Dear Faculty Curriculum Committee:

Please find enclosed our proposal from the Department of Physics and Astronomy for a new concentration in Computational Neuroscience (CNS) for Physics majors.

This new concentration complements the existing biology-psychology Neuroscience Minor by capturing Physics/Mathematics/Computer Science/Discovery Informatics majors. Since the inception of Neuroscience Minor, over 30 undergraduates belonging to these majors were mentored in CNS, coauthored peer-reviewed papers in (computational) neuroscience, presented at international/ national/ local neuroscience meetings, and some are working towards their Ph.D. in (computational) neuroscience, but none of them graduate with a minor in neuroscience. This CNS targets those Physics/Mathematics/Computer Science/Discovery Informatics majors who are interested and have the adequate background to successfully pursue a mathematical and computational neuroscience program. At the same time, as the Director of Neuroscience Minor mentioned in her letter of support for our initiative, our very high physics/math/computer science requirements make it very difficult to include it this concentration under the umbrella of the existing minor.

The new concentration requires Physics students to take, in addition to two core courses and a capstone experience in computational neuroscience offered by Physics and Astronomy department, extra courses in Psychology (see the attached letter of support from the chairman of the department - Dr. Thomas Ross), Biology (see the attached letters of support from the chairman of the department - Dr. Willem Hillenius – and the Director of Neuroscience Minor – Dr. Elizabeth Meyer-Bernstein), Mathematics (see the attached letters of support from the chairman of the department - Dr. Robert Mignone), and Computer Science (see the attached letters of support from the chairman of the department - Dr. Christopher Wilson Starr).

We also included the new syllabus of the "Digital Signal and Image Processing with Biomedical Applications" course, which is one of the core requirements for this new concentration.

Sincerely,

Sorinel A. Oprisan
A. CONTACT INFORMATION.

Name: Dr. Sorinel A. Oprisan  Phone:  843-953-0780  Email: oprisans@cofc.edu
School: Sciences and Mathematics  Department or Program: Physics and Astronomy

B. CATEGORY OF REVIEW. Please check all that apply, then fill out the specified parts of the form.

☐ Change Request (fill out all sections)
☐ Add an existing course to requirements or electives
☐ Add a new course to requirements or electives (attach completed course form for each)
☐ Delete courses from requirements or electives
☒ Add or modify concentration, emphasis, or track (Note that emphases under 18 hours will not be noted on the transcript. All concentrations, emphases, tracks, etc., with 18 hours or more are called “concentration” on the transcript.)

☐ Terminate Program (fill out C, F, G, and H)
☐ Terminate degree
☐ Terminate major
☐ Terminate emphasis, concentration, or track

C. RATIONALE AND EXPLANATION. Please describe the request you are making and explain why you are making it.

We would like to add a concentration in Computational Neuroscience (CMS) to the existing Physics Major. CMS is broadly defined as the interdisciplinary field that uses mathematical and computational models to investigate the brain's functions in all aspects from molecular to behavioral level. As such, CMS requires a strong background in physics, mathematics, computer science, biology, and psychology. The main objective of this new concentration is to teach our students how to use mathematical and computational methods for solving current problems in biomedical field, in particular in neuroscience. We will offer to Physics and Astronomy majors, and to other interested students, in-depth training on biophysical modeling of excitable cells, data acquisition, analysis and interpretation tailored to bio-signals. The proposed CMS concentration will offer to Physics and Astronomy majors a balanced approach between depth and breadth of knowledge. We acknowledge that CMS is an interdisciplinary endeavor and, therefore, the breadth of the concentration stems from the mandatory electives in (1) biology/psychology/neuroscience, and (2) mathematics/computer science. This new CMS concentration complements the existing biology-psychology Neuroscience Minor by capturing an audience that was not targeted by the existing Neuroscience Minor, i.e., Physics/Mathematics/Computer Science/Discovery Informatics majors. During the last seven years, undergraduates belonging to these majors were mentored in CMS, coauthored peer-reviewed papers in (computational) neuroscience, presented at international/national/local neuroscience meetings, and some are working towards their Ph.D. in (computational) neuroscience, but none of them graduate with a minor in neuroscience. This CMS targets those Physics/Mathematics/Computer Science/Discovery Informatics majors who are interested and have the adequate background to successfully pursue a mathematical and computational neuroscience program. No double counting is allowed between this concentration and any other concentration or minor.

D. CURRICULUM. For revised programs, please attach the complete curriculum. Distinguish between required and elective courses, and note any prerequisites, co-requisites, sequencing, or other restrictions.

Provide the catalog description and course list exactly as they should appear in the catalog. For each new course, submit the Curriculum Committee’s Course Form and a sample syllabus.

Students must take a minimum of 18 credits as listed below.

"PR" indicates a pre-requisite. "CO" indicates a co-requisite. Course descriptions and PR/CO are listed according to the current (2012-2013) catalog.

1. Required Courses (11 credits)
CSCI 220 Computer Programming | 3
(PR: CSCI 120 or CSCI 180 or CSCI 210 or MATH 111 CO: CSCI 220L)
CSCI 220L Computer Programming | Lab | 1
(CO: CSCI 220)
BIOI 396/PHYS 296, Biophysical Modeling of Excitable Cells | 3
(PR: BIOI 111 and 111L or HONS 151 and 151L and BIOI 112 and 112L or HONS 152 and 152L and PHYS 111 and 111L and PHYS 112 and 112 L or HONS 158 and 158L or BIOI 211 and 211D and BIOI 305 and PHYS 101 and 101L and PHYS 102 and 102L; PR or CO: MATH 250)
PHYS 394, Digital Signal and Image Processing with Biomedical Applications (with laboratory) | 3
(New course, Prerequisites: PHYS 122 with lab or HONS 158 with lab, Co-requisite: PHYS 394, Digital Signal and Image Processing with Biomedical Applications Laboratory)
PHYS 394L, Digital Signal and Image Processing with Biomedical Applications Laboratory | 1
(New course, Prerequisites: PHYS 122 with lab or HONS 158 with lab, Co-requisite: PHYS 394, Digital Signal and Image Processing with Biomedical Applications)

2. Elective (Complete minimum 7 credit hours from the following electives. Each elective must be from a different group.)

Group I
BIOI 305 Genetics | 3
(PR: BIOI 111/111L and BIOI 112/112L. CO or PR: BIOI 211 and 211D, MATH 250 or equivalent course in statistics or permission of instructor.)
BIOI 312 Molecular Biology | 3
(PR: BIOI 111/111L, BIOI 112/112L, BIOI 211/211D and BIOI 305; one year of chemistry. CHEM 232 can be substituted for BIOI 211 and 305. CO or PR: MATH 250 or equivalent course in statistics or permission of instructor.)
BIOI 313 Cell Biology | 3
(PR: BIOI 111/111L, BIOI 112/112L, and BIOI 211/211D; one year of chemistry. CO or PR: BIOI 305. CHEM 232 can be substituted for BIOI 211 and 305, MATH 250 or equivalent course in statistics or permission of instructor.)
BIOI 321 General and Comparative Physiology | 4
(PR: BIOI 111/111L, BIOI 112/112L, BIOI 211/211D, and BIOI 305; one year of chemistry. CHEM 232 can be substituted for BIOI 211 and 305. CO or PR: MATH 250 or equivalent course in statistics or permission of instructor.)
BIOI 343 Animal Behavior | 4
(PR: BIOI 111/111L, BIOI 112/112L, BIOI 211/211D, and BIOI 305. CO or PR: MATH 250 or equivalent course in statistics or permission of instructor.)
BIOI 351/PSYC 351, Principles of Neurobiology | 3
(PR: PSYC 103 and BIOI 111 and 111L or HONS 151 and 151L and BIOI 112 and 112L or HONS 152 and 152L; BIOI 211 and 211D or PSYC 214; PR or CO: MATH 250)
BIOI 352/PSYC 352, Neurobiology and Behavior | 3
(PR: BIOI 351 or PSYC 351 or PSYC 214; PR or CO: MATH 250)
BIOI 446/PSYC 446, Special Topics in Neuroscience: Techniques in Neuroscience | 4
BIOI 447/PSYC 447/NSCII 447, Seminar in Neuroscience | 3
(PR: BIOI 351 or PSYC 351 and BIOI 352 or PSYC 352; CO: BIOI 448 or PSYC 448; PR or CO: MATH 250)
PSYC 213 Conditioning and Learning | 3
(PR: PSYC 103)
PSYC 214 Behavioral Neuroscience | 3
(PR: PSYC 103)
PSYC 215 Cognitive Psychology | 3
(PR: PSYC 103)
PSYC 216 Sensation and Perception | 3
(PR: PSYC 103)
PSYC 221 Abnormal Psychology | 3
(PR: PSYC 103)
PSYC 318 Comparative Psychology | 3
(PR: PSYC 103)
PSYC 353 Hormones and Behavior | 3
(PR: PSYC 103 and PSYC 214 or PSYC 216)
PSYC 386 Behavioral Pharmacology | 3
(PR: PSYC 103, either PSYC 214 or BIOI/PSYC 351; PSYC 211 and 220 or 250 or permission of the instructor.)
PSYC 387 Neuropsychology | 3
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSYC 464</td>
<td>Advanced Behavioral Neuroscience with Lab</td>
<td>3</td>
</tr>
<tr>
<td>PSYC 466</td>
<td>Advanced Sensation and Perception with Lab</td>
<td>3</td>
</tr>
<tr>
<td>PSYC 468</td>
<td>Advanced Cognitive Psychology with Lab</td>
<td>3</td>
</tr>
<tr>
<td>MATH 207</td>
<td>Discrete Structures I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 307</td>
<td>Discrete Structures II</td>
<td>3</td>
</tr>
<tr>
<td>MATH 245</td>
<td>Numerical Methods and Mathematical Computation</td>
<td>3</td>
</tr>
<tr>
<td>MATH 246</td>
<td>Mathematical Computing and Programming Lab</td>
<td>1</td>
</tr>
<tr>
<td>MATH 445</td>
<td>Numerical Analysis</td>
<td>3</td>
</tr>
<tr>
<td>MATH 451</td>
<td>Linear Programming and Optimization</td>
<td>3</td>
</tr>
<tr>
<td>MATH 452</td>
<td>Operations Research</td>
<td>3</td>
</tr>
<tr>
<td>MATH 470</td>
<td>Mathematical Modeling</td>
<td>3</td>
</tr>
<tr>
<td>MATH 440</td>
<td>Statistical Learning I</td>
<td>3</td>
</tr>
<tr>
<td>CSCI 221</td>
<td>Computer Programming II</td>
<td>3</td>
</tr>
<tr>
<td>CSCI 230</td>
<td>Data Structure and Algorithms</td>
<td>3</td>
</tr>
<tr>
<td>CSCI 334</td>
<td>Data Mining</td>
<td>3</td>
</tr>
<tr>
<td>CSCI 360</td>
<td>Software Architecture and Design</td>
<td>3</td>
</tr>
<tr>
<td>CSCI 362</td>
<td>Software Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CSCI 380</td>
<td>User Interface Development</td>
<td>3</td>
</tr>
<tr>
<td>CSCI 470</td>
<td>Principles of Artificial Intelligence</td>
<td>3</td>
</tr>
<tr>
<td>CSCI 480</td>
<td>Principles of Computer Graphics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 203</td>
<td>Physics and Medicine</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 270</td>
<td>Nanotechnology in Medicine</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 298</td>
<td>Special Topics*</td>
<td>1-3</td>
</tr>
<tr>
<td>PHYS 320</td>
<td>Intro to Electronics</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 340</td>
<td>Photonics</td>
<td>4</td>
</tr>
</tbody>
</table>
PHYS 381, Internship* 3
- or - (Not both!)
PHYS 390, Research* 3
HONS 390 Special Topics* 3-6
   (PR: None)
PHYS 390 Research* 1-3; repeatable up to 6
   (PR: Department chair and instructor permission)
PHYS 399 Tutorial* 3; repeatable up to 12
   (PR: Junior standing and department chair and instructor permission)
PHYS 405, Thermal Physics 3
   (PR: PHYS 230)
PHYS 407, Introduction to Nuclear Physics 3
   (PR: PHYS 230)
PHYS 408, Introduction to Solid State Physics 3
   (PR: PHYS 230)
PHYS 412, Special Topics* 3-4
PHYS 415, Fluid Mechanics 3
   (PR: MATH 323 and PHYS 301)
PHYS 420 Senior Research* OR 3
   (PR: PHYS 419 and instructor and department chair permission)
PHYS 499 Bachelor’s Essay* OR BIOL 448/PSYC 448/NSCI 448, Bachelor’s Essay in Neuroscience
   (PR: PHYS 419 and instructor and department chair permission)

Note: Credit will not be awarded for both Senior Research (PHYS 420) and Bachelor’s Essay (PHYS 499/BIOL 448/PSYC 448/NSCI 448).

*Must be CNS related and conducted under the mentorship of a neuroscience faculty from the C of C or co-mentorship with MUSC faculty. Prior written approval must be obtained from the coordinator of CNS concentration.
### E. STUDENT LEARNING OUTCOMES AND ASSESSMENT.

<table>
<thead>
<tr>
<th>Student Learning Outcomes</th>
<th>Assessment Method and Performance Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>What will students know and be able to do when they complete the major or program?</td>
<td>How will each outcome be measured? Who will be assessed, when, and how often? How well should students be able to do on the assessment?</td>
</tr>
<tr>
<td><strong>1. Demonstrate the ability to use mathematical models in solving biophysically-related problems in the field of excitable cells and biological neural networks.</strong></td>
<td>Abstract mathematical competence will be demonstrated through quizzes, homework assignments, tests and final exam. The students should be able to identify the elements of a mathematical model, e.g., ionic currents that make-up the rate equation for membrane voltage, and have a qualitative understanding of the solution of rate models.</td>
</tr>
<tr>
<td><strong>2. Demonstrate the ability to implement computer codes that simulate biophysically-relevant mathematical models in the field of excitable cells and biological neural networks.</strong></td>
<td>Computational competence will be demonstrated through quizzes, homework assignments, computer laboratories, tests and final exam, and end-of-semester projects. The students should be able to identify the appropriate computer code for their specific problem, download from existing CNS databases, e.g., NeuronDB, and successfully run numerical simulations. The students should be able to match mathematical equations to computer implementations in existing codes, modify and use computer code in numerical simulations.</td>
</tr>
<tr>
<td><strong>3. Demonstrate the ability to use existing computer packages to acquire, store, retrieve, and analyze bio-signals.</strong></td>
<td>Computational competence will be demonstrated through, homework assignments, computer laboratories, and end-of-semester projects. The students should be able to manipulate the basic parameters of specific packages, upload data into the program, perform data analysis, export results (spreadsheets and graphs), and prepare presentations based on given data.</td>
</tr>
<tr>
<td><strong>4.</strong></td>
<td></td>
</tr>
</tbody>
</table>

Additional Outcomes or Comments: Through this additional opportunity offered to Physics and Astronomy majors, the students will connect abstract mathematical concepts (derivatives, integrals, and differential equations), computer implementation of a mathematical model, and biophysical meaning of the results. The students will master standard techniques in bio-signals and image processing (spectral analysis, filtering, time-frequency domain mapping, etc.) that will prove invaluable in the marketplace or graduate school. In the end, the same signal and image processing techniques they will learn in CNS apply everywhere physicists can measure a signal. And physicists are doing just that – measure and analyze signals – from the faint vibrations at subatomic level to images of distant galaxies.

### F. IMPACT ON EXISTING PROGRAMS AND COURSES.

Please describe the impact of this request on other programs and courses. If you are deleting a minor, please describe the effect on all programs that will
be impacted; if you are adding or changing a minor, please explain any overlap with existing programs at
the College.

The proposed Computational Neuroscience (CNS) concentration is unique at the College of Charleston and there are only
a handful of schools offering such an opportunity to undergraduates. The proposed concentration will allow Physics and
Astronomy majors to explore the mathematical and computational complexities of biophysical modeling from a physics
perspective. This new CNS concentration aligns with the department's goal of "excellence in teaching within a liberal arts
environment". We strive to serve an important need in our society, and to provide a career path for students who want to
be a part of the solution to the problems associated with bioengineering and computer modeling of real-world biophysical
systems.

This new CNS concentration encourages Physics and Astronomy majors to apply their theoretical knowledge on
differential equations and signal processing to solving real-world problems. Through our strong collaboration with the
Medical University of South Carolina, we will involve our undergraduates in projects such as predicting the onset of
epileptic seizure from EEG recordings, measuring the effect of amphetamines on learning by estimating the power
spectrum of brain's waves, designing and implementing electronic neurons for prosthetic devices, etc.

It is not expected that this new program will cause any student to change their major. This new CNS concentration is
designed both to give our Physics and Astronomy majors an extra option that has strong career aspects and to attract
new students to the College. We expect this CNS concentration to result in some BA students taking more upper-level
physics/mathematics/computer science classes that they had previously, and also promote some growth in the number of
BS majors. In either case, there is ample expansion room in the physics courses (by approximately a factor of two) to
accommodate the growth.

G. COSTS ASSOCIATED WITH THE REQUESTED ACTION. List all of the new costs or cost savings
(including new faculty/staff requests, library, or equipment) associated with your request.

New faculty/staff: No additional faculty or adjunct lines are required.
Equipment/space: No additional resources are required. The instructional laboratory resources in Physics and
Astronomy Department can also serve this CNS concentration.
Library: No additional resources are required. The library currently has a number of related holdings, a large collection of
books suitable for supplementary readings, and subscriptions to related journals, e.g., Journal of Computational
Neuroscience, Frontiers in Computational Neuroscience, Journal of Mathematical Neuroscience, etc.

H. CHECKLIST

☒ I have completed all relevant parts of the form.
☒ I have attached a cover letter that describes my request and lists all the documents I am submitting.
☒ I have attached a Course Form for each newly-created or modified course.
☒ (For proposals that affect other departments in any way) I have attached an acknowledgement from the
relevant department.
☒ I have provided the complete curriculum for the program, concentration, emphasis, etc., including the
description and course list, exactly as it should appear in the catalog.

Page 6 of 7
1. Signature of Department Chair or Program Director:

Narayanan Kirthiramu
Date: 1/23/2013

2. Signature of Academic Dean:

Paul Abraham
Date: 2/10/13

3. Signature of Provost:

Date: 3/7/13

4. Signature of Curriculum Committee Chair:

Date:

5. Signature of Budget Committee Chair:

Date:

6. Signature of Academic Planning Committee Chair:

Date:

7. Signature of Faculty Senate Secretary:

Date:

Date Approved by Faculty Senate:
Dear Faculty Curriculum Committee:

Please find enclosed our proposal from the Department of Physics and Astronomy for a new course – “Digital Signal and Image Processing with Biomedical Applications.”

Physicists dedicate a significant portion of their formal training to designing and carrying out experiments that record signals, e.g., daily temperature, air pressure, speed of winds, or images, e.g., optical/acoustic images of propagating waves through different media, interference patterns, visible/infrared/X ray images of galaxies, etc. The second largest task for physicists is to analyze the signals and images they recorded. This course provides a systematic introduction to the fundamental methods and tools used in modern physics for the purpose of acquiring, storing, analyzing, and visualizing signals and images. Although the concepts covered by this course are general and applicable to any type of signal, we will emphasize the applications to bio-signals. The actual signals that will be used by students to carry out class projects and lab activities were obtained from existing databases and from our collaborators at MUSC. The signals that will be used in this class include human electroencephalograms, in vivo and in vitro single-cell recordings, local field potential recordings from slices, etc.

This new course supports all key learning outcomes associated with our Physics major (see the Office for Institutional Effectiveness and Planning website): (1) This course fosters scientific manuscript preparation skills through extensive lab report writings and the end-of-semester computational project. (2) This course enhances computational skills that the students will use for solving theoretical and/or applied problems. (3) This course develops statistical understanding of experimental results and teaches students how to apply statistical tools and techniques, e.g., to signal denoising and enhancing signals through stochastic/statistical learning.

The detailed syllabus of the new course is included in this package.

Sincerely,

Sorinel A. Oprisan
FACULTY CURRICULUM COMMITTEE
COURSE FORM

Instructions:
- Please fill out one of these forms for each course you are adding, changing, deactivating, or reactivating.
- Fill out the parts of the form specified in part B. You must do this before your request can move forward!
- Remember that your changes will not be implemented until the next catalog year at the earliest.
- If you have questions, please start by checking the instructions on the website. Please feel free to contact the committee chairs with any remaining questions you might have.

A. CONTACT/COURSE INFORMATION.

Name: Sorinel A. Oprisan  Phone: 843-953-0780  Email: oprisans@cofc.edu

Department or Program: Physics and Astronomy  School: SSM

Subject Acronym and Course Number: PHYS 394

B. TYPE OF REQUEST. Please check all that apply, then fill out the specified parts of the form.

☐ Add a New Course (complete parts C, D, F, G, H, I, J, K)
☐ Change Part of an Existing Course (complete parts C, D, E, F, G, I, J, K)
  ☐ Course Number
  ☐ Course Name
  ☐ Course Description
  ☐ Credit/Contact Hours
  ☐ Restrictions (prerequisites, co-requisites, junior/senior standing, etc.)
☐ Deactivate an Existing Course (complete parts C, D, E, G, I, J, K)
☐ Reactivate a Previously-Deactivated Course (complete parts C, D, E, G, I, J, K)

C. RATIONALE AND EXPLANATION. Please describe your request and explain why you are making it.

D. Physicists dedicate a significant portion of their formal training to designing and carrying out experiments that record signals, e.g., daily temperature, air pressure, speed of winds, or images, e.g., optical/acoustic images of propagating waves through different media, interference patterns, visible/infrared/X ray images of galaxies, etc. The second largest task for physicists is to analyze the signals and images they recorded. This course provides a systematic introduction to the fundamental methods and tools used in modern physics for the purpose of acquiring, storing, analyzing, and visualizing signals and images. Although the concepts covered by this course are general and applicable to any type of signal, we will emphasize the applications to bio-signals. The actual signals that will be used by students to carry out class projects and lab activities were obtained from existing databases and from our collaborators at MUSC. The signals that will be used in this class include human electroencephalograms, in vivo and in vitro single-cell recordings, local field potential recordings from slices, etc.

E. IMPACT ON EXISTING PROGRAMS AND COURSES. Please briefly describe the impact of your request on other programs and courses. If another program requires the course, you must submit their written acknowledgement with this proposal. Also, the affected program must describe any change in the number of credit hours they require. Include a list of similar courses in other departments and explain any overlap.

This course is only required by the newly proposed concentration in computational neuroscience within the Department of Physics and Astronomy. To our knowledge, there is no other course currently listed in the Catalog that covers the same topics. During our discussion with the Department of Computer Science (CS), we learned that they also offered in the past a special topics class on image processing. However, after reviewing
our syllabus together with the chairman of CS department it was clear that we do not overlap. Briefly, CS
teaches the algorithms behind image processing, how the algorithms are coded in specific programming
languages (C, Python, etc.), study the numerical efficiency/complexity and optimization of image processing
algorithms. Our course focuses on how to use the existing tools, we do not teach how a certain algorithm was
implemented, we rather teach how to use existing computational tools, how to apply them to our bio-signals
and how to read the results of such computations.

F. EXISTING COURSE INFORMATION. If you are proposing a new course, just leave this blank.
Otherwise, please fill out all fields.

Department: 
School: 
Subject Acronym: 
Course number: 

Credit hours: __ lecture __ lab __ seminar __ independent study
Contact hours: __ lecture __ lab __ seminar __ independent study

Course title:

Course description (maximum 50 words, exactly as it appears in the catalog):

Restrictions (pre-requisites, co-requisites, majors only, etc.):

Cross-listing, if any:

Is this course repeatable? □ yes  □ no  If yes, how many total credit hours may the student earn? ____

G. NEW COURSE INFORMATION. If you are deactivating a course, leave this blank. Otherwise, please
fill out all fields. For changed courses, use boldface for the information that is changing.

Department: Physics and Astronomy  School: SSM  Subject Acronym:  PHYS  Course Number: 394

Credit hours:  3 lecture  1 lab  3 seminar  2 independent study
Contact hours:  3 lecture  3 lab  3 seminar  2 independent study

Course title: Digital Signal and Image Processing with Biomedical Applications

Course description (maximum 50 words, exactly as it appears in the catalog):

A systematic presentation of mathematical aspects and the corresponding computational techniques and
tools currently used in digital signal and image processing. The topics include signal sampling, temporal
and frequency domain representations, filtering, denoising, enhancing, and visualization of signals with
emphasis on biomedical data.

Restrictions (pre-requisites, co-requisites, majors only, etc.):

Pre-requisites: PHYS 112 with lab or HONS 158 with lab
Co-requisite: Introduction to Signal and Image Processing with Biomedical Applications Laboratory

Cross-listing, if any (submit approval from relevant department): none

Is this course repeatable? □ yes  □ no  If yes, how many total credit hours may the student earn? ____
Is there an activity, lab, or other fee associated with this course? ☒ yes □ no  
*Note: All fees require approval from the Board of Trustees.*

If this is a newly-created course, is it intended to be the equivalent of an existing course? □ yes ☒ no  
If so, which course? ________________  
*Note: You must deactivate the course by submitting an additional Course Form.*

**H. COSTS.** List all of the new costs or cost savings (including new faculty/staff requests, library, equipment, etc.) associated with your request.

- **New faculty/staff:** No additional faculty or adjunct lines are required.  
- **Equipment/space:** No additional resources are required. The instructional laboratory resources in Physics and Astronomy Department can also serve this course.  
- **Library:** No additional resources are required. The library currently has a number of related holdings, a large collection of books suitable for supplementary readings, and subscriptions to related journals in the field of digital signal and image processing with biomedical applications, e.g., Journal of Computational Neuroscience, Frontiers in Computational Neuroscience, Journal of Mathematical Neuroscience, etc.

**H. STUDENT LEARNING OUTCOMES AND ASSESSMENT.**

<table>
<thead>
<tr>
<th>Student Learning Outcomes</th>
<th>Assessment Method and Performance Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>What will students know and be able to do when they complete the course?</td>
<td>How will each outcome be measured? Who will be assessed, when, and how often? How well should students be able to do on the assessment?</td>
</tr>
<tr>
<td>1. Demonstrate the ability to use mathematical models of filters, Fourier representation of signals, denoising and enhancing techniques as applied to biomedical data.</td>
<td>Abstract mathematical competence will be demonstrated through quizzes, homework assignments, tests and final exam/computational project. The students should be able to identify the elements of a mathematical model, e.g., the Nyquist limit of Fourier representation of signals, the frequency band of wavelets, and the parameters of a z-transforms.</td>
</tr>
<tr>
<td>2. Demonstrate the ability to implement small, high-level, computer codes that can read, analyze and visualize biomedical data.</td>
<td>Computational competence will be demonstrated through quizzes, homework assignments, computer laboratories, tests and final exam/end-of-semester projects. The students should be able to download, install, and run computer codes from existing databases dedicated to biomedical applications of signal and image processing. The students should be able to match mathematical equations to computer implementations in existing codes, modify and use computer code in numerical simulations.</td>
</tr>
<tr>
<td>3. Demonstrate the ability to use existing computer packages to acquire, store, retrieve, and analyze bio-signals.</td>
<td>Mathematical and computational competence will be demonstrated through homework assignments, computer laboratories, and end-of-semester projects. The students should be able to identify the appropriate computational tools for a given data set, e.g., EEG tools are different from local field potential tools or from single-cell recordings. The students should be able to manipulate the basic parameters of specific packages, upload data into the program, perform data analysis, export results (spreadsheets and graphs), and prepare presentations based on given data.</td>
</tr>
</tbody>
</table>
How does this course align with the student learning outcomes articulated for the major, program, or general education? What program-level outcome or outcomes does it support? Is the content or skill introduced, reinforced, or demonstrated in this course?

The above student learning outcomes for this course are derived from those listed by the Department of Physics and Astronomy on Office for Institutional Effectiveness and Planning website. In particular, the first learning objective of our major, i.e., “1. Physics majors will employ scientific manuscript preparation skills (e.g. Microsoft equation editor, LaTeX, and/or by creating and embedding figures in manuscripts)” will be achieved through extensive lab report writings and the end-of-semester computational project. The second learning outcome for all our majors, i.e., “Physics majors will demonstrate the ability to use computational analysis techniques (e.g. IDL, Mathematica, spreadsheets) to solve theoretical and/or applied problems” is the essence of this new computational course in digital signal and image processing. We will enhance the computational training and experience offered to our students in a crucial field for all physicists – signal processing – which covers techniques from data acquisition up to data visualization. Finally, the last of the three learning outcome established by the department for our majors, i.e., “Physics majors will demonstrate the ability to use statistical methods to compare experimental results and/or observations to theory” is naturally embedded in our signal processing course, which, among other techniques, will use statistical estimators for denoising signals, computing signal to noise ratio, enhancing signals through stochastic/statistical learning, etc. This course supports all key outcomes associated with our major.

1. PROGRAM CHANGES. Will this course be added to the existing degree requirements or list of approved electives of a major, minor, or concentration? If so, please explain briefly and attach a Change Minor or Change Major/Program Form as appropriate.

This course is a core requirement for the new concentration in computational neuroscience for Physics majors. Both the new course and the concentration are presented for approval simultaneously.

J. CHECKLIST.

☒ I have completed all relevant parts of the form.

☒ I have attached a cover letter that describes my request and lists all the documents I am submitting.

☒ (For new courses only) I have attached a syllabus.

☐ (For courses used in any way by other departments, including cross-listing) I have attached an acknowledgement from the relevant department.

☐ (For courses intended to fulfill a Gen Ed requirement) I have submitted the proposal to the Gen Ed committee.
K. APPROVAL AND SIGNATURES.

1. Signature of Department Chair or Program Director:

   
   Date: 1/23/2013

2. Signature of Academic Dean:

   
   Date: 2/11/13

3. Signature of Provost:

   
   
   Date: ____________

4. Signature of Curriculum Committee Chair:

   
   
   Date: ____________

5. Signature of Faculty Senate Secretary:

   
   
   Date: ____________

Date Approved by Faculty Senate: ____________
DIGITAL SIGNAL AND IMAGE PROCESSING WITH BIOMEDICAL APPLICATIONS

"The world of science and engineering is filled with signals: images from remote space probes, voltages generated by the heart and brain, radar and sonar echoes, seismic vibrations, and countless other applications. Digital Signal Processing (DSP) is the science of using computers to understand these types of data. This includes a wide variety of goals: filtering, speech recognition, image enhancement, data compression, neural networks, and much more. DSP is one of the most powerful technologies that will shape science and engineering in the twenty-first century." (From The Scientist and Engineer’s Guide to Digital Signal Processing)

This course will present in a systematic way the mathematical theory underlying DSP techniques, such as Fourier, digital filter design, signal compression, etc. The theoretical algorithms for signal processing will be implemented using industry standard programming language in order to build biomedical applications on a strong theoretical background.

1 COURSE PHILOSOPHY

This course will introduce the students to the basic theoretical methods used in digital signal and image processing with biomedical physics applications. Although historically the origin of digital signal processing (DSP) is in electrical engineering and referred initially to electrical signals through telephone wires and radio waves, it expanded and nowadays includes single or multiple electrode recordings from biological tissue, denoising and enhancement of signals produced by medical devices in hospitals, e.g., electroencephalography (EEG) and electromyography (EMG), etc. Likewise, images are seen as two-dimensional signals and all signal processing techniques (filtering, denoising, resampling, etc) apply to images. Some image enhancement algorithms will be exemplified with x-ray and ultrasound images. The purpose is to demonstrate how relevant biological structures are identified and how the process can be automated. This course will also exemplify basic segmentation and pattern recognition algorithms for localization and identification of biologically relevant structures in medical images.

This course covers the fundamentals of DSP and their use in various biomedical applications. The subject matter covers basic principles of processing signals, sampling and quantization, time and frequency domain representation and analysis of discrete-time signals and systems, digital filter design. The course will also review classic analog filter design, finite-precision effects on data reconstruction, adaptive systems, signal compression and coding. The signal and image processing concepts are always emphasized in relation to their biomedical applications. All theoretical techniques will be practiced both on actual signals made available to us by our collaborators at Medical University of South Carolina and from public databases.

2a Goals/Student Learning Outcomes

- Define and apply the fundamentals of DSP and possible biomedical applications.
- Demonstrate a strong mathematical understanding of signal representations.
- Demonstrate the ability to design, implement, and use DSP tools for data analysis.
- Discuss the advantages and limitations of computer algorithms used in DSP.
- Discuss historical and contemporary impact of DSP on daily life.
• Communicate effectively.
• Apply advanced mathematics (including differential equations and statistics), science, and engineering to solve the problems at the interface between engineering and biology.

2b Objectives
After the successful completion of this class, the students will be able to:
• Distinguish between analog and digital signals.
• Understand the advantages and limitations of DSP along with their fundamental tradeoffs.
• Represent signals in various dimensions (1D, 2D, etc.)
• Express the relationship between frequency and time/space representations of signals.
• Represent and process signals both in the temporal/spatial as well as frequency domain.
• Acquire, store, filter, enhance, and visualize, high dimensional data such as 2D pictures, 3D biomedical images.
• Design standard filters for signal denoising, enhancement, and restoration.
• Understand where and how DSP techniques are used in real life and practical applications.
• Develop simple DSP applications in Matlab and/or other platforms.
• Determine properties of discrete-time systems such as linearity, stability, shift-invariance, and causality.
• Model signals using difference equations and compute their solutions.
• Visualize and compute discrete-time convolutions and correlations.
• Apply the Z-transform as a tool in system modeling and analysis. Perform Z and inverse Z using tables, Partial Fraction Expansion, and power series expansion.
• Draw block diagrams of common digital filters.
• Demonstrate an understanding of the discrete-time Fourier transform (DFT) and the concept of digital frequency.
• Calculate the DFT of a signal.
• Choose the sampling rate for a digital system and understand the effects of aliasing.
• Design and implement digital filters by hand and by using Matlab.
• Design FIR filters using the window design method.

3 COURSE LOGISTIC

3a Pre-requisites: PHYS 112 with lab or HONS 158 with lab.
Co-requisite: Introduction to Signal and Image Processing with Biomedical Applications Lab.
The programming language of this class is MATLAB. Recommended math background: college linear algebra (MATH 203) or equivalent.

3b Textbooks
• Eugene N. Bruce, Biomedical Signal Processing and Signal Modeling, John Wiley & Sons, 2000
• Edward Neuman, Matlab Tutorials, Southern Illinois University at Carbondale (available for downloading through course management website).
3c  Lectures

Each class period will be in the form of an interactive discussion based on the feedback I received from the reading assignments such that you actually tailor the lecture according to your needs.

The lecture could be periodically interrupted by short concept tests, short multiple-choice questions that focus on the more difficult concepts. You will be able to answer these questions using your “clicker.” The purpose of the in-class concept questions is to challenge your understanding of the newly introduced material without worrying about your grade -- just your participation. They provide a form of continuous self-assessment and also give me important feedback. The goals of these concept questions are to build intuition and confidence, to overcome any confusion, and to clarify conceptual difficulties. Students are expected to not only attend class, but also to actively participate in the concept discussions with their classmates and with the instructor. All of the concept questions will also be available for review online immediately after each class. To respond to the conceptual questions asked in class you need a device that is capable of communicating with our computers. Physics and Astronomy Department bought the remote control units (“clickers”) for classroom response that you can borrow at the beginning of each lecture. The borrowed clicker must be returned at the end of the class. You cannot share a clicker with another student during the class meeting because neither of you will receive credit. Using more than one clicker or otherwise impersonating another student in class constitutes academic dishonesty.

3d  Lab sessions

*Digital Signal and Image Processing with Biomedical Applications* relies heavily on computers and software packages, such as Matlab, to solve problems related to data manipulation/visualization. There is a separate and mandatory three contact hours (one credit) lab in conjunction with this lecture.

3c  Support resources

There are many ways to get assistance with the material in this course.

- Office hours: I will always be available during the posted office hours. If you cannot meet me during any of the posted times, call/email me to make an appointment.
- E-mail: oprisans@cofc.edu. Please consider posting your query related to the course materials on the discussion board on our course management system. This way we avoid duplication of commonly asked questions and others in the class will benefit from your question.
- Phone: (843) 953-0780.
- Other resources: The College offers many other resources for help, including tutoring and reserve materials. The Center for Student Learning offers a comprehensive academic support program available to all students. The Center is located on the first floor of Addlestone Library. Please call (843) 953-5635 or check their website (http://www.cofc.edu/~csl/) for more information.
4a Final exam

The final exam is comprehensive and scheduled for ..., between ... and ... in the Rita Hollings Science Center, room ... (http://www.cofc.edu/~register/courseCalendars.htm). The date and time of the final exam were set by the Office of Registrar and cannot be changed. There will be no make-ups for the tests or the final exam.

An alternative format to the traditional written comprehensive final exam is the option of a semester-long computational project related to signal and image processing with biomedical applications. The project could be your individual effort or a group project with no more than three members. To receive a grade for your computational project you must: (1) prepare a PowerPoint presentation and present it during the scheduled time at the end of the semester, and (2) submit an electronic final report (LaTeX preferred) no later than the final exam date to obrisans@cofc.edu. If you decide to complete a computational project, then you must submit an initial draft, no later than one month after the beginning of the semester, containing the following items:

- a tentative title
- name(s) of the student(s) involved (no more than three)
- a short abstract (less than 300 words) describing the purpose of the project, required resources, cost of implementation, and expected results
- a timeline for your project with measurable milestones
- a list of references

The project title and the abstract are not final and you are free to alter them during the semester. Constantly inform me about your progress in order to make sure that the final presentation and written report are acceptable.

The final presentation of your project should be short (15-20 minutes) and prepared in PowerPoint. A possible layout of the presentation is as follows:

- background (because not everybody is familiar with the bibliography you read for this project and the importance of your biomedical application)
- statement of the problem
- biomedical relevance and impact of the problem you addressed
- methods and results
- conclusion and further work

The presentation and your final report will be made available through our course management system to all students. The final report should be brief but self-consistent. The report should be organized as a research paper (LaTeX preferred). A possible layout of the presentation is as follows:
• Title
• Author(s)
• Abstract
• Introduction
• Methods and Results
• Conclusions
• Acknowledgments
• References

If I found the project extensive enough to justify a group effort, and unless you decide to explicitly state the percent effort, I will assume that each member of the group contributed equally and will receive the same grade.

4b In-class tests

There will be (up to) four in-class tests during the semester. The tests will consist of a mix of conceptual and quantitative problems, and they may be in multiple-choice format. The concept questions will be similar to the concept questions solved in class or from your reading quizzes. The quantitative problems will be similar to the assigned homework problems and the examples given in your textbook. The in-class test with the lowest score is dropped from the final grade calculation. There will be no make-ups for the tests or the final exam!

No textbooks, notes, or any other kind of help is allowed during tests and final exam. During the semester we will compile a short formula sheet that will be made available to everyone during the tests.

4c Homework

All homework assignments are based on the end of the chapter problems from the adopted textbook. They will consist mostly of quantitative evaluations with the purpose of developing your problem solving skill and sharpen your conceptual understanding of signal processing techniques.

Although not required, I strongly advise you to keep detailed solutions of the problems that you solved and bring them with you during office hours such that I have a clear understanding of your line of thought. Finally, a notebook containing detailed solutions to homework assignments will be an invaluable resource for your tests and final exam preparation.

In case our lectures overlap with C of C observed religious holidays, illness, or other personal emergency you can request a deadline extension. Any such requests must be made before the due date.

4d Reading assignments

Readings from the adopted textbook and additional materials will be assigned for each class meeting. I do not expect you to understand everything before coming to class, but only to familiarize yourself with new material through critical reading. The purpose of reading quizzes is to maintain an active tone of our class, signaling to me which part of the curriculum is most difficult to you, and maximize your benefit from lecture and stimulate class participation. I will read your answers to posted reading assignment, reply to some of you before class, and address
frequently raised issues during class. Each reading assignment quiz will be available online through our course management system at least 24 hours before the deadline. The deadline for the reading quiz is usually the noon of the day before our class meeting such that I have enough time to read your answers. Any missed reading quiz gets zero points and there is no make-up. The quiz questions are graded on a two-point scale (2 = demonstrates reading; 1 = room for improvement; 0 = unsatisfactory). Your answer should prove that you have read the material for understanding and are beginning to synthesize the information in a coherent manner. The correctness of your answer is irrelevant at this stage.

If the course management system server is not available to complete the assignment online, you may submit your reading assignment via e-mail to oprisans@cofc.edu. In the event of a total network failure, hand in a summary, in your own words, of the contents of the reading assignment plus a paragraph describing which part(s) of the reading you found confusing or interesting. The summary should be two to three paragraphs long, may not contain equations or definitions copied from your textbook.

4f The grading scale is as follows:

<table>
<thead>
<tr>
<th>Letter grade</th>
<th>A</th>
<th>A-</th>
<th>B+</th>
<th>B</th>
<th>B-</th>
<th>C+</th>
<th>C</th>
<th>C-</th>
<th>D+</th>
<th>D</th>
<th>D-</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality</td>
<td>4.0</td>
<td>3.7</td>
<td>3.3</td>
<td>3.0</td>
<td>2.7</td>
<td>2.3</td>
<td>2.0</td>
<td>1.7</td>
<td>1.3</td>
<td>1.0</td>
<td>0.7</td>
<td>0.0</td>
</tr>
<tr>
<td>points</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage</td>
<td>93.0-100</td>
<td>90.0-92.9</td>
<td>87.0-89.9</td>
<td>83.0-86.9</td>
<td>80.0-82.9</td>
<td>77.0-79.9</td>
<td>73.0-76.9</td>
<td>70.0-72.9</td>
<td>67.0-69.9</td>
<td>63.0-66.9</td>
<td>60.0-62.9</td>
<td>Bellow 60</td>
</tr>
</tbody>
</table>

5 COURSE POLICIES

5a Collaboration

I strongly encourage collaboration in and out of class. I recommend that you form small study groups (3-6 students) and work together on your homework assignments, lab assignments and computational projects. Because the course is graded on an absolute scale, you will never reduce your grade by helping others—to the contrary, by doing so you will reinforce your own knowledge and improve your performance. Before working together or consulting others on any assignment, it pays to give yourself the opportunity to work on it alone.

Activities for which collaboration is not permitted are: reading quizzes, in-class tests, and the final exam.

5b Class conduct

There shall be no eating, drinking, or sleeping in the class. Cell phones, beepers, headsets and any other electronic devices that may disrupt the class must be turned off and put away prior to class unless you have a job requiring them to be on for safety (firefighter, EMT, etc.). Talking on cell phones in class is strictly prohibited. Please refer to the student handbook for additional information.

6 of 9
5c Attendance is important because we will develop a flexible lecture based on your feedback from reading assignments. Although the in-class concept tests will be available online along with their correct answer, by missing a class you miss the opportunity to express yourself, argue with your neighbors about the logic of your deductions, and correct your own, or help other correcting their misunderstandings. In addition, according to the College of Charleston Academic Regulations, “students are expected to attend all classes and laboratory meetings of each course in which they enroll.”

5d Accommodations for Special Needs Students

The College of Charleston is committed to fully provide for the needs of enrolled or admitted students who have disabilities under Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990. Please contact the Center for Disability Services (http://www.cofc.edu/~cds/) by phone: (843) 953-1431 and (843) 953-8284, or email them at SNAP@cofc.edu to make your needs known. According to http://www.cofc.edu/~cds/, “Legally students have a right not to be identified as disabled if they so choose. They will not receive accommodations unless they identify themselves, but that too is their choice. The student should have a letter from the Director of Disability Services stating that he or she has been approved for these services, or you may ask to see his or her Professor Notification Letter from the Center for Disability Services confirming that the student is eligible for these services. If the student has not been approved for SNAP Services, you are not required to provide any accommodations. Final examinations must be taken at the time scheduled” with a few exceptions (see http://www.cofc.edu/~cds/). “Permission to reschedule exams may be obtained from the Office of the Registrar with written permission of the instructor.” (for details see http://www.cofc.edu/~cds/).

5e Academic Honesty Policy

Academic integrity is fundamental to the process of learning and evaluating academic performance. Academic dishonesty will not be tolerated. Academic dishonesty includes, but is not limited to, the following: cheating, plagiarism, tampering with academic records and examinations, falsifying identity and being an accessory to acts of academic dishonesty. Please refer to the Academic Integrity and the Honor Code and the College of Charleston Student Handbook 2005-2006 – “A Guide to Civil and Honorable Conduct”, for further information.
The following is a tentative list of topics for *Signal and Image Processing with Biomedical Applications* lectures. Both the topics and/or the test dates could change during the semester to accommodate unforeseen events. It is your responsibility to check our course management system on a regular basis (at least once before each class meeting) to make sure you have the latest information.

**Week 1:** Characteristics of bio-signals: non-linear, non-stationary, and not normally distributed. Sampling and quantization. Vector space models for signals and images with biomedical applications. Typical Sources of Biomedical Signals. What is Noise?


**Week 3:** Discrete Time Fourier Transforms (DTFT) and Discrete Fourier Transforms (DFT)

**Week 4:** Circular convolution, Fast Fourier Transform (FFT) algorithms, and Z-Transforms

**Week 5:** Filters and Fourier Transforms: finite impulse response (FIR) and widowning

**Week 6:** FIR: weighted least square, and Parks-McClellan method.

**Week 7:** Nyquist criteria for sampling signals: sampling and aliasing

**Week 8:** Oversampling, upsampling and downsampling. Examples of biomedical signal processing - Probabilistic estimation.

**Week 9:** Noise Removal and Signal Compensation. Wavelets: time-frequency tilings, uncertainty principle. MEG motor activity detector.

**Week 10:** Harr wavelets and multiresolution. Hart rate estimation using harmonic analysis.

**Week 11:** Wavelet Analysis and Synthesis Matrices. Decoding multi-electrode EEGs using spectral methods.

**Week 12:** Coding and compression with wavelets. Independent components analysis of electrophysiologival recordings.

**Week 12:** Quantization and Compression. Filter Banks and Modulation Matrices. Perfect Reconstruction (PR) Filter Banks

**Week 13:** Image acquisition, digital image representation, spatial Resolution, aliasing and distance measures

**Week 14:** Image enhancement, image statistics with histograms, enhance medical images. Ultrasound image processing.

Additional readings (those available through the C of C Addlestone Library are marked with *):

- **Linear algebra**
  - Jonathan S. Golan, *The linear algebra a beginning graduate student ought to know*, 2012*.

- **General DSP**
• Zahir M. Hussain, Amin Z. Sadik, Peter O'Shea, Digital signal processing: an introduction with MATLAB and applications, 2011*.
• E.S. Gopi, Mathematical summary for digital signal processing applications with Matlab, 2011*.
• Shlomo Engelberg, Digital signal processing: an experimental approach, 2008*.
• Ashfaq A. Khan, Digital signal processing fundamentals, 2005*.
• Rulph Chassaing, Digital signal processing: laboratory experiments using C and the TMS320C31 DSK, 1999*.
• General Image Processing
  • Chris Solomon, Toby Breckon, Fundamentals of digital image processing: a practical approach with examples in Matlab, 2011*.
  • Maria Petrou, Costas Petrou, Image processing: the fundamentals, 2010*.
  • Tinku Acharya, Ajoy K. Ray, Image processing: principles and applications, 2005*.
• Applications of Signal and Image Processing
  • João Manuel R.S. Tavares, R.M. Natal Jorge, Computational vision and medical image processing: recent trends, 2011*.
  • Thomas M. Deserno, Biomedical image processing, 2011*.
  • E. Neri, D. Caramella, C. Bartolozzi (eds.), Image processing in radiology: current applications, 2008*.
  • Wolfgang Keller, Wavelets in geodesy and geodynamics, 2004*.
  • J.C. van den Berg, Wavelets in physics, 1999*.
• Spectral analysis
• Wavelets and Multi-rate Signal Processing
  • S. Allen Broughton, Kurt Bryan, Discrete Fourier analysis and wavelets: applications to signal and image processing, 2009*.
  • Michael W. Frazier, An introduction to wavelets through linear algebra, 1999*.
INTRODUCTION TO SIGNAL AND IMAGE PROCESSING LABORATORY

"The world of science and engineering is filled with signals: images from remote space probes, voltages generated by the heart and brain, radar and sonar echoes, seismic vibrations, and countless other applications. Digital Signal Processing (DSP) is the science of using computers to understand these types of data. This includes a wide variety of goals: filtering, speech recognition, image enhancement, data compression, neural networks, and much more. DSP is one of the most powerful technologies that will shape science and engineering in the twenty-first century." (From The Scientist and Engineer's Guide to Digital Signal Processing)

This laboratory is taught in conjunction with the Introduction to Signal and Image Processing course and will cover practical algorithms for DSP techniques, such as Fourier, digital filter design, and signal compression.

1 COURSE PHILOSOPHY

This laboratory will introduce the students to the implementation of the basic algorithms in digital signal and image processing. The lab activities will include implementations of basic algorithms in processing signals, sampling and quantization, time and frequency domain representation and analysis of discrete-time signals and systems, digital filter design. The lab will also implement classic analog filter design, finite-precision effects on data reconstruction, adaptive systems, signal compression and coding. Throughout the entire course, the signal and image processing concepts are emphasized in relation to their biomedical applications.

2 GOALS AND OBJECTIVES

2a Goals

- Learn the fundamentals of DSP and possible applications.
- Develop a strong mathematical understanding of signal representations.
- Demonstrate the ability to design, implement, and use DSP tools for data analysis.
- Develop an appreciation of the advantages and limitations of computer algorithms used in DSP.
- Learn about historical and contemporary impact of DSP on daily life.
- Enhance the ability to communicate effectively.
- Develop the capability to apply advanced mathematics (including differential equations and statistics), science, and engineering to solve the problems at the interface of engineering and biology.

2b Objectives

After the successful completion of this class, the students will be able to:

- Distinguish between analog and digital signals.
- Understand the advantages and limitations of DSP along with their fundamental tradeoffs.
- Represent signals in various dimensions (1D, 2D, etc.)
- Express the relationship between frequency and time/space representations of signals.
- Represent and process signals both in the temporal/spatial as well as frequency domain.
• Process, i.e., acquire, store, filter, enhance, visualize, high dimensional data such as 2D pictures, 3D medical images.
• Design standard filters for signal denoising, enhancement, and restoration.
• Understand where and how DSP techniques are used in real life and practical applications.
• Develop simple DSP applications in MATLAB and/or other development platforms.
• Determine properties of discrete-time systems such as linearity, stability, shift-invariance, and causality.
• Model signals using difference equations and compute their solutions.
• Visualize and compute discrete-time convolutions and correlations.
• Apply the Z-transform as a tool in system modeling and analysis. Perform Z and inverse Z using tables, Partial Fraction Expansion, and power series expansion.
• Draw block diagrams of common digital filters.
• Demonstrate an understanding of the discrete-time Fourier transform (DFT) and the concept of digital frequency.
• Calculate the DFT of a signal
• Choose the sampling rate for a digital system and understand the effects of aliasing.
• Design and implement digital filters by hand and by using Matlab.
• Design FIR filters using the window design method.

3 COURSE LOGISTIC

3a Pre-requisites: PHYS 112 with lab or HONS 158 with lab
Co-requisite: Introduction to Signal and Image Processing

3b Textbooks and Software Packages

• Edward Neuman, Matlab Tutorials, Southern Illinois University at Carbondale (available for downloading through course management website).
• We will use Matlab with a few standard toolboxes (Signal Processing, Image Acquisition, Image Processing, etc.) There will be laptop computers available with necessary software installed. Although not required, I strongly recommend you to purchase a Matlab student license and install it on your home computer for your convenience.

Additional readings: Practical Biomedical Signal Analysis Using MATLAB® (Series in Medical Physics and Biomedical Engineering), Katarzyn J. Blinowska, Jaroslaw Zygielowicz, CRC Press; 1 edition (September 12, 2011).

3c Lectures

After the reading quiz (5-15 minutes) and an optional brief discussion of its solution, we will systematically review the basic components of the algorithms and details of their actual implementation in computer codes. Students are expected to not only attend each lab, but to also actively participate in the discussion of the concepts with their classmates and with the
instructor. After the systematic review of the theoretical concepts, algorithms, and computational
details (15-45 minutes) we will start the designated activities. All students are expected to
participate in lab activities. It is strongly recommended that each student carry his/her own lab
notebook with a summary of the theory, algorithms, printouts of computer codes, raw data,
calculations and conclusions.

3d Support resources
There are many ways to get assistance with the material in this course.
• Office hours: I will always be available during the posted office hours. If you cannot
meet me during any of the posted times, call/email me to make an appointment.
• E-mail: obrisans@cofc.edu. Please consider posting your query on the discussion board
on our course management system. This way, duplication of commonly asked questions
is avoided and others in the class will benefit from your question.
• Phone: (843) 953-0780.
• Other resources: The College offers many other resources for help, including tutoring and
reserve materials. The Center for Student Learning offers a comprehensive academic
support program available to all students. The Center is located on the first floor of
Addlestone Library. Please call (843) 953-5635 or check their website
(http://www.cofc.edu/~csl/) for more information.

4. GRADING POLICIES
The structure of your the grade

<table>
<thead>
<tr>
<th>Lab reports</th>
<th>70 points</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-class quizzes</td>
<td>25 points</td>
</tr>
<tr>
<td>Attendance and in-class performance</td>
<td>5 points</td>
</tr>
</tbody>
</table>

I encourage you to see me at any time for my assessment of your work. Questions about points
awarded on lab work should be brought up no later than 24 hours after the materials are handed
back to students. It is the students’ responsibility to check that the grade posted online matches
the grade you have on your hard copies. I will drop your lowest lab and quiz grades.

In-class quizzes
Each lab session will begin with a short (5-15 minutes) quiz consisting of both conceptual and
quantitative questions based on the material from both the previous and the current lab. The
quizzes will be graded immediately or promptly returned during the next lab meeting. These
quizzes are intended to ensure that you are adequately prepared before coming to class. They are
mainly based on our lectures and previous labs. You will receive no credit and there is no
makeup for a missed quiz. In case of special circumstances (major religious holidays, illness, or
other personal emergencies) you may chose to drop the missing quiz.

Lab notebook
I strongly advise you to carefully collect all summaries of theoretical and experimental
procedures presented during the lecture, recorded data during experiments, calculations, graphs,
error analysis, etc. in your lab notebook. The lab notes can be somewhat sketchy, but whoever
reads your notes should be able to understand the objectives of the lab, the method, the
Theoretical background, and be able to perform the experiment in order to validate your measurements.

Lab report
Lab reports should be either individual or done in collaboration with another colleague. Lab reports will be due either at the end of the laboratory period or at the beginning of the next class meeting. I will specify which is the case early in each lab period. Late reports may be accepted, but carry a 25% penalty for each day.

A good lab report will show the reader that you understand both the theoretical and computational aspects of the implemented algorithm. A good lab report is: neat, clear, well organized, complete, thoughtful, and reflects your understanding of the laboratory. Your lab report is also an exercise on general observation and communication skills, and the ability to draw valid conclusions. These skills are valuable in any field. Make the lab report clear and concise. A very long report generally indicates that you don't have a clear idea of what you are doing or why you are doing it.

The format of your lab report (LaTeX preferred) should follow the style of a journal paper and include the following sections:

Title page
  Title
  Author(s), date, lab section, instructor's name
  Abstract

Introduction
  Objectives
  Theoretical background
  Materials and experimental/computational procedure

Results
  Experimental data
  Graphs should be on graph paper or computer generated plots. Each figure and table must be labeled, carry units when appropriate, have a caption, and should be referred in the main text at least once.
  Error analysis
  Discussion of the limitations of the experiment, and intrinsic sources of error are almost always appropriate. Quantify the errors intrinsic to the procedure and tools. Looking at these errors allows the reader to have a sense of the quality of your results. Have some sense, or explicit statements about how big an effect the uncertainties and errors had on the result. Human error (i.e., a screw-up) is not what goes here. If you make a mistake, fix it.

Results and Discussion
  This is where you give your answers, discuss their significance, and compare/contrast to accepted values, and perhaps speculate on how to do it better, within reason.

Conclusions
  Don't repeat the results, but interpret the significance of them. Did you prove or disprove anything? Did you support something? Did you meet the objective(s)? Avoid subjective evaluations of your results or the experiment such as “Our results are good.” Group effort

4 of 9
reports should have a brief statement describing the division of labor. It is expected that students will rotate the responsibilities in generating the reports. The instructor reserves the right to assign a particular part of a lab exercise to a student.

Homework solutions

Attendance and in-lab performance
This portion of your grade will depend on your attendance both physically and mentally. You are expected to be in class on time each week—absences or tardiness will adversely affect your grade. While in class, your attention should be focused on your lab tasks— not, for example, on your cell phone. You are expected to come to class prepared and work efficiently until you and your partner have completed the assignment.

Missed labs must be made up to receive credit. However, make-ups are allowed only based on an official Absence Memorandum notice received directly from the Associate Dean of Students Office. You will need your instructor’s permission for any makeup and you must return an individual lab report no later than one week after the lab was completed.

The grading scale is as follows:

<table>
<thead>
<tr>
<th>Letter grade</th>
<th>A-</th>
<th>B+</th>
<th>B</th>
<th>B-</th>
<th>C+</th>
<th>C</th>
<th>C-</th>
<th>D+</th>
<th>D</th>
<th>D-</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality points</td>
<td>4.0</td>
<td>3.7</td>
<td>3.3</td>
<td>3.0</td>
<td>2.7</td>
<td>2.3</td>
<td>2.0</td>
<td>1.7</td>
<td>1.3</td>
<td>1.0</td>
<td>0.7</td>
</tr>
<tr>
<td>Percentage</td>
<td>93.00-100</td>
<td>90.00-92.99</td>
<td>86.00-89.99</td>
<td>83.00-85.99</td>
<td>80.00-82.99</td>
<td>76.00-79.99</td>
<td>73.00-75.99</td>
<td>70.00-72.99</td>
<td>66.00-69.99</td>
<td>63.00-65.99</td>
<td>60.00-62.99</td>
</tr>
</tbody>
</table>

All grades are stored and computed with two decimal places during the entire semester.

5 COURSE POLICIES

5a Collaboration

I strongly encourage collaboration in and out of class. I recommend that you form small study groups (3-6 students) and work together on your homework assignments, lab assignments and projects. Because the course is graded on an absolute scale, you will never reduce your grade by helping others—to the contrary, by doing so you will reinforce your own knowledge and improve your performance. Before working together or consulting others on any assignment, it pays to give yourself the opportunity to work on it alone.

Activities for which collaboration is not permitted are: reading quizzes, in-class tests, and the final exam.

5b Class conduct

There shall be no eating, drinking, or sleeping in the class. Cell phones, beepers, headsets and any other electronic devices that may disrupt the class must be turned off and put away prior to class unless you have a job requiring them to be on for safety (firefighter, EMT, etc.). Talking on cell phones in class is strictly prohibited. Please refer to the student handbook for additional information.
5c Attendance is important because we will develop a flexible lecture based on your feedback from reading assignments. Although the in-class concept tests will be available online with their correct answer, by missing a class you miss the opportunity to express yourself, argue with your neighbors about the logic of your deductions, and correct your own, or help other correcting their misunderstandings. In addition, according to the College of Charleston Academic Regulations, "students are expected to attend all classes and laboratory meetings of each course in which they enroll."

5d Accommodations for Special Needs Students

The College of Charleston is committed to fully provide for the needs of enrolled or admitted students who have disabilities under Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990. Please contact the Center for Disability Services (http://www.cofc.edu/~cds/) by phone: (843) 953-1431 and (843) 953-8284, or email them at SNAP@cofc.edu to make your needs known. According to http://www.cofc.edu/~cds/, "Legally students have a right not to be identified as disabled if they so choose. They will not receive accommodations unless they identify themselves, but that too is their choice. The student should have a letter from the Director of Disability Services stating that he or she has been approved for these services, or you may ask to see his or her Professor Notification Letter from the Center for Disability Services confirming that the student is eligible for these services. If the student has not been approved for SNAP Services, you are not required to provide any accommodations. Final examinations must be taken at the time scheduled" with a few exceptions (see http://www.cofc.edu/~cds/). "Permission to reschedule exams may be obtained from the Office of the Registrar with written permission of the instructor." (for details see http://www.cofc.edu/~cds/).

5e Academic Honesty Policy

Academic integrity is fundamental to the process of learning and evaluating academic performance. Academic dishonesty will not be tolerated. Academic dishonesty includes, but is not limited to, the following: cheating, plagiarism, tampering with academic records and examinations, falsifying identity and being an accessory to acts of academic dishonesty. Please refer to the Academic Integrity and the Honor Code and the College of Charleston Student Handbook 2005-2006 – "A Guide to Civil and Honorable Conduct", for further information.
LECTURE SCHEDULE

The following is a tentative schedule for our laboratories and both the topics and/or the test dates could change during the semester to accommodate unforeseen events. It is your responsibility to check our course management system on a regular basis (at least once before each class meeting) to make sure you have the latest information.

Week 1-2: Fundamentals of MATLAB


Week 6-8: Blind Source Separation Applied to ECG/EEG - Statistical Methods. Wiener Filtering, Principal Component Analysis, and Independent Component Analysis.


Week 12-14: Image Segmentation for MRI Scans. Noise Reduction, Brain Contours, 3-D Visualization, 2-D Slices and Image Alignment.
From: "Hillenius, Willem Jacob" <HilleniusW@cofc.edu>
Subject: Re: letter of support for computational neuroscience concentration offered to Physics and Astronomy majors
Date: October 18, 2012 1:47:34 PM EDT
To: "Oprisan, Sorinel Adrian" <OprisanS@cofc.edu>
Cc: "Kuthirummal, Narayanan" <KuthirummalN@cofc.edu>

Dear Dr. Oprisan,

I support the creation of this new concentration of Computational Neuroscience. With respect to the effect on the Biology curriculum, as I see it, this concentration will follow the same pattern as the current Neuroscience minor, and will either capture students currently already in that minor, or else bring additional students into these courses. In either case, I do not expect the creation of this concentration will negatively impact these courses.

Please let me know if you need additional comments.

Sincerely,

Jaap Hillenius
-----
Jaap Hillenius
Professor & Chair
Department of Biology
College of Charleston
66 George Street
Charleston, SC 29424
USA

T: (843) 953-5504
F: (843) 953-5453
E: hilleniusw@cofc.edu

---

From: <Oprisan>, Sorinel Adrian <OprisanS@cofc.edu>
Date: Wednesday, October 3, 2012 4:49 PM
To: Willem Jacob Hillenius <hilleniusw@cofc.edu>
Subject: letter of support for computational neuroscience concentration for Physics and Astronomy majors

Dear Dr. Hillenius:

We would like to ask for a letter of support in favor of our new proposal: a Computational Neuroscience (CNS) concentration in the Department of Physics and Astronomy (see attached).

The target-audience of this new CNS concentration is our Physics and Astronomy majors and the program will build on their already strong math and computer science background. However, we also want our students to explore Biology and Psychology courses related to neuroscience. The students will learn 1) new modeling approaches currently used in biophysics of excitable cells and computational neuroscience, and 2) apply signal processing tools to existing online...
databases, data we record at the College of Charleston, or data collected from our collaborators at Medical University of South Carolina. For example, we have ongoing research projects with one lab at MUSC conducting 24/7 recordings from epileptic patients and another collaboration focused on electrophysiological data analysis regarding amphetamines effects on learning in mice.

Physics and Astronomy majors - our primary target audience of this CNS concentration - are not required to take Biology courses, except for some General Education requirement. Through this new CNS concentration, we want to encourage Physics and Astronomy majors to take more Biology courses, especially neuroscience-oriented. This is one reason we place Biology courses in a required elective category. We hope that you will find this potential extra enrollment of Physics and Astronomy majors in some Biology courses required for this new CNS concentration as a positive element. We also welcome suggestions and corrections that will strengthen our proposal.

Our aim is to submit the proposal to the College-wide Curriculum Committee this Fall semester. We would greatly appreciate your support for this new initiative aimed at Physics and Astronomy majors.

Thank you for your consideration.

Sincerely,
Sorinel Oprisan, Ph.D.

Associate Professor
Department of Physics and Astronomy
College of Charleston
Rita Liddy Hollings Science Center
58 Coming Street
Charleston, SC 29424
p: 843.953.0780
f: 843.953.4824
e: oprisans@cofc.edu
November 27, 2012

Dear Dr. Oprisan,

This letter is written in support of your proposed Concentration in Computational Neuroscience that you wish to develop within the Physics Department. Through our discussions on this matter it is clear that this concentration in its current format with only two computationally oriented courses will be more appropriately developed in the Physics Department than within the Neuroscience Program. This decision is based primarily on the extensive quantitate background necessary for computational neuroscience that our current neuroscience course offerings cannot accommodate. As per our discussions that have included the Physics and Astronomy chairman, it is evident that to include this concentration in its present format under the Neuroscience Program would not serve the students well, as the curriculum would be too diluted to provide any academic depth. I understand and support your desire to develop an opportunity for physics students to concentrate in computational neuroscience within your department since the current minor is often too cumbersome for the students to combine with a Physics Major. Since the expected number of students enrolled in the concentration is small, I do not anticipate this program to pose any issues for the Neuroscience Program. Your expertise in computational neuroscience is a unique and valuable component that distinguishes our undergraduate neuroscience program. My hope is that by providing students with a means by which to specialize in this area at this stage in their education, it will draw them into the exciting, rapidly expanding field of computational neuroscience.

Sincerely,

Beth Meyer-Bernstein
Associate Professor, Biology
Director, Neuroscience Program
Dear Sorinel,

Very interesting concentration. Yes we support it. I have two issues to raise: first, we have not offered math 260 in years and have no current plans of offering it. We plan to take it out of the catalog. You require 11 hours of electives from groups I and II, but there does not seem to be any requirement from the courses listed in group III.

Also, I'm considering putting in a proposal for an NSF grant and would like to talk with you sometime about the potential for involving this concentration in the proposal.

Bob

Synopsis:

The long-range goal of EXTREEMS-QED is to support efforts to educate the next generation of mathematics and statistics undergraduate students to confront new challenges in computational and data-enabled science and engineering (CDS&E). EXTREEMS-QED projects must enhance the knowledge and skills of most, if not all, the institution's mathematics and statistics majors through training that incorporates computational tools for analysis of large data sets and for modeling and simulation of complex systems.

Funded activities are expected to provide opportunities for undergraduate research and hands-on experiences centered on CDS&E; result in significant changes to the undergraduate mathematics and statistics curriculum; have broad institutional support and department-wide commitment that encourage collaborations within and across disciplines; and include professional development activities for faculty or for K-12 teachers.

EXTREEMS-QED is a joint effort of the Directorate of Mathematical and Physical Sciences and the Office of Cyberinfrastructure at the National Science Foundation. The Office of Cyberinfrastructure is interested in supporting educational activities that incorporate cyberinfrastructure considerations at a fundamental level, and in efforts that leverage and advance major NSF investments in cyberinfrastructure. Cyberinfrastructure consists of advanced computing systems, data storage systems, instruments and data repositories, visualization environments, and people, all linked together by software and high performance networks to improve research productivity and enable breakthroughs not otherwise possible. Examples of NSF investments in cyberinfrastructure can be found at [http://www.nsf.gov/od/oci/cif21/cybinf_list.jsp].

http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504765&org=DMS&from=home

From: <Oprisan>, Sorinel Adrian <OprisanS@cofc.edu>
Date: Wednesday, October 3, 2012 4:16 PM
To: Robert Mignone <MignoneR@cofc.edu>
Subject: letter of support for computational neuroscience concentration offered to Physics and Astronomy majors

Dear Dr. Mignone:
We would like to ask for a letter of support in favor of our new proposal: a Computational Neuroscience (CNS) concentration in the Department of Physics and Astronomy.

The target-audience of this new CNS concentration is our Physics and Astronomy majors and the program will build on their already strong math and computer science background. The students will learn 1) new modeling approaches currently used in biophysics of excitable cells and computational neuroscience, and 2) apply signal processing tools to existing online databases, data we record at the College of Charleston, or data collected from our collaborators at Medical University of South Carolina. For example, we have ongoing research projects with one lab at MUSC conducting 24/7 recordings from epileptic patients and another collaboration focused on electrophysiological data analysis regarding amphetamines effects on learning in mice.

Physics and Astronomy majors - our primary target audience of this CNS concentration - are required to take a significant number of courses in Mathematics. Eventually, some, if not most, of our students double-major in Physics/Astronomy and Mathematics or at least graduate with a minor in Mathematics. Through this new CNS concentration, we want to encourage Physics and Astronomy majors to take even more Math courses. This is one reason we place Math courses in a required elective category. We hope that you will find this potential extra enrollment of Physics and Astronomy majors in some upper-level Math courses required for this new CNS concentration as a positive element. We also welcome suggestions and corrections that will strengthen our proposal.

Our aim is to submit the proposal to the College-wide Curriculum Committee this Fall semester. We would greatly appreciate your support for this new initiative aimed at Physics and Astronomy majors.

Thank you for your consideration.

Sincerely,
Sorinel Oprisan, Ph.D.

Associate Professor
Department of Physics and Astronomy
College of Charleston
Rita Liddy Hollings Science Center
58 Coming Street
Charleston, SC 29424
p: 843.953.0780
f: 843.953.4824
e: oprisans@cofc.edu
Hi Sorinel,

Thanks for writing! I am forwarding this request our Curriculum Committee Chairs (Mark Hurd & Cindi May). Our Curriculum Committee will make a recommendation to me, then I will be happy to provide any indications of acknowledgement and support in accordance with their recommendations.

I do not foresee any problems, however the committee may be able to make some recommendations for enhancing the PSYC course listings or with making sure the listings are up to date with our current course catalog. For example, you list some PSYC courses which are no longer offered (e.g., PSYC 360, 364, 368). Mark and the department curriculum committee can help with this. The committee meets fairly often, so we should be able to provide you with a timely response.

Best wishes,
Tom

---

From: Oprisan, Sorinel Adrian
Sent: Wednesday, October 03, 2012 4:33 PM
To: Ross, Thomas P
Subject: letter of support for computational neuroscience concentration offered to Physics and Astronomy majors

Dear Dr. Ross:

We would like to ask for a letter of support in favor of our new proposal: a Computational Neuroscience (CNS) concentration in the Department of Physics and Astronomy (see attached).

The target-audience of this new CNS concentration is our Physics and Astronomy majors and the program will build on their already strong math and computer science background. However, we also want our students to explore biology and psychology courses related to neuroscience. The students will learn 1) new modeling approaches currently used in biophysics of excitable cells and computational neuroscience, and 2) apply signal processing tools to existing online databases, data we record at the College of Charleston, or data collected from our collaborators at Medical University of South Carolina. For example, we have ongoing research projects with one lab at MUSC conducting 24/7 recordings from epileptic patients and another collaboration focused on electrophysiological data analysis regarding amphetamines effects on learning in mice.

Physics and Astronomy majors - our primary target audience of this CNS concentration - are not required to take Psychology courses, except for some General Education requirement. Through this new CNS concentration, we want to encourage Physics and Astronomy majors to take more Psychology courses, especially neuroscience-oriented. This is one reason we place Psychology courses in a required elective category. We hope that you will find this potential extra enrollment of Physics and Astronomy majors in some Psychology courses required for this new CNS concentration as a positive element. We also welcome suggestions and corrections that will strengthen our proposal.
Our aim is to submit the proposal to the College-wide Curriculum Committee this Fall semester. We would greatly appreciate your support for this new initiative aimed at Physics and Astronomy majors.

Thank you for your consideration.

Sincerely,
Sorinel Oprisan, Ph.D.

Associate Professor
Department of Physics and Astronomy
College of Charleston
Rita Liddy Hollings Science Center
58 Coming Street
Charleston, SC 29424
p: 843.953.0780
f: 843.953.4824
e: aprisans@cofc.edu
From: "Starr, Christopher Wilson" <StarrC@cofc.edu>
Subject: Re: computational neuroscience
Date: December 7, 2012 3:10:51 PM EST
To: "Oprisan, Sorinel Adrian" <OprisanS@cofc.edu>

December 7, 2012
RE: Letter of support for neuroscience
From: Chris Starr, Chair, Computer Science

Dr. Oprisan,
Computer Science fully supports the new computational neuroscience concentration. We are excited to see this program and perhaps a future major in neuroscience because of the value it can deliver to the College and to computer science majors as well.
Best regards,
Chris Starr

Christopher Starr, PhD, Department Head
Director, Software Innovations Lab
Computer Science, College of Charleston
Charleston, SC 29424
843-953-8150
starrc@cofc.edu

Office: Room 224, J.C. Long Building
9 Liberty St
Charleston, SC 20401

From: <Oprisan>, Sorinel Adrian <OprisanS@cofc.edu>
Date: Friday, December 7, 2012 9:41 AM
To: Chris Starr <StarrC@cofc.edu>
Subject: Re: computational neuroscience

Dear Chris,

As I mentioned briefly during the SSM social event, physics department gave me green light to send the new computational neuroscience concentration to the next Faculty Curriculum Committee (FCC).
We would like to catch the next FCC meeting and hope to pass it through the Senate asap in order to offer the "digital signal/image processing with biomedical applications" class next fall semester.
I would greatly appreciate your letter of support for our initiative.
Thank you for meeting with us and offering us the opportunity to explain the details of the new proposed concentration in physics department.

Sincerely,
Sorinel Oprisan

On Nov 14, 2012, at 10:48 AM, Starr, Christopher Wilson wrote:

Kristi,
Please schedule a meeting with me, Dr. Narayanan, and Sorinel Oprisan on Friday or early next week. 30 minutes should do.
Topic: Computational Neuroscience
Thank you,
Chris
From: <Oprisan>, Sorinel Adrian <OprisanS@cofc.edu>
Date: Wednesday, November 14, 2012 10:13 AM
To: Chris Starr <StarrC@cofc.edu>
Cc: "Kuthirummal, Narayanan" <KuthirummalN@cofc.edu>
Subject: Re: computational neuroscience

Thank you. What time?

Sincerely,
Sorinel Oprisan

On Nov 14, 2012, at 10:04 AM, Starr, Christopher Wilson wrote:

Sorinel,
Sure. Let's meet. Would it be OK with you to also bring in NK?
Chris

From: <Oprisan>, Sorinel Adrian <OprisanS@cofc.edu>
Date: Wednesday, November 14, 2012 9:53 AM
To: Chris Starr <StarrC@cofc.edu>
Subject: computational neuroscience

Dear Dr. Starr,

I would like to setup a followup meeting with you regarding our proposal for a concentration in computational neuroscience in Physics and Astronomy Department. Please let me know when I can stop by your office for a brief followup. Thank you.

Sincerely,
Sorinel Oprisan

On Oct 23, 2012, at 1:30 PM, Oprisan, Sorinel Adrian wrote:

Dear Dr. Starr:

Thank you for giving me the opportunity to explain to you what is the intended mission of the envisioned Computational Neuroscience concentration. I am grateful for your suggestions and comments that helped me actually clarify for myself (and hopefully make it clearer to other, too) that what we work with is biological signals and images. Therefore, I made a small correction to the title of the new course, which now reads "Digital Signal and Image Processing with Biomedical Applications" and attached a tentative syllabus to this email. Please let me know if you find the change (and the attached syllabus) appropriate and in line with our envisioned computational neuroscience concentration. Thank you again for your consideration.

Sincerely,
Sorinel Oprisan
<signal_processing.pdf><CNS_concentration_v1.docx>