



## College of Engineering Syllabus

### 1. Course Name and Number

Modern Probability Theory and Stochastic Processes, ECE 730

### 2. Credits and contact hours

3 cr., 3 x 50 minutes/week for 15 weeks = 37.5 hours

### 3. Canvas Course URL

<https://canvas.wisc.edu/courses/108167>

### 4. Course Designations and Attributes

Graduate 50%

### 5. Meeting Time and Location

MWF 11:00-11:50 in 2540 Engineering Hall

### 6. Indicate whether the course is required, elective, or selected elective.

N/A for graduate courses

### 7. Instructional Mode

all face-to-face

### 8. How Credit Hours Are Met by the Course

Traditional Carnegie Definition - One hour (i.e., 50 minutes) of classroom or direct faculty/instructor instruction and a minimum of two hours of out of class student work each week over approximately 15 weeks.

### 9. INSTRUCTORS AND TEACHING ASSISTANTS

#### 9.1 Instructor Title and Name

Prof. John A. Gubner

#### 9.2 Instructor Availability

After class and by appointment. Office: 2554 Engineering Hall.

#### 9.3 Instructor Email/Preferred Contact

John.Gubner@wisc.edu

#### 9.4 Teaching Assistant

N/A

## **10. OFFICIAL COURSE DESCRIPTION**

### **Course Description**

Stochastic processes in linear and nonlinear systems; stationarity, continuity, ergodicity; power spectrum and systems; estimation theory, filtering and prediction; harmonic analysis; nonstationary normal processes. Enroll Info: ECE 331 or equiv.

### **11. Requisites**

Graduate/professional standing

## **12. LEARNING OUTCOMES**

### **12.1 Course Learning Outcomes**

1. Compute probabilities and expectations using probability mass functions and densities together with the laws of total probability and substitution, along with the property of independence when applicable.
2. Explain how diagonalization of the covariance matrix of a random vector is used in principal component analysis.
3. Work with Gaussian random vectors, joint densities, and characteristic functions.
4. Design matched filters and Wiener filters (linear estimators) for random vectors and continuous-time random processes.
5. Perform basic calculations using properties of the Poisson process and the Wiener process.
6. Use convergence in mean, convergence in probability, convergence in distribution, and almost-sure convergence to derive properties of limits of sequences of random variables.

### **12.2 ABET STUDENT OUTCOMES**

N/A for graduate courses

## **13. BRIEF LIST OF TOPICS TO BE COVERED**

- Characterization of random processes passed through linear, time-invariant systems (correlation, covariance, power spectral density).
- Application of the orthogonality principle to estimation problems and conditional expectation.
- Karhunen-Loeve expansion of random processes.
- Markov Chains.
- Law of large numbers and central limit theorem and their application to statistics.

## **14. DISCUSSION SESSIONS**

N/A

## **15. LABORATORY SESSIONS**

N/A

## 16. REQUIRED TEXTBOOK, SOFTWARE & OTHER COURSE MATERIALS

- Required textbook:  
J. A. Gubner, *Probability and Random Processes for Electrical and Computer Engineers*, 2006.
- Other texts you may wish to consult:  
[1] None.
- Matlab, available from <https://it.wisc.edu/services/software/>.

## GRADING

10% Class Participation

10% Homework

40% Midterm Exam

40% Final Exam

## EXAMS, QUIZZES, PAPERS & OTHER MAJOR GRADED WORK

- The Midterm Exam will be an evening exam held on a mutually agreeable date. One sheet of 8.5-by-11 inch paper with notes on both sides is allowed.
- The Final Exam will be Tuesday, 18 December 2018 from 2:45 pm – 4:45 pm. Two sheets of 8.5-by-11 inch paper with notes on both sides are allowed.

## HOMEWORK & OTHER ASSIGNMENTS

- You may discuss the HW with other students taking the class and with me.
- Do not show your HW solutions to other students.
- Do not look at the HW solutions of other students.
- Do not copy the solution from another source.
- HW is due in class. If you cannot come to class, scan it (black & white pdf preferred) and email it to the instructor.

## RULES, RIGHTS & RESPONSIBILITIES

See the Guide's [Rules, Rights and Responsibilities](#)

## ACADEMIC INTEGRITY

By enrolling in this course, each student assumes the responsibilities of an active participant in UW-Madison's community of scholars in which everyone's academic work and behavior are held to the highest academic integrity standards. Academic misconduct compromises the integrity of the university. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these acts are examples of academic misconduct, which can result in disciplinary action. This includes but is not limited to failure on the assignment/course, disciplinary probation, or suspension. Substantial or repeated cases of misconduct will be forwarded to the Office of Student Conduct & Community Standards for additional review. For more information, refer to <https://conduct.students.wisc.edu/academic-integrity/>.

## **ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES**

**McBurney Disability Resource Center syllabus statement:** “The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform faculty [me] of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. Faculty [I], will work either directly with the student [you] or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA.” <http://mcburney.wisc.edu/facstaffother/faculty/syllabus.php>

## **DIVERSITY & INCLUSION**

**Institutional statement on diversity:** “Diversity is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals.

The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background – people who as students, faculty, and staff serve Wisconsin and the world.” <https://diversity.wisc.edu/>