructions

In this lab, you will use a Topcon ES series total station to conduct a closed traverse. While it is not best practice, each member of your group should have at least one instrument setup during your survey. You will take direct and reverse angles for each of your shots to insure the integrity of your survey. Plan out your survey so that your stations are relatively equidistant and so you can complete the survey with at least four setups.

Your deliverables for this lab are pictures of your field notes and an Excel file with your data (DMS converted to DD). If you are taking this course for graduate credit, you are also expected to write a short report describing your data.

This lab is **DUE** on Nov. 7th by 11:59 pm. Submit your field notes (pictures of them) and Excel file to the submission dropbox on D2L. Make sure that you use the proper naming convention as defined below.

Submission Checklist

[] – pictures of your field notes
"LASTNAME_Lab_9_fieldnotes"

[] – .xlsx of your data
"LASTNAME_Lab_9_data.xlsx"

For graduate credit, also include:

[] - .docx with your 'report'
"LASTNAME_Lab_9_CollectingTraverseData_Report.docx"

Part I – Conduct a Closed Traverse

All survey data is to be recorded in your field notebook using the suggested format (Figure 1). Remember, paper is cheap, do not scrunch. Make sure you draw a sketch of your survey and record all of the other important information. Have at least one group member take notes while the other is using the instrument. Tradeoff who is holding the prism/taking notes/using the instrument. All group members will gain experience doing all three tasks.

Instrument at BM ##					
h_i =		h_r =			
BM/TM	D/R	HA	ZA	HD	ZD
		° ' "	° ' "	ft	ft
BM##	D	0°00'00"			
TM01	D				
BM##	R				
TM01	R				
Instrument at TM01					
h_i =		h_r =			
BM/TM	D/R	HA	ZA	HD	ZD
		° ' "	° ' "	ft	ft
TM01	D	0°00'00"			
TM02	D				
TM01	R				
TM02	R				

Figure 1 – Suggested format for your field notes

Each group will be assigned a starting benchmark (BM), a backsight BM, and two ending BMs (Figure 2). First, walk from your starting BM to your ending BM to your plan your survey. When planning your survey, you want at least 4 setups to be used (so that everyone gets a chance to setup and operate the TS) and so that all of your shots (expect for the initial backsight) are relatively equidistant.

Once your survey is planned, set up on your starting benchmark. Measure the height of the instrument, and write down the height of the prism. Then, in direct mode, zero your HA on the backsight BM, measure to the prism, and record all the required data. Flip the TS into reverse mode, turn (right) back to the backsight BM, measure, and take all of the required data. Flip back to direct mode, move the prism to your first temporary mark (TM01), turn (right) to the prism, shoot in the prism, and take all of the required data. Flip to reverse mode, turn (right) to the prism, and take all of the required data.

Move the TS to TM01 and repeat the above steps (make sure you zero your HA in direct mode on your previous setup location). Take turns setting up and shooting each survey location. Be cognizant of the other groups and stay out of their line of sight. If you are not operating the instrument or holding the rod, you should be taking notes (and making sure the operator is doing everything correctly). After your survey has been completed, make sure to clean up any flagging/TMs that were set.

Part II – Data Entry

Use the Excel worksheet from D2L to enter your data. You will be converting your DMS (degrees, minutes, and seconds) to DD (decimal degrees) to make your calculations (in future labs) easier. Use formula 1 to convert DD to DMS,

$$DD = D + (M/60) + (S/3600) \quad (1)$$

Part III –Report

If you are taking this course for graduate credit, you need to write a survey report that describes what you did and why you got the answers that you did (for all portions of the lab). Make sure to insert figures, tables, graphs (as appropriate) and reference them properly (see how Figure 1 [above] was referenced in the text).

Figure 2 – Instrument ($I_{\#}$) and prism ($P_{\#}$) locations for each group. Far right prism locations should be used as the zero HA.

PROJECT IMAGES

Figure 5: Student Surveying Training

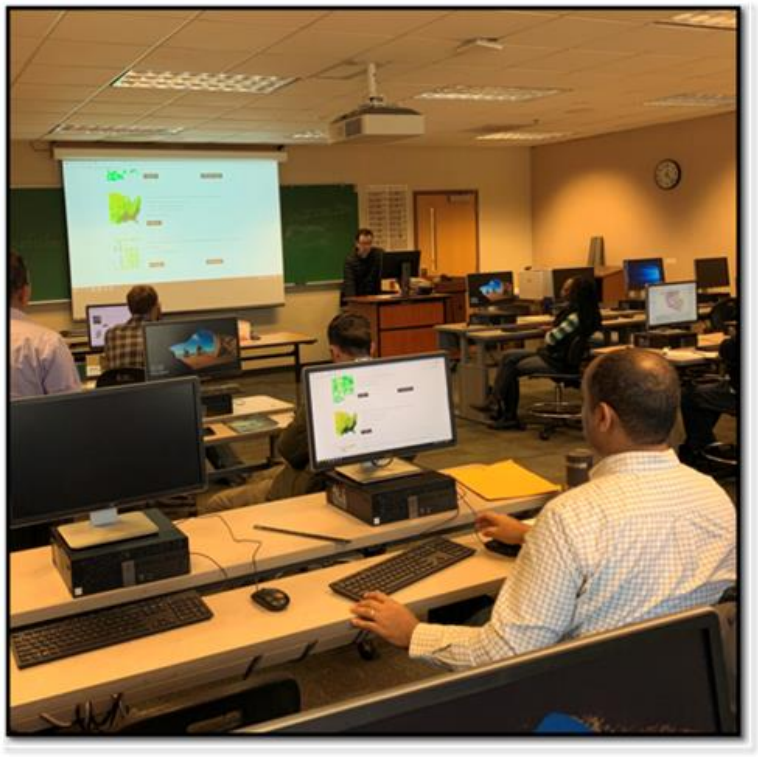


Figure 6: Faculty GIS Lab Training

Figure 7: Peer teaching of GIS lab exercises.

Figure 8: Student-led UAS drone demo.

Figure 9: Faculty outreach tabling for Geospatial and Surveying Certificate

Figure 10: Before the UNG REED Summit

PROJECT SUMMARY

The Applying Geospatial and Engineering Technology (AGET) project goal was to improve the education of engineering and science technicians at the undergraduate level by preparing students to succeed in technological professions through associate degree and certificate programs. Three measurable project objectives were attained during the 3-year project performance period. The first objective, curriculum development, was to prepare students to succeed in fast-growing technician professions, through development of two new academic programs. In support of the National Science Foundation (NSF) Advanced Technological Education (ATE) funded AGET project, an Associate of Science that includes geospatial engineering technology (GET) and associated courses with directed emphasis areas, a technician level certificate in Land Surveying and associated courses, plus two new environmental science courses were developed at the University of North Georgia's Gainesville Campus. The UNG Gainesville Campus is predominately a 2-year campus with an access mission where the majority of students are enrolled in Associate Degree programs. The development and approval of the new academic programs was accomplished early in the time line of the project increasing the academic opportunities and workforce development initiatives in the region. To facilitate strong industry related skills and support of the AGET project, an Executive Advisory Board (EAB) was formed and significantly strengthened curricular development, recruitment, implementation and dissemination efforts. Workforce development, the second project objective, was enhanced in the region through the project's curricular developments and has increased the geospatial and engineering technician workforce by way of the additional courses, certificate and degree pathway. The project provided a seamless transition from high schools and technical colleges to the above new associate degree and certificate program. Dissemination of project activities, a third objective, was achieved through various professional papers, conference presentations, and a lessons learned manual.

Completed project deliverables and outcomes include curriculum development where courses were developed leading to new stackable Associate of Science degree pathway in geospatial engineering technologies and a new technician level certificate in Land Surveying. Courses are aimed at entry-level students and build progressive steps in understanding engineering CAD, surveying, geospatial science and technology (GST), and applied skills via directed emphasis

areas for specific science and engineering technician careers. New courses developed in support of these programs included: Surveying 1, Surveying 2, Legal Aspects of Surveying, Professional Practice of Surveying, Physical Environmental Science, and Environmental Management and Sustainability. Since the project's inception, 154 students have enrolled in Surveying 1, 63 students in Surveying 2, 91 students in the Legal Aspects of Surveying, 40 students in Professional Practice of Surveying, 438 students in Physical Environmental Science, and 130 students in Environmental Sustainability and Management. The project additionally supported a redesigned Graphics and Information Visualization course that integrates CAD, GST, and surveying.

The project supported industry outreach, high school recruiting and temporary employment of new full and part-time surveying faculty members. With the success of the projects new courses and programs, the University now supports a permanent state funded Senior Lecturer of Surveying Practice position. The new position serves as the lead instructor, advisor, recruiter and promoter of the surveying program at high schools and within the surveying industry. The university also supports an additional part-time surveying faculty member.

As a result of the AGET project, additional spin off courses and credentials were developed outside of the original project goals. These include an Introductory UAS course, a Terrestrial Lidar course, an Aerial Geomatics Methods course and a graduate certificate in Geomatics. The graduate certificate consists of four new courses including graduate versions of the Legal Aspects of Surveying and Professional Practice of Surveying and graduate versions of Aerial Geomatics Methods and Terrestrial Lidar. As a result of these additional courses and credentials, a student has stackable options beginning from the technician level, to professional level and finally to graduate level coursework associated with surveying and geospatial engineering technology.

Geospatial lab exercises were supported and developed by the project and workshops were offered to faculty to facilitate implementation of lab exercises in courses and academic units outside of the academic home of the grant team. Although workshop implementation was somewhat impeded due to modality changes etc. associated with the pandemic, AGET team members were able to assist in supporting the implementation of those exercises in a variety of

courses. The geospatial course materials and lab exercises continue to be made available to faculty in other disciplines through a project web site.

In summary, the work very successfully met the original goals and expectations of the project, resulted in additional new courses and programs outside of the original goals, and met a critical workforce need in the state of Georgia by offering the required coursework necessary toward licensure as a professional land surveyor. Overall, the new courses and programs developed successfully and immediately meet workforce needs toward employment while concurrently articulating with baccalaureate degrees programs.

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