EEL 6537 --- SPECTRUM SENSING AND SPARSE SIGNAL RECOVERY

1. **Catalog Description:** (3 credits) Spectrum, such as the radio spectrum, is a precious resource. We focus on sensing the spectrum from measurements of the signals and noise.
2. **Pre-requisites**: EEL 5544 and EEL 5525, or equivalent.

3. **Course Objectives:** The primary focus of this course is on various aspects of spectrum sensing. Diverse spectrum sensing methods will be introduced, including non-parametric, parametric, and semi-parametric algorithms. For semi-parametric algorithms, we will discuss sparse signal recovery methods, including LASSO, BP, Square-Root LASSO, FOCUSS, SLIM, SPICE, etc. Their merits and limitations will be discussed. The applications of spectrum sensing to diverse fields, such as radar, sonar, and communications, will be addressed.

4. **Contribution of course to meeting the professional component:** N/A.

5. **Relationship of course to program outcomes**: N/A.

6. **Instructor: Professor Jian Li**
   a. Office location: 465 EB
   b. Telephone: 392-2642
   c. E-mail address: li@dsp.ufl.edu
   d. Web site: www.sal.ufl.edu
   e. Office hours: by appointments.

7. **Teaching Assistant:** N/A.
   a. Office location
   b. Telephone
   c. E-mail address
   d. Office hours

8. **Meeting Times:** T and R, 5:10 – 7:05 pm.

9. **Class/laboratory schedule**: 3 sessions each week and 50 minutes each session.

10. **Meeting Location:** 239 Larsen Hall

11. **Material and Supply Fees:** N/A.

12. **Textbooks and Software Required:**
   a. Title: Spectral Analysis of Signals (free download available from Professor Stoica's website)
   b. Authors: P. Stoica and R. L. Moses
   c. Publication date and edition: 2005, 1st Edition

     d.   ISBN number: 0-13-113956-8

13. **Recommended Reading:**
- S. M. Kay, *Modern Spectral Estimation: Theory and Application*, Prentice Hall, 1988.
- S. Lawrence Marple, Jr., *Digital Spectral Analysis with Applications*, Prentice Hall, 1987.
- Charles W. Therrien, *Discrete Random Signals and Statistical Signal Processing*, Prentice Hall, 1992.

14. **Course Outline**:
- Introduction to spectrum sensing and review of the fundamentals of digital signal processing -- 2 lectures.
- Fundamentals of estimation theory including maximum likelihood estimators and Cramer-Rao bounds -- 2 lectures.
- Nonparametric methods and the trade-offs between resolution and variance -- 5 lectures
- Parametric methods, including Prony, HOYW, MUSIC, ESPRIT, and RELAX methods, and model order selection methods -- 14 lectures.
- Semi-parametric methods, including LASSO, BP, Square-Root LASSO, FOCUSS, SLIM, SPICE, etc. -- 9 lectures.
- Filter-bank approaches and most recent advances for spectrum sensing -- 5 lectures.

15. **Attendance and Expectations**: Attendance required. Cell phones not allowed.

16. **Grading** – Homework problems and their solutions will be discussed regularly. One project requiring 4-page conference style report: 100%.

17. **Grading Scale**: Grades are to be curved.

In order to graduate, graduate students must have an overall GPA and an upper-division GPA of 3.0 or better (B or better). Note: a B- average is equivalent to a GPA of 2.67, and therefore, it does not satisfy this graduation requirement. For more information on grades and grading policies, please visit:

http://gradschool.ufl.edu/catalog/current-catalog/catalog-general-regulations.html#grades

18. **Make-up Exam Policy:** No make-up exams.

19. **Honesty Policy** – All students admitted to the University of Florida have signed a statement of academic honesty committing themselves to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action. This statement is a reminder to uphold your obligation as a UF student and to be honest in all work submitted and exams taken in this course and all others.

20. **Accommodation for Students with Disabilities** – Students Requesting classroom accommodation must first register with the Dean of Students Office. That office will provide the student with documentation that he/she must provide to the course instructor when requesting accommodation.

21. **UF Counseling Services** –Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include:
    - UF Counseling & Wellness Center, 3190 Radio Rd, 392-1575, psychological and psychiatric services.
    - Career Resource Center, Reitz Union, 392-1601, career and job search services.

22. **Software Use** – All faculty, staff and student of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.