**Course Syllabus**
**EE562**
(formerly EE562a)

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| **Term**: | Fall 2016 |
| **Course title**: | Random Processes in Engineering |
| **Lecture**: | Monday & Wednesday, 11am-12:20 pm, OHE 100B |
| **Discussion Session**: | Friday, 5:00-5:50 pm, OHE 100C |
| **Instructor**: | Robert Scholtz |
| **Office Hours:** | Monday & Wednsday, 2:00-3:30 pm, EEB 500B |
| **Contact**: | (213) 740-7327, scholtz@usc.edu |
| **Teaching Assistant**: | Parisa Mansourifard |
| **Office Hours**: | |
| **Contact**: | parisama@usc.edu |
| **Grader**: | To be decided |
| **Contact:** | |

**Prerequisite knowledge**:
1. Linear Algebra, matrix theory, linear spaces, bases, eigenvectors, eigenvalues, etc. (EE 441 or pass placement exam).
2. Probability theory and random variables, moments, transformations of random variables, characteristic functions, etc. (EE 464 or EE503 or pass placement exam).

**Recommended preparation**:
Fourier, Laplace, and z transforms, complex variables, contour integrals, and residue theory (EE 401 or equivalent)

**Reading Materials**:
1. Supplemental Course Notes, available on DEN website, cover 100% of course and homework.

2. Similar reading but not required: Henry Stark and John W. Woods, *Probability and Random Processes*, Prentice Hall, 2002

**Homework**: Approximately 8-9 problem sets
**Midterm Exam**: Monday, October 17, 11 am (1hour, 20 min.)
**Final exam**: Wednesday, December 7, 11 am (2 hours)
**Grading Policy**: Homework 10%, Midterm 35%, Final 55%

**Content**:
This is a first course in random processes for engineers, and is a prerequisite for many courses in communications, controls and signal processing.
1. Definition of random processes: random variables, random vectors, random sequences, random waveforms, etc.
2. Second order statistics: Properties of correlation functions.
3. Covariance matrix factorization, eigenvalues, eigenvectors, causal factoring and whitening concepts.
4. Gaussian processes.
5. Simple hypothesis tests.
6. Linear minimum-mean-square-error estimation, orthogonality principle.

(Midterm on the above material)

7. Linear operations on random processes, convergence concepts: convolution, integration, differentiation.
8. Frequency domain analysis: time invariant linear operations.
9. Energy spectra, power spectra, white noise approximations.
10. Linear transformations of wide-sense stationary random processes, spectral factorization, and applications.
11. Poisson distributed events in time, Campbell's theorem
12. Karhuenen-Loeve expansions on finite intervals.
13. Narrowband process representations.
14. Time averages, ergodicity.

(Final covers the whole course, but with an emphasis on topics 7-14.)

**Homework Policy:** You can work alone or in groups on the homework. (Attempt the homework alone first.) As an important part of the learning process, it is imperative that you attempt all homework problems and turn in the homework, even if late.

**More on the Grading Policy:** This policy has evolved to accommodate situations in which students cannot get homework turned in on time because of travel, other examinations, etc.

For a student who turns all homework in on time, the measure Q of the quality of his/her work in the course is given by

$$Q = 0.1\, Q_{HW} + 0.35\, Q_M + 0.55\, Q_F$$

where

$Q_{HW}$ = (student's total homework score)/(total homework score possible)
$Q_M$ = (student's midterm score)/(maximum possible midterm score)
$Q_F$ = (student's final score)/ (maximum possible final score)

Suppose now that a student turns in $N_{IN}$ homework assignments in on time, turns in $N_L$ assignments late, and does not turn in $N_0$ assignments. The quality Q of his work in the class is given by

$$Q = 0.1\,[(N_{IN}+N_0)/(N_{IN}+N_L+N_0)]\, Q_{HWM} + [0.35+(0.35/0.9)(N_L/(N_{IN}+N_L+N_0))0.1]Q_M + [0.55+(0.55/0.9)(N_L/(N_{IN}+N_L+N_0))0.1]\, Q_F$$

where

$Q_{HWM}$ = (student's total homework score on $N_{IN}$ assignments)/(total homework score possible on $N_{IN} + N_0$ assignments)

Hence the weight that would be assigned to homework that is turned in late is transferred to the midterm and final exam. Homework that is never turned in earns a 0 as a homework grade. In the past, students typically earn higher $Q_{HW}$ (or $Q_{HWM}$) scores than $Q_M$ and $Q_F$ exam scores, so it is in the student's interest to turn in the homework on time (or if not on time, then turn it in late). As long as $N_0 = 0$, it is mathematically possible for the ideal student to achieve Q=1 (the best possible overall quality score) although this has never happened!

As a guide for assigning letter grades, a student usually earns a passing grade (B) if his quality score is at least half that of the highest quality score earned by students in the class. This is a guideline because the exams are designed to be approximately 50% straightforward questions that all students should answer, and 50% more difficult questions.

**Academic Conduct**

Plagiarism - presenting someone else's ideas as your own, either verbatim or recast in your own words - is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Section 11, *Behavior Violating University Standards* https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions/. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct/. Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* http://equity.usc.edu/ or to the *Department of Public Safety* http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us. This is important for the safety whole USC community. Another member of the university community - such as a friend, classmate, advisor, or faculty member - can help initiate the report, or can initiate the report on behalf of another person. *The Center for Women and Men* http://www.usc.edu/student-affairs/cwm/ provides 24/7 confidential support, and the sexual assault resource center webpage sarc@usc.edu describes reporting options and other resources.

**Support Systems**

A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the *American Language Institute* http://dornsife.usc.edu/ali, which sponsors courses and workshops specifically for international graduate students. The *Office of Disability Services and Programs* http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html

provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information* http://emergency.usc.edu/ will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.