**PURDUE UNIVERSITY**

**REQUEST FOR ADDITION, EXPIRATION, OR REVISION OF A GRADUATE COURSE (50000-99999 LEVEL)**

**DEPARTMENT:** Engineering  
**EFFECTIVE SESSION:** Fall 2010

**INSTRUCTIONS:** Please check the items below which describe the purpose of this request.

- [ ] 1. New course with supporting documents (complete proposal form)
- [x] 2. Add existing course offered at another campus
- [ ] 3. Expiration of a course
- [ ] 4. Change in course number
- [ ] 5. Change in course title
- [ ] 6. Change in course credit/type

**PROPOSED:**

- **Subject Abbreviation:** ECE
- **Course Number:** 53960
- **Long Title:** Digital Signal Processing I
- **Short Title:**

**EXISTING:**

- **Subject Abbreviation:**
- **Course Number:**
- **Long Title:**
- **Short Title:**

Abbreviated title will be entered by the Office of the Registrar if omitted. (30 CHARACTERS ONLY)

**CREDIT TYPE**

- 1. Fixed Credit: Cr. Hrs. 3
- 2. Variable Credit Range:
  - Minimum Cr. Hrs. (Check One)
  - Or
  - Maximum Cr. Hrs.
- 3. Equivalent Credit: Yes
- 4. Thesis Credit: Yes

**COURSE ATTRIBUTES:**

- 1. Pass/Not Pass Only
- 2. Satisfactory/Unsatisfactory Only
- 3. Repeatable
- 4. Credit by Examination
- 5. Special Fees
- 6. Registration Approval Type
- 7. Variable Title
- 8. Honors
- 9. Full Time Privilege
- 10. Off Campus Experience

**COURSE DESCRIPTION (INCLUDE REQUISITES/RESTRICTIONS):**

Theory and algorithms for processing of deterministic and stochastic signals. Topics include discrete signals, systems, and transforms, linear filtering, fast Fourier transform, nonlinear filtering, spectrum estimation, linear prediction, adaptive filtering, and array signal processing. Prerequisites: ECE 436 Digital Signal Processing and ECE 392 Probabilistic Methods in Electrical Engineering, or equivalent.

**TERMS OFFERED**

- [ ] Summer
- [x] Fall
- [ ] Spring

**CAMPUS(ES) INVOLVED**

- [x] Calumet
- [x] Ft. Wayne
- [X] W. Lafayette

**Schedule Type**

<table>
<thead>
<tr>
<th>Minutes</th>
<th>Meetings</th>
<th>Weeks Offered</th>
<th>% of Credit Allocated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recitation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presentation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laboratory</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lab Prep</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Studio</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experiential</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ind. Study</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pract/Observe</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Cross-Listed Courses**

- [ ]

**OFFICE OF THE REGISTRAR**

- Calumet Department Head
- Calumet School Dean
- Calumet Undergrad Curriculum Committee
- Calumet Undergraduate Curriculum Committee
- Calumet Chancellor
- Undergrad Curriculum Committee
- Undergraduate Curriculum Committee
- Date Approved by Graduate Council
- Graduate Council Secretary
- West Lafayette Registrar
- West Lafayette Registrar
Supporting Document for a New Graduate Course

To: Purdue University Graduate Council
From: Faculty Member: Elizabeth Thompson
Department: Engineering
Campus: Fort Wayne
Date: 6/30/2010
Subject: Proposal for New Graduate Course-Documentation Required by the Graduate Council to Accompany Registrar's Form 40G

Contact for information if questions arise:
Name: Don Mueller
Phone Number: 260-481-5707
E-mail: muellerd@ipfw.edu
Campus Address: ET 321 (Fort Wayne Campus)

Course Subject Abbreviation and Number: BCE 538
Course Title: Digital Signal Processing I
Teaching ECE 538 at IPFW
Digital Signal Processing I

a. Justification for the Course

ECE 538 is one of the required core courses for the Electrical Engineering specialization in the Master of Science in Engineering degree at IPFW. This will provide a solid foundation in the fundamentals of Digital Signal Processing (DSP) and will be used as a prerequisite to more advanced signal processing courses to be developed in the future. This topic will be of great interest to employees of several of the local industries in and around Fort Wayne that are heavily involved in DSP.

b. Learning Outcomes and Methods of Evaluation or Assessment

A student who successfully fulfills the course requirements will have demonstrated:

- An understanding of the autocorrelation and covariance methods of estimating the correlation matrix.
- Knowledge of the Discrete Time Fourier Transform (DTFT) and its relationship to the Discrete Fourier Transform (DFT).
- Comprehension of parametric methods of spectrum estimation, including autoregressive modeling, minimum variance, linear prediction, and eigendecomposition-based methods.
- An understanding of nonparametric methods of spectrum estimation, including the periodogram and the correlogram.
- An understanding of linear filters, including the Wiener filter, as applied stochastic to signals.
- An introduction to adaptive filters, including the method of steepest descent and the least-mean-square (LMS) algorithms.

Methods of Evaluation or Assessment:

**Homeworks:** Several homeworks incorporating textbook problems will be assigned

**Projects:** Two Matlab projects will be assigned involving spectral analysis, adaptive filtering, or other course topics

**Tests:** Two hour and 15 minute exams and one two hour final.

c. Prerequisites

ECE 436, Digital Signal Processing, and ECE 302, Probabilistic Methods in Electrical Engineering, or equivalent.
d. Course Instructor

Elizabeth A. Thompson, Ph.D.
Associate Professor of Electrical Engineering
Department of Engineering
IPFW

e. Course Outline

<table>
<thead>
<tr>
<th>Topic:</th>
<th>Number of Lectures</th>
<th>Text Sections</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Review: Discrete-Time Signals Systems, &amp; Transforms</td>
<td>1</td>
<td>1.1-1.4</td>
</tr>
<tr>
<td>A. Basic Sampling Theory and D/A Conversion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Discrete-Time Linear Systems</td>
<td>2.1-2.3</td>
<td></td>
</tr>
<tr>
<td>C. z-Transform</td>
<td>3.1-3.5</td>
<td></td>
</tr>
<tr>
<td>D. Discrete-Time Fourier Transform</td>
<td>4.1-4.5</td>
<td></td>
</tr>
<tr>
<td>E. Discrete Fourier Transform</td>
<td>7.1-7.4</td>
<td></td>
</tr>
<tr>
<td>II. Sampling &amp; Reconstruction</td>
<td>4</td>
<td>6.1-6.6</td>
</tr>
<tr>
<td>A. Nyquist rate &amp; Aliasing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Multirate DSP</td>
<td>11.2-11.4</td>
<td></td>
</tr>
<tr>
<td>C. Efficient Up-sampling/Down-sampling</td>
<td>11.5</td>
<td></td>
</tr>
<tr>
<td>D. Mult-Stage Interpolation</td>
<td>11.6</td>
<td></td>
</tr>
<tr>
<td>III. Nonparametric Methods of Power Spectrum Estimation</td>
<td>8</td>
<td>12.1-12.2</td>
</tr>
<tr>
<td>A. Discrete random processes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Estimation of the autocorrelation sequence</td>
<td>14.1.2</td>
<td></td>
</tr>
<tr>
<td>C. Estimation of the correlation matrix</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. Periodogram; smoothed periodograms</td>
<td>14.2</td>
<td></td>
</tr>
<tr>
<td>E. Correlogram</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV. Model-Based Spectrum Estimation</td>
<td>10</td>
<td>14.3</td>
</tr>
<tr>
<td>A. Autoregressive (AR) Modelling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Forward/Backward Linear Prediction</td>
<td>12.3</td>
<td></td>
</tr>
<tr>
<td>C. Minimum Variance Method</td>
<td>14.4</td>
<td></td>
</tr>
<tr>
<td>D. Eigenstructure Methods I: MUSIC</td>
<td>14.5.2, 14.5.3</td>
<td></td>
</tr>
<tr>
<td>E. Eigenstructure Methods II: ESPRIT</td>
<td>14.5.1,14.5.4</td>
<td></td>
</tr>
<tr>
<td>V. Adaptive Signal Processing</td>
<td>6</td>
<td>12.7</td>
</tr>
<tr>
<td>A. Wiener Filters/Wiener-Hopf equations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Steepest Descent algorithm</td>
<td>13.2</td>
<td></td>
</tr>
<tr>
<td>C. LMS algorithm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

f. Reading List

**Supplemental Reading to be used as reference:**


g. **Library Resources**

Walter E. Helmke Library on the IPFW campus creates a virtual and physical environment that supports the IPFW community in efforts to discover and access vital information. Helmke Library provides high-quality information resources, expert information services, and innovative instruction fully integrated with the educational goals of IPFW.

The Institute of Electrical and Electronics Engineers (IEEE) conference and journal publications are available through Helmke Library as E-Journals. In addition, the library contains holdings of many texts and online resources on the subject of digital signal processing.

h. **Example of a Course syllabus**

See attached.
Indian University—Purdue University at Fort Wayne
Department of Engineering
ECE 538 Digital Signal Processing I
Spring Semester 2010

Professor: Elizabeth A. Thompson
Office: ET 321J
Phone: (260) 481-6361
E-mail: thompson@engr.ipfw.edu
Office Hours:
M noon -2:00 p.m.
T  6-7:30 p.m.
R  6-7:30 p.m.


Prerequisite: ECE 436, Digital Signal Processing, and ECE 302, Probabilistic Methods in Electrical Engineering, or equivalent.

Topics: Sampling and reconstruction, parametric and nonparametric methods of spectrum estimation, adaptive signal processing

Grading:

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>90-100%</td>
<td>A</td>
</tr>
<tr>
<td>80-89 %</td>
<td>B</td>
</tr>
<tr>
<td>70-79 %</td>
<td>C</td>
</tr>
<tr>
<td>60-69 %</td>
<td>D</td>
</tr>
<tr>
<td>Below 60 %</td>
<td>F</td>
</tr>
</tbody>
</table>

Grading Distribution:

- Homework: 25%
- Midterms (2): 30%
- Design Projects (2): 25%
- Final Exam: 20%
- Total: 100%

Design Projects: Two MATLAB projects will be assigned involving spectral analysis, adaptive filtering, or other course topics. Written and/or oral reports will be required at the completion of the projects.

Homework: No late homework will be accepted. Homework is to be turned in at the beginning of class (within the first 5 minutes) on the day it is due. A grade of zero will be assigned for a late or missing homework.

Tests: No make up tests will be given. A grade of zero will be assigned for a missed test. The dates of the two full-period tests and the final exam are as follows:
Test 1  Wednesday, February 10, 2010
Test 2  Wednesday, March 24, 2010
Final  Wednesday, May 5, 2010, 6:15-8:15 p.m.

Attendance: It is expected that you will attend all classes.

Academic Honesty: Each student is expected to submit only his or her own work for credit. The penalty for cheating on a homework, test, or design project will result in a grade of zero on that assignment.

Disabilities: If you have a disability and need assistance, special arrangements can be made to accommodate most needs. Contact the Director of Services for Students with Disabilities (Walb Union, Room 113, telephone number 481-6658) as soon as possible to work out the details. Once the Director has provided you with a letter attesting to your needs for modification, bring the letter to me. For more information, please visit the web site for SSD at http://www.ipfw.edu/ssd/

Course Outcomes

A student who successfully fulfills the course requirements will have demonstrated:

- An understanding of the autocorrelation and covariance methods of estimating the correlation matrix.
- Knowledge of the Discrete Time Fourier Transform (DTFT) and its relationship to the Discrete Fourier Transform (DFT).
- Comprehension of parametric methods of spectrum estimation, including autoregressive modeling, minimum variance, linear prediction, and eigendecomposition-based methods.
- An understanding of nonparametric methods of spectrum estimation, including the periodogram and the correlogram.
- An understanding of linear filters, including the Wiener filter, as applied stochastic to signals.
- An introduction to adaptive filters, including the method of steepest descent and the least-mean-square (LMS) algorithms.