

# FLORIDA ATLANTIC UNIVERSITY™

## Graduate Programs—NEW COURSE PROPOSAL<sup>1</sup>

UGPC APPROVAL \_\_\_\_\_  
 UFS APPROVAL \_\_\_\_\_  
 SCNS SUBMITTAL \_\_\_\_\_  
 CONFIRMED \_\_\_\_\_  
 BANNER POSTED \_\_\_\_\_  
 CATALOG \_\_\_\_\_

DEPARTMENT: CIVIL, ENVIRONMENTAL AND  
 GEOMATICS ENGINEERING

COLLEGE: ENGINEERING AND COMPUTER SCIENCE

**RECOMMENDED COURSE IDENTIFICATION:**

PREFIX CEG COURSE NUMBER 5304 LAB CODE (L or C) C

(TO OBTAIN A COURSE NUMBER, CONTACT [MJENNING@FAU.EDU](mailto:MJENNING@FAU.EDU))

COMPLETE COURSE TITLE: TERRESTRIAL LASER SCANNING

**EFFECTIVE DATE**

(first term course will be offered)

CREDITS<sup>2</sup>: 3

TEXTBOOK INFORMATION: AIRBORNE AND TERRESTRIAL LASER SCANNING, HARDBACK – ISBN 9781439827987,  
 EDITOR(S): GEORGE VOSSELMAN, HANS-GERD MAAS, PUBLISHED: MARCH 5, 2010 BY CRC PRESS

GRADING (SELECT ONLY ONE GRADING OPTION): REGULAR  SATISFACTORY/UNSATISFACTORY \_\_\_\_\_

COURSE DESCRIPTION, NO MORE THAN THREE LINES: THIS COURSE GIVES AN INTRODUCTION TO APPLICATIONS OF TERRESTRIAL LASER SCANNING SYSTEMS IN GEOSCIENCES, ENGINEERING, URBAN PLANNING, FORESTRY, ARCHITECTURE, EMERGENCY PLANNING AND FORENSICS.

PREREQUISITES\*: NONE

COREQUISITES\*: NONE

REGISTRATION CONTROLS (MAJOR, COLLEGE, LEVEL)\*:

\* PREREQUISITES, COREQUISITES AND REGISTRATION CONTROLS WILL BE ENFORCED FOR ALL COURSE SECTIONS.

MINIMUM QUALIFICATIONS NEEDED TO TEACH THIS COURSE: PHD IN GEOMATICS ENGINEERING OR CLOSELY RELATED FIELD

Faculty contact, email and complete phone number:  
 Dr. Sudhagar Nagarajan.  
 Civil, Environmental and Geomatics Engineering  
 Florida Atlantic University  
 777 Glades Road, Building 36, Room 203  
 Boca Raton, FL, 33431  
 Phone: (561) 297 3104  
 E-mail: [snagarajan@fau.edu](mailto:snagarajan@fau.edu)

Please consult and list departments that might be affected by the new course and attach comments.

No other departments affected.

**Approved by:**

Department Chair: \_\_\_\_\_

College Curriculum Chair: \_\_\_\_\_

College Dean: \_\_\_\_\_

UGPC Chair: \_\_\_\_\_

Graduate College Dean: \_\_\_\_\_

UFS President: \_\_\_\_\_

Provost: \_\_\_\_\_

**Date:**

9/29/14

9/29/14

10/1/2014

10/5/14

10-15-14

1. Syllabus must be attached; see guidelines for requirements: [www.fau.edu/provost/files/course\\_syllabus.2011.pdf](http://www.fau.edu/provost/files/course_syllabus.2011.pdf)

2. Review Provost Memorandum: **Definition of a Credit Hour** [www.fau.edu/provost/files/Definition\\_Credit\\_Hour\\_Memo\\_2012.pdf](http://www.fau.edu/provost/files/Definition_Credit_Hour_Memo_2012.pdf)

3. Consent from affected departments (attach if necessary)

Email this form and syllabus to [UGPC@fau.edu](mailto:UGPC@fau.edu) **one week before** the University Graduate Programs Committee meeting so that materials may be viewed on the UGPC website prior to the meeting.

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<b>1. Course title/number, number of credit hours</b>	
Terrestrial Laser Scanning (CGN5304)	3 credit hours
<b>2. Course prerequisites, corequisites, and where the course fits in the program of study</b>	
Prerequisite: None	
<b>3. Course logistics</b>	
Semester: Spring 2014 This is a face to face class with combined lab segment Class time: TBD	
<b>4. Instructor contact information</b>	
Dr. Sudhagar Nagarajan. Civil, Environmental and Geomatics Engineering College of Engineering and Computer Science Florida Atlantic University 777 Glades Road, Building 36, Room 203 Boca Raton, FL, 33431 Phone: (561) 297 3104 E-mail: snagarajan@fau.edu	
<b>5. Course description</b>	
This course gives an introduction to applications of terrestrial laser scanning systems in geosciences, engineering, urban planning, forestry, architecture, emergency planning and forensics.	
<b>6. Course objectives/student learning outcomes/program outcomes</b>	
<i>Course objectives</i>	By the end of the semester, the students will have strong understanding on 1) working principles of terrestrial laser scanning systems, 2) applying laser scanning to various engineering and geosciences problems.
<i>Student learning outcomes &amp; relationship to ABET a-k outcomes</i>	<ol style="list-style-type: none"> <li>1. By the end of week 1, the students will have ability to explain the principles of laser scanning (a, b, k)</li> <li>2. By the end of week 3, the student will have clear knowledge of terrestrial laser scanning sensors and various scanning techniques (a, b, e)</li> <li>3. By the end of week 5, the students will be able to demonstrate georeferencing laser scanning data. (a, b)</li> <li>4. By the end of week 6, the students will be able to calibrate and determine laser scanner errors (a, b, g, k)</li> <li>5. By week 11, the students will have ability to apply terrestrial laser scanning technology in various engineering, geology and urban planning applications (a, b, c, d, f, g, h, j, k)</li> <li>6. By the end of week 14, the students will have ability to use laser scanners and extract 3D models from them (a, b, c, d, e, f, g, h, k)</li> <li>7. By the end of the course, the students will have the ability to design and implement a terrestrial laser scanning project independently (a, b, c, d, e, f, g, j, k)</li> </ol>



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<i>Relationship to program outcomes</i>	<p><b>Outcome 1:</b> An understanding of professional and ethical responsibility (High)</p> <p><b>Outcome 2:</b> A working knowledge of fundamentals, engineering tools, and experimental methodologies (High)</p> <p><b>Outcome 3:</b> An understanding of the social, economic, and political contexts in which engineers must function (Medium)</p> <p><b>Outcome 4:</b> An ability to plan and execute an engineering design to meet an identified need (High)</p> <p><b>Outcome 5:</b> An ability to function on multi-disciplinary teams (High)</p> <p><b>Outcome 6:</b> An ability to communicate effectively (High)</p> <p><b>Outcome 7:</b> Graduates will have proficiency in the following areas of civil engineering: (i) structural engineering, (ii) transportation engineering, (iii) geotechnical engineering, (iv) water resources, and (v) environmental engineering (Low)</p> <p><b>Outcome 8:</b> Graduates will have an adequate appreciation for the role of civil engineering in infrastructure planning and sustainability including safety, risk assessment, and hazard mitigation (High)</p> <p><b>Outcome 9:</b> Graduates will be successful in finding professional employment and/or pursuing further academic studies (High)</p>
<b>7. Course evaluation method</b>	
<p>Course attendance: 10%</p> <p>Assignments: 30%</p> <p>Lab exercises: 10%</p> <p>Project: 10%</p> <p>Mid-term exam: 15%</p> <p>Final exam: 25%</p>	
<b>8. Policy on makeup tests, late work, and incompletes</b>	
<p>Makeup tests are given only if there is solid evidence of a medical or otherwise serious emergency that prevented the student of participating in the exam. Makeup exam should be administered and proctored by department personnel unless there are other pre-approved arrangements.</p> <p>Incomplete grades are against the policy of the department. Unless there is solid evidence of medical or otherwise serious emergency situation incomplete grades will not be given.</p>	
<b>9. Special course requirements</b>	
<p>All assigned homework must be submitted on or before the posted time. Per day 10% penalty will be enforced for late submissions.</p> <p>To succeed in this course all exams must be taken. The reasons for missing an exam must be documented, i.e. doctor's note etc. An unsatisfactory excuse will result in an F entered for that exam. Make-up exams will be administered for ONLY valid reasons.</p> <p>All exams will be taken on the honor system and must be done by the student ONLY with NO ASSISTANCE FROM ANYONE. A student MAY NOT provide assistance to another student.</p> <p>You are encouraged to work in groups to complete the homework assignments and/or to study together. However, the completed homework assignments must be your own work.</p>	
<b>10. Classroom etiquette policy</b>	
<p>1. Cell phones and beepers should have the ringers turned off as a courtesy to the instructor and your</p>	

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fellow classmates.

2. Computers must be closed and turned off in class
3. You can leave only on breaks
4. Exams will be given only at the scheduled times and places. No make-ups, except in documented emergencies. No one is exempt from the final examination.
5. Attendance to class is required. You are expected to attend and participate in all class sessions. Final grades will be reduced by one letter for every three (3) unexcused absences (as determined by the instructor). Attendance to at least one (1) professional meeting is required.
6. You are expected to complete the assigned reading prior to the date indicated on the class schedule, to do all homework assignments, and to participate fully in the group projects.
7. Assignments are due at the beginning of class on the date indicated on the assignment sheet.

University policy requires that in order to enhance and maintain a productive atmosphere for education, personal communication devices, such as cellular phones and laptops, are to be disabled in class sessions. You are expected to complete the assigned reading prior to the date indicated on the class schedule, to do all homework assignments, and to participate fully in the group projects

#### **11. Disability policy statement**

In compliance with the Americans with Disabilities Act (ADA), students who require special accommodations due to a disability to properly execute coursework must register with the Office for Students with Disabilities (OSD) located in Boca Raton campus, SU 133 (561) 297-3880 and follow all OSD procedures.

#### **12. Honor code policy**

Consultation with your classmates on assignments is expected and encouraged; however what you turn in must be your own work. Representing the work of others as your own is unethical and may result in sanctions (see the FAU Policy on Academic Honesty). FAU is committed to a policy of honesty in academic affairs. The instructor's duty is to pursue any reasonable allegation, taking action where appropriate, as described in the appropriate section of the FAU Catalog (<http://www.fau.edu/ug-cat/academic.htm#irregular>) and the Florida Administrative Code. Please be advised that the copying of material from the world wide web or any other written material is considered plagiarism and is also a breach of the Honor Code.

Students at Florida Atlantic University are expected to maintain the highest ethical standards. Academic dishonesty is considered a serious breach of these ethical standards, because it interferes with the university mission to provide a high quality education in which no student enjoys unfair advantage over any other. Academic dishonesty is also destructive of the university community, which is grounded in a system of mutual trust and place high value on personal integrity and individual responsibility. Harsh penalties are associated with academic dishonesty. See University Regulation 4.001 at [www.fau.edu/regulations/chapter4/4.001\\_Honor\\_Code.pdf](http://www.fau.edu/regulations/chapter4/4.001_Honor_Code.pdf).

Florida Atlantic University  
Regulation 4.001 Code of Academic Integrity

(1) Purpose. Students at Florida Atlantic University are expected to maintain the highest ethical standards. Dishonesty is considered a serious breach of these ethical standards, because it interferes with the University mission to provide a high quality education in which no student enjoys an unfair advantage over any other. Dishonesty is also destructive of the University community, which is grounded in a system of mutual trust and places high value on personal integrity and individual responsibility.

(2) Definitions. The FAU Code of Academic Integrity prohibits dishonesty and requires a faculty member, student, or staff member to notify an instructor when there is reason to believe dishonesty has occurred in a course/program requirement. The instructor must pursue any reasonable allegation, taking action

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where appropriate. Examples of academic dishonesty include, but are not limited to, the following:

**(A) Cheating**

1. The unauthorized use of notes, books, electronic devices, or other study aids while taking an examination or working on an assignment.
2. Providing unauthorized assistance to or receiving assistance from another student during an examination or while working on an assignment.
3. Having someone take an exam or complete an assignment in one's place.
4. Securing an exam, receiving an unauthorized copy of an exam, or sharing a copy of an exam.

**(B) Plagiarism**

1. The presentation of words from any other source or another person as one's own without proper quotation and citation.
2. Putting someone else's ideas or facts into your own words (paraphrasing) without proper citation.
3. Turning in someone else's work as one's own, including the buying and selling of term papers or assignments.

**(C) Other Forms of Dishonesty**

1. Falsifying or inventing information, data, or citations.
2. Failing to comply with examination regulations or failing to obey the instructions of an examination proctor.
3. Submitting the same paper or assignment, or part thereof, in more than one class without the written consent of both instructors.
4. Any other form of academic cheating, plagiarism, or dishonesty.

**(3) Procedures.**

(A) If the instructor determines that there is sufficient evidence to believe that a student engaged in dishonesty, the instructor will meet with the student at the earliest possible opportunity and provide notice to the student of the instructor's perception of the

facts, the charges against the student, and the sanction. The instructor may not remove the student from the course until the appeal process has come to a conclusion.

(B) If, after this meeting, the instructor continues to believe that the student engaged in dishonesty, the instructor will provide the student written notice of the charges and the penalty. A copy of this statement shall be sent to the chair of the department or director of the school/program administering the course.

(C) The student is entitled to an opportunity to be heard at a meeting with the instructor and chair/director to review and discuss the instructor's charges/statement. Such request for a meeting must be made in writing and received by the chair/director within five (5) business days of receipt of the instructor's charges/statement. The purpose of the meeting is to discuss the facts and to advise the student of the appeal process. The chair/director will provide the student, the instructor, and the dean of the college administering the course a summary of both the student's position and the instructor's position.

(D) The student may appeal in writing to the dean of the college administering the course. The appeal must be received by the dean within five (5) business days of receipt of the chair/director's summary from the review meeting. The dean will convene a Faculty-Student Council ("Council"), which will be composed of the dean (or designee), two faculty members, and two students. The dean (or designee) will act as chair of the Council, direct the hearing, and maintain the minutes and all records of the appeal hearing, which will not be transcribed or recorded. The hearing is an educational activity subject to student privacy laws/regulations, and the strict rules of evidence do not apply. The student may choose to be accompanied by a single advisor, but only the student may speak on her/his own behalf. The student and instructor may present testimony and documents on his/her behalf. Additional witnesses may be



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permitted to speak at the dean's (or designee's) discretion and only if relevant and helpful to the Council. The Council will deliberate and make a recommendation to the dean to affirm or void the instructor's findings of academic dishonesty. The dean (or designee) will inform the student and instructor in writing of his/her findings of academic dishonesty after receipt of the Council's recommendation.

(E) The student may request an appeal in writing of the dean's findings of academic dishonesty to the University Provost (or designee) and include relevant documentation in support of such appeal. The University Provost (or designee) will notify the student, dean, and instructor of his/her decision in writing. This decision by the Provost (or designee) constitutes final University action.

(F) If there is a finding that the Code of Academic Integrity has been violated, the chair will notify the University Registrar that the following notation be included on both the student's official transcript and on the student's internal record: "Violation of Code of Academic Integrity, University Regulations 4.001." If such violation is appealed and overturned, the dean or University Provost (or their designees) will notify the University

Registrar that such notation should be removed from the student's transcript and internal record.

**(4) Penalties.**

(A) The instructor will determine the penalty to be administered to the student in the course. Penalty grades cannot be removed by drop, withdrawal, or forgiveness policy. Students should be aware that, in some Colleges/programs, failure in a course or a finding of dishonesty may result in other penalties, including expulsion or suspension from the College/program.

(B) In the case of a first offense, the student may elect to complete a peer counseling program administered by the Division of Student Affairs by the end of the semester following the semester in which the dishonesty occurred. Upon successful completion of this program, the notation regarding violation of the Code of Academic Integrity will be expunged from the student's official transcript. The grade, however, will remain unchanged and cannot be removed by drop or forgiveness policy. Also, the notation will remain in internal University student records.

(C) In the case of a repeat offense, even if the notation of violation of the Code of Academic Integrity from the first offense had been expunged from the official transcript as a result of successful completion of the peer counseling program, the student will be expelled from the University.

Specific Authority: Article IX of the Florida Constitution, 1001.706, 1001.74 F.S., Board of Governors Regulations 1.001, 6.010, and 6.0105. History–New 10-1-75, Amended 12-17-78, 3-28-84, Formerly 6C5-4.01, Amended 11-11-87. Formerly 6C5-4.001. Amended 5-26-10

See University Regulation 4.001 at [www.fau.edu/regulations/chapter4/4.001\\_Honor\\_Code.pdf](http://www.fau.edu/regulations/chapter4/4.001_Honor_Code.pdf).

**13. Required texts/reading**

Airborne and Terrestrial Laser Scanning, ISBN 9781439827987, Editor(s):George Vosselman, Hans-Gerd Maas, Published: March 5, 2010 by CRC Press

**14. Supplementary/recommended readings**

- Terrestrial laser scanning: Error sources, self-calibration and direct georeferencing, 2009, Yuriy Reshetyuk, ISBN-13: 978-3639175509, VDM Verlag (July 9, 2009)
- Topographic Laser Ranging and Scanning: Principles and Processing. Ji Shan and Charles K. Toth (Eds.) CRC Press: Boca Raton, FL. 2009
- Bahadır Ergün (2011). Terrestrial Laser Scanning Data Integration in Surveying Engineering, Laser

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Scanning, Theory and Applications, Prof. Chau-Chang Wang (Ed.), ISBN: 978-953-307-205-0, InTech, DOI: 10.5772/14728. Available from: <http://www.intechopen.com/books/laser-scanning-theory-and-applications/terrestrial-laser-scanning-data-integration-in-surveying-engineering>

**15. Course topical outline, including dates for exams/quizzes, papers, completion of reading**

Week 1: Principles of laser scanning technology  
Week 2: Terrestrial laser scanning sensors  
Week 3: Scanning techniques  
Week 4: Positioning with GPS and INS  
Week 5: Georeferencing of terrestrial laser scanning data  
Week 6: Errors and calibration  
Week 7: Co-registration of multiple scans  
Week 8: Lab Exercise: Laser Scanning data acquisition and registration in Leica's Cyclone software  
Week 9: Lab Exercise: Feature extraction using Cyclone software  
Week 10: Applications  
Week 11: Applications  
Week 12: Applications  
Week 13: Applications  
Week 14: Project Presentation  
Week 15: Course review