FAU
FLORIDA ATLANTIC UNIVERSITY

NEW COURSE PROPOSAL
Graduate Programs

Department Civil, Environmental & Geomatics Engineering

College College of Engineering & Computer Science
*(To obtain a course number, contact **erudolph@fau.edu**)*

UGPC Approval _____
UFS Approval _____
SCNS Submittal _____
Confirmed _____
Banner Posted _____
Catalog _____

Prefix CES **Number** 5144	*(L = Lab Course; C = Combined Lecture/Lab; add if appropriate)* **Lab Code**	**Type of Course** Lecture	**Course Title** Structural Health Monitoring

Credits *(Review Provost Memorandum)*: 3

Effective Date *(TERM & YEAR)*: Fall of 2019

Grading *(Select One Option)*: Regular ◉ Sat/UnSat ○

Course Description *(Syllabus must be attached; see Guidelines)*

This course will explore the theory and applications of structural health monitoring, which is a new technology to diagnose the state of structural conditions based on sensor data and novel data analytics approaches. This course will cover various important topics, including sensing technology, signal processing, machine learning, and optimization. Students are expected to gain a deep understanding of sensor-embedded structural maintenance systems and to learn how to visualize and process sensor data.

Prerequisites	**Corequisites**	**Registration Controls** *(Major, College, Level)*
CES 3102C – Analysis of Structures with a minimum grade of "C"	None	None

Prerequisites, Corequisites and Registration Controls are enforced for all sections of course

Minimum qualifications needed to teach course:	**List textbook information in syllabus or here**
Member of the FAU graduate faculty and has a terminal degree in the subject area (or a closely related field.)	1. "Structural Health Monitoring: A Machine Learning Perspective" by Charles R. Farrar, and Keith Worden, John Wiley & Sons., 2012, ISBN-10: 1119994330, ISBN-13: 978-9781119994336.
Faculty Contact/Email/Phone jangj@fau.edu	**List/Attach comments from departments affected by new course** None

Approved by	***Date***
Department Chair	3/7/19
College Curriculum Chair	3/11/19
College Dean	3/11/2019
UGPC Chair	3/27/2019
UGC Chair	3/27/19
Graduate College Dean	3/27/2019
UFS President	
Provost	

Email this form and syllabus to UGPC@fau.edu one week before the UGPC meeting.

GRADUATE COLLEGE
MAR 12 2019
Received

FAUnewcourseGrad, created Summer 2017

Department of Civil, Environmental & Geomatics Engineering
Florida Atlantic University
Course Syllabus

1. Course title/number, number of credit hours	
Structural Health Monitoring (CES 5144)	3 credit hours
2. Course prerequisites, corequisites, and where the course fits in the program of study	
CES 3102C – Analysis of Structures with a minimum grade of "C"	
3. Course logistics	
Fall 2019; Location: FL 401; Time: 07:10PM -- 10:00PM, Wednesday	
4. Instructor contact information	
Instructor's name *Office address* *Office Hours* *Contact telephone number* *Email address*	Dr. Jinwoo Jang EE 320 Thursday 2:00PM - 4:00PM 561.297.2987 jangj@fau.edu
5. TA contact information	
TA's name *Office address* *Office Hours* *Contact telephone number* *Email address*	Not applicable
6. Course description	
This course will explore the theory and applications of structural health monitoring, which is a new technology to diagnose the state of structural conditions based on sensor data and novel data analytics approaches. This course will cover various important topics, including sensing technology, signal processing, machine learning, and optimization. Students are expected to gain a deep understanding of sensor-embedded structural maintenance systems and to learn how to visualize and process sensor data.	
7. Course objectives/student learning outcomes/program outcomes	
Course objectives	This course will deliver novel sensor data analytics to identify structural stiffness-related parameters through the use of mathematical and data-driven modeling. This course will help students' understanding in global structural behavior, vibration signal processing, damage sensitive feature extraction, structural damage estimation, and structural modeling.
Student learning outcomes & relationship to ABET 1-7 objectives	• An understanding of SHM technology (1,2,3,4,7) • An understanding of various sensing technology (1,2,3,7) • An ability to estimate structural damage and its severity (1,2,3,6) • An ability to analyze and interpret vibration sensor data (1,2,3,6) • An ability to visualize and animate the vibration responses of a structure (1,2,3,6)

Relationship to program educational objectives	• An understanding of professional and ethical responsibility (high) • A working knowledge of fundamentals, engineering tools, and experimental methodologies (high) • An understanding of the social, economic, and political contexts in which engineers must function (medium) • An ability to plan and execute an engineering design to meet an identified need (medium) • An ability to function on multi-disciplinary teams (high) • An ability to communicate effectively (medium) • 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 (high) • 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) • Graduates will be successful in finding professional employment and/or pursuing further academic studies (high)

8. Course evaluation method (note percentages subject to change)

Homework	30%	*Note*: The minimum grade required to pass the course is "C."
Midterm	30%	
Project	20%	
Final	20%	

Participation in University-approved activities or religious observances, with prior notice, will not be penalized. Keep copies of all quizzes and homework assignments for ABET purposes. Exams are closed book. A project is an individual project using MATLAB. Students are required to submit a final report for the project.

9. Course grading scale

Course grades are assigned according to the attached Department of Civil, Environmental & Geomatics Engineering Grading Guidelines. Assignments and reports must be prepared according to the required formats.
The overall performance as related to course objectives and outcomes is evaluated and considered during grading.

Grading Scale:
90 and above: "A", 87-89: "A-", 83-86: "B+", 80-82: "B", 77-79 : "B-", 73-76: "C+", 70-72: "C", 67-69: "C-", 63-66: "D+", 60-62: "D", 51-59: "D-", 50 and below: "F."

10. Policy on makeup tests, late work, and incompletes

1. *Exams* will be given only at the scheduled times and places, unless previous arrangements have been made no less than one (1) full week in advance. No one is exempt from exams.
2. *Makeups* 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 exams will be administered and proctored by department personnel unless there are other pre-approved arrangements.
3. *Late work* is not acceptable.
4. *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. Note: Incomplete grades are only reserved for those students who were passing but could not complete the required work due to exceptional circumstances.
5. All homework will be completed individually in a neat and clear manner. Homework is due at the beginning of class on the due date. Late policy: 10 points off for the first day; 20 points off for the second day; and maximum 50 points after a solution is posted.

11. Special course requirements

Not applicable

12. Classroom etiquette policy

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 face-to-face class sessions. Please review the university Netiquette policy guidelines at http://www.fau.edu/irm/about/netiquette.php.

13. Attendance policy statement

Students are expected to attend all of their scheduled University classes and to satisfy all academic objectives as outlined by the instructor. The effect of absences upon grades is determined by the instructor, and the University reserves the right to deal at any time with individual cases of non-attendance.
Students are responsible for arranging to make up work missed because of legitimate class absence, such as illness, family emergencies, military obligation, court-imposed legal obligations or participation in University-approved activities. Examples of University-approved reasons for absences include participating on an athletic or scholastic team, musical and theatrical performances and debate activities. It is the student's responsibility to give the instructor notice prior to any anticipated absences and within a reasonable amount of time after an unanticipated absence, ordinarily by the next scheduled class meeting. Instructors must allow each student who is absent for a University-approved reason the opportunity to make up work missed without any reduction in the student's final course grade as a direct result of such absence.

14. Disability policy statement

In compliance with the Americans with Disabilities Act Amendments Act (ADAAA), students who require reasonable accommodations due to a disability to properly execute coursework must register with Student Accessibility Services (SAS) and follow all SAS procedures. SAS has offices across three of FAU's campuses – Boca Raton, Davie and Jupiter – however disability services are available for students on all campuses. For more information, please visit the SAS website at www.fau.edu/sas/.

15. Counseling and Psychological Services (CAPS) Center

Life as a university student can be challenging physically, mentally and emotionally. Students who find stress negatively affecting their ability to achieve academic or personal goals may wish to consider utilizing FAU's Counseling and Psychological Services (CAPS) Center. CAPS provides FAU students a range of services – individual counseling, support meetings, and psychiatric services, to name a few – offered to help improve and maintain emotional well-being. For more information, go to http://www.fau.edu/counseling/.

16. Code of Academic Integrity policy statement

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 an unfair advantage over any other. Academic 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. Harsh penalties are associated with academic dishonesty. For more information, see University Regulation 4.001. www.fau.edu/regulations/chapter4/4.001_Code_of_Academic_Integrity.pdf

17. Required texts/reading

No required textbook

18. Supplementary/recommended readings

1. "Structural Health Monitoring: A Machine Learning Perspective" by Charles R. Farrar, and Keith Worden, John Wiley & Sons., 2012, ISBN-10: 1119994330, ISBN-13: 978-9781119994336.
2. "Structural Health Monitoring" by Daniel Balageas, Claus-Peter Fritzen, and Alfredo Güemes, John Wiley \& Sons., 2010, ISBN-10: 0470394404, ISBN-13: 9780470394403.

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

Week	*Topics*	*Assignments*
1	Introduction to SHM	
2	Sensing technology and vibration-based damage detection	**HW #1 due**
3	System idealization and sampling	
4	Material properties vs. modal properties of a system	**HW #2 due**
5	Structural damping estimation from vibration data	
6	Damage sensitive feature extraction	**HW# 3 due**
7	**Midterm** (Material from Weeks 1-6)	
8	Operational Modal analysis	
9	Frequency domain analysis	**HW #4 due**
10	Laplace transform	
11	Modal decomposition	**HW #5 due**
12	Introduction to machine learning	
13	Supervised machine learning	**HW #6 due**
14	Unsupervised machine learning	**Final project due**
15	**Final Exam** (Material from Weeks 1-14)	