Department of Ocean and Mechanical Engineering
Florida Atlantic University
Course Syllabus

1. Course title/number, number of credit hours	
Ocean and Environmental Data Analysis - EOC 4631C	3 credit hours

2. Course prerequisites, co-requisites, and where the course fits in the program of study

Prerequisites:
- EOC 3130L OE Lab
- EGN 4323 Vibration Synthesis and Analysis (both with a grade of C or above)

Co-requisite:
- EGN 4323 Vibration Synthesis and Analysis

3. Course logistics

Term: Fall 2019
This is a classroom lecture course with 6 laboratory experiments
Class location and time: M-W 10-11:20 am (lecture), room ST233
Office hours: M-W 8:40 am – 10 am (posted on instructor's door)
The course has no design content

4. Instructor contact information

Instructor's name	Dr. Pierre-Philippe Beaujean
Office address	Seatech: 101 North Beach Road
Office Hours	Room 225A
Contact telephone number	Dania Beach, FL 33004
Email address	pbeaujea@fau.edu

5. TA contact information

TA's name	None
Office address	
Office Hours	
Contact telephone number	
Email address	

6. Course description

Fourier transform applications to the processing of ocean engineering related types of signals. Introduction to probability and statistics. Digital processing techniques. Laboratory work involving analysis of ocean engineering-related signals using modern data acquisition systems.

7. Course objectives/student learning outcomes/program outcomes

Course objectives	The objective of the course is to provide the students with a basic and applied knowledge of probabilistic and statistical methods to analyze random phenomena, with an emphasis on ocean environmental data study.
Student learning outcomes & relationship to ABET a-k objectives	1. An ability to design and conduct experiments, as well as to analyze and interpret data, including good laboratory safety procedures, formulation of plans for data gathering to achieve objectives, documentation of collected data, experimental procedures, analysis and interpretation of data and determination of measurement errors. (b/6)

	2. An understanding of professional and ethical responsibility including understanding a code of ethics, demonstration of ethical behavior and taking personal responsibility for the student's actions. (f/4) 3. An ability to study ocean phenomena as random events and understand the concept of estimation and accuracy. (a,e,k/1,2,6) 4. A thorough understanding of time and frequency analysis of random events with an emphasis on ocean physics. (a,e,k/1,2,6) 5. An ability to associate a confidence level to any numerical estimate, from probability density function and time coherence to power spectral density (Fourier) analysis. (a,e,k/1,2,6) 6. An ability to measure the correlation between two physical phenomena, such as ocean ambient noise and surface wave activity for example. (a,e,k/1,2,6) 7. An ability to make such environmental measurements as ambient acoustic noise, surface waves or sound velocity profiles, followed by a thorough data analysis. (a,e,k/1,2,6)

8. Course evaluation method

Laboratory reports and demos (6) 30% Quizzes 25% Midterm (4 pages of notes) 20% Final exam (open book and notes) 25%	Homework problems will be assigned on a regular basis. Homework need not be submitted. Starting on the second week of class, at the beginning of class each Wednesday (with some exceptions, see schedule), there will be an open notes, open book quiz based on the homework problems. The answers to the quiz will be graded and the homework quiz marks will count for 25% of the grade.

9. Course grading scale

Grading Scale:
95 and above: "A", 90-95: "A-", 85-90: "B+", 80-85: "B", 75-80 : "B-", 70-75: "C+", 65-70: "C", 60-65: "C-", 55-60: "D+", 50-55: "D", 45-50: "D-", 45 and below: "F."

The final grade for the course will be the numerical average of grades assigned for all work specified above weighted according to the percentages shown. The instructor reserves the right, in exceptional cases, to raise or lower the final numerically averaged course grade by 2.5% in cases where the instructor does not believe that the average is representative of the student's performance in the class (for example if the grade in the final exam is much better than in the rest of the course). Normally, the student will receive the numerically-averaged letter grade for the course.

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

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

Late work is not acceptable.

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.

11. Special course requirements

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 class sessions.

13. 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)—in Boca Raton, SU 133 (561-297-3880); in Davie, LA 203 (954-236-1222); or in Jupiter, SR 110 (561-799-8585) —and follow all SAS procedures.

14. Honor code policy

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_Code_of_Academic_Integrity.pdf

15. Counseling and Psychological Services 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. Required texts/reading

Cooper and McGillem, "Probabilistic Methods of Signal and System Analysis",
3rd ed., Oxford, ISBN 0-19-512354-9, 1999

17. Supplementary/recommended readings

Navidi, "Statistics for Engineers and Scientists",
1st ed., McGraw-Hill, ISBN 0-07-255160-7.
Emery and Thomson, "Data Analysis Methods in Physical Oceanography",
2nd ed., Elsevier, ISBN 0-444-50757-4.

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

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1) Introduction to environmental data analysis:
   a) General definitions.
2) Introduction to Probability
   a) Concept of random variable, expectation, probability distribution and density functions, statistical moments.
   b) Uniform and Gaussian distributions.
   c) Central limit theorem, conditional probability density function.
3) Elements of statistics and random processes:
   a) Histograms, trends, goodness-of-fit test.
   b) Statistical averaging.
   c) Confidence intervals and mapping, hypothesis testing.
   d) Regression and curve fitting.
   e) Propagation of error.
4) Experimentation:
   a) Laboratory safety procedures.
   b) Formulation of plans for data gathering to achieve objectives.
   c) Documentation of collected data.
   d) Experimental procedures.
   e) Sensors, sampling and determination of measurement errors.
   f) Analysis (time, frequency) and interpretation of data.
5) Frequency analysis
   a) Fourier series.
   b) Fourier transform.
   c) Power spectral density analysis.
   d) Discrete and Fast Fourier transform.
   e) Correlation function, Power spectral density, periodograms.
   f) Data filtering.
6) Elements of sensor fusion
   a) Synchronization and resampling issues
   b) Introduction to Kalman filtering (time permitting)
7) Professional and ethical responsibility, contemporary issues in engineering:
   a) Understanding a code of ethics.
   b) Demonstration of ethical behavior.
   c) Taking personal responsibility for one's actions.

Canvas: Class notes, practice exercises and problems, laboratory assignments and administrative information will be posted on *Canvas*. Make sure you can access the information related to this class as early as possible.

Class notes: Class notes for the coming week will be posted every Wednesday afternoon, with the exception of the first week of class. In this case, the class notes will be posted on the afternoon of the first day of class. Make sure you carry a printed copy with you at the beginning of each class.

Homework: Weekly homework will be assigned. The homework will be posted on Wednesday afternoon and will be due the following Thursday. The instructor will post the solutions on *Canvas*.

Laboratory assignments: Six laboratory assignments are scheduled. Every assignment is considered as an individual work. Do not submit any work that is not yours. It is encouraged to exchange ideas between students, but do not copy any portions of another student's work. You must perform all the required calculations. Any two copies (or more) showing identical content will receive an F. The MATLAB programs written for the laboratory assignment must be included in the report. Laboratory reports are due within 10 days of taking the lab.

No Class: September 4 (Labor Day); November 10 (Veteran's Day, observed); November 23-26 (Thanksgiving Recess)

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Class No.	Week	Topic
1	1	1) (a), 2) (a)
2	1	2) (a)
3	2	2) (b)
4	2	2) (b), quiz 1
5	5	2) (c)
6	5	2) (c)
7	6	3) (a) and (b)
8	6	3) (c) and (d), quiz 2
9	7	3) (d) and (e), practice problems
Midterm	7	8:50-10:50 am (SAS student), 9:30-10:50 am (all students) Classes 1-8 + practice problems (post grades by 10/6/1
10	8	4) (a)-(c)
11	8	4) (a)-(c)
12	9	4) (f) Lab 1 - Mission planning and field experimentation with an unmanned vehicle, data editing in MATLAB
13	9	4) (d)-(f)
14	10	4) (f) Lab 2 - Introduction to digital ports, analog ports and serial ports using a micro-controller in C
15	10	4) (f) Lab 3 - Collecting and averaging GPS data using a micro-controller in C
16	11	5) (a-c)
17	11	5) (a-d), quiz 3
18	12	5) (d) Lab 4 - Detecting and analyzing an incoming acoustic signal using a micro-controller in C
19	12	5) (e), quiz 4
20	13	5) (f)
22	14	6) (a)-(b)
23	14	5) (f) Lab 5 - Collecting and filtering IMU data using a micro-controller in C and with Simulink
24	15	7) (a)-(c), quiz 5
25	15	Lab 6 - Fusing IMU and GPS data using a micro-controller in C and with Simulink
26	16	Practice problems

Final Exam: 8-10 am, Wednesday December 12th