ASEN5307 – Engineering Data Analysis Methods - Fall 2018

Instructor	Dr. R. Steven Nerem (Office: ECNT319, Ph. 492-6721, Email: nerem@colorado.edu)
Class Time	TTh 8:00 am – 9:15 pm
Class Location	ECCR 105
Class Web Page	http://canvas.colorado.edu
Office Hours	10-11 TTH, or anytime door is open, or by email
Class Assistant	Zach Fester (Zachary.Fester@colorado.edu)
Required Text	*MATLAB Recipes for Earth Sciences*, 2015, 4th Edition by Martin H. Trauth, Springer ISBN-13: 978-3662462430
Grading	Mid-Term Exam (20%) Final Exam (20%) Homework (40%) (10 pts deducted for each day late!) Research Project (20%) 90-100 = A, 80-89 = B, 70-79 = C, 60-69 = D, < 60 = F
Schedule	October 18 –Mid-Term Exam December 11 – Research Projects Due, Last Day of Class December 13 – Final Exam
Lecture Material	PDF files will be posted on the class website.
Course Overview	Gives students broad exposure to a variety of traditional and modern statistical methods for filtering and analyzing data. Topics include estimation and filtering methods, principal component analyses and spectral analyses. Introduces these methods and provides practical experience with their use. Students carry out problem assignments. Prior knowledge of MATLAB and/or Python is recommended.

Syllabus – ASEN5307
Engineering Data Analysis Methods

I. Introduction
1. Collecting Data
2. Data Calibration and Interpolation
3. Data Editing
4. Presenting Data

II. Statistics and Error Handling
1. Uncertainties in Measurements
2. Empirical Distributions
3. Theoretical Distributions
4. t-test, F-test, $\chi 2$ test
5. Confidence Intervals
6. Correlation Coefficient
7. Degrees of Freedom
8. Estimation Methods
9. Curve Fitting
10. Covariance and Error Analysis
11. Residual Analysis and Data Editing
12. Linear Regression Analysis
13. Bootstrap and Jackknife Estimates

III. Time-Series Analysis
1. Fourier Analysis
2. Harmonic Analysis
3. Blackman-Tukey Spectral Analysis
4. Cross-Spectral Analysis
5. Wavelet Analysis
6. Analyzing Unevenly Spaced Data
7. Lomb-Scargle Powerspectrum

IV. Signal Processing
    1. Linear Time Invariant Systems
    2. Convolution and Filtering
    3. Recursive and Nonrecursive Filters
    4. Impulse and Frequency Response
    5. Filter Design
        a. Running Mean Filters
        b. Lanczos-window Cosine Filters
        c. Butterworth Filters
        d. Frequency Domain Filtering

V. Spatial Analysis of Data Fields
    1. Gridding and Contouring
    2. Spherical Harmonics
    4. Objective Analysis, Kriging
    5. Principal Component Analysis (including SVD)
    6. Independent Component Analysis
    7. Empirical Orthogonal Functions

Syllabus Statements

Accommodation for Disabilities

If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the Disability Services website. Contact Disability Services at 303-492-8671 or dsinfo@colorado.edu for further assistance. If you have a temporary medical condition or injury, see Temporary Medical Conditions under the Students tab on the Disability Services website.

Classroom Behavior

Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. For more information, see the policies on classroom behavior and the Student Code of Conduct.

Honor Code

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code. Violations of the policy may include: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code (honor@colorado.edu); 303-492-5550). Students who are found responsible for violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code as well as academic sanctions from the faculty member. Additional information regarding the Honor Code academic integrity policy can be found at the Honor Code Office website.

Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation

The University of Colorado Boulder (CU Boulder) is committed to fostering a positive and welcoming learning, working, and living environment. CU Boulder will not tolerate acts of sexual misconduct (including sexual assault, exploitation, harassment, dating or domestic violence, and stalking), discrimination, and harassment by members of our community. Individuals who believe they have been subject to misconduct or retaliatory actions for reporting a concern should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-

2127 or cureport@colorado.edu. Information about the OIEC, university policies, anonymous reporting, and the campus resources can be found on the OIEC website.

Please know that faculty and instructors have a responsibility to inform OIEC when made aware of incidents of sexual misconduct, discrimination, harassment and/or related retaliation, to ensure that individuals impacted receive information about options for reporting and support resources.

Religious Holidays

Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. Please contact the professor during the first week of class if you expect to have any conflicts with religious holidays during the semester, and he will make every effort to accommodate you.

See the campus policy regarding religious observances for full details.