Senate Reference No. 13-20

MEMORANDUM

TO: Fort Wayne Senate

FROM: Talia Bugel, Chair
Curriculum Review Subcommittee

DATE: January 3, 2014

SUBJ: Concentration in Computational Physics; Concentration in Engineering Physics.

The Curriculum Review Subcommittee met on November 6, 2013 to review the attached proposals for

a) a Computational Physics Concentration; and

b) an Engineering Physics Concentration

for the Bachelor of Science in Physics curriculum.

The committee finds that the proposed concentrations require no Senate review.

Approving:	Not Approving	Absent
Talia Bugel		Ron Duchovic (Sabbatical leave)
Nancy Jackson		Craig Hill (Sabbatical leave)
Rebecca Jensen		
Myeong Hwan Kim		
Susan Skekloff		
Steve Sarratore (*ex officio*)		

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COLLEGE OF ARTS AND SCIENCES
OFFICE OF THE DEAN

Date: May 10, 2013

To: Joseph Khamalah
Interim Assistant Vice Chancellor for Academic Programs

From: Carl N. Drummond, Dean

Subj: New COAS-Approved Physics Concentrations:
Concentration in Computational Physics
Concentration in Engineering Physics

The Curriculum Committee of the College of Arts and Sciences has reviewed and approved two new Concentrations in Physics at their April 29, 2013 meeting. Attached you will find documentation (hard copies and email copies being sent).

These new Concentrations are being sent to you for the initiation of the remaining steps beyond the college level.

CND/kb

cc: COAS Curriculum Committee
Mark Masters, Chair, Department of Physics

PROG #32

Proposal for a Concentration in Computational Physics
Indiana University - Purdue University Fort Wayne
April 16, 2013

prepared by Mark F. Masters, Ph.D., Department of Physics

1. **Name of proposed new program**

Bachelor of Science in Physics with a concentration in Computational Physics

2. **Title of degree to be conferred**

Bachelor of Science

3. **Field of study, department, and school involved**

Computational Physics/Physics, Department of Physics, COAS

4. **Objectives of the proposed concentration**

There are several objectives for this concentration:

a. Computation (computer modeling) in physics has become an incredibly important field of study. It is used in everything from modeling physical systems such as fluid flows to modeling atomic interactions to modeling financial systems. We are in the process of adding computational requirements to the degree program, but this allows students to focus on computation and have this noted on their transcript.

b. Occasionally, we have students who have limited success in laboratory situations. These students have been known to complete the degree except for the laboratory portion of the curriculum. We would rather these students finish the degree on a timely manner. Since physics has a strong tradition of theoretical, computational, and mathematical branches, it seems only fitting to offer these students the opportunity to not take the intermediate and advanced laboratory, but to concentrate on using the computer to solve physical problems.

c. Within physics, it is critical to provide students with more options than just simply physics as is recommended by the SPIN-UP report and our last program review. SPIN-UP was a National Science Foundation sponsored project that investigated qualities that make a successful, thriving physics department. (http://www.aps.org/programs/education/undergrad/faculty/spinup/upload/SPIN-UP-Report.pdf) In this project, it was found that having one or more concentrations is extremely beneficial to the physics program, helping to attract more majors.

5. **Proposed date of initiation of the new program**

Fall 2014

6. **A statement describing the relationship of the proposed program to the mission and scope of the campus**

Department Mission: The relevant part of the Department of Physics Mission Statement is "producing well prepared graduates who are confident in their abilities and understanding of

approved at 4/29/13 ca mtg

physics," and "Physics Majors will gain a strong working knowledge of basic science and physics."

The proposed concentration is clearly within this mission. Computational physics is an important approach to solving physical problems within physics and the department believes that the students would benefit from a concentration in these areas rather than the straight physics degree.

College Mission: "...the college provides students with a breadth of knowledge about the global environment and fosters an appreciation and respect for diversity. The College of Arts and Sciences equips students to think critically, communicate effectively, and develop creative solutions to future challenges."

This proposed concentration is directly related to the college mission statement, in particular, the breadth of knowledge and creative solutions to future challenges. It does so by providing a concentration that is of growing importance.

IPFW Mission: "We offer a broad range of high-quality undergraduate, graduate, and continuing education programs that meet regional needs ..."

The proposed concentration will be of high quality and provide a unique opportunity for students of Northeast Indiana.

7. **A statement describing the relationship of the proposed program to already existing programs at the campus.**

There are no computational physics programs at IPFW. There are several modeling classes (Computational Physics, Math Modeling, and Computer modeling). But there are no thematic programs that concentrate on using computers in physics. .

8. **A statement describing the relationship of this program to similar programs in other regional and Indiana post-secondary educational institutions.**

The only other computational physics program in Indiana is a specialization in Computational Physics within Purdue's Applied Physics degree.

9. **A statement describing cooperative endeavors explored and/or intended with other institutions particularly those located in the same geographic region.**

There are no other institutions in the region with an computational physics program.

10. **A statement indicating need for the concentration in terms of manpower supply and demand.**

This concentration adds courses, specialization and focus to a physics degree which is inherently a general program. Looking at www.hoosierdata.in.gov, it is clear that there will be significant demand for computer and mathematical occupations physical scientists in the next 4 years. This data does not provide fine details about physical scientists nor does it provide information about educational levels of these scientists.

However, there are a number of companies that have an interest in computational problems. These include Exelis, in which there is significant use of computational models to compare with observations; Northrop Grumman, with work in optical atmospheric effects, and Raytheon which

does a significant amount of modeling work.

11. **A statement describing resources over and above present levels required to initiate the program**

The computational physics concentration consists of the physics program sans two laboratories and the addition of a number of computer or mathematics classes. Since the computer classes and math classes exist at present, there should be little demand on these programs. Additionally, the library resources should be nothing more than are presently required for physics, mathematics and computer science.

12. **Proposed Curriculum**

The proposed curriculum starts with the basic physics degree without electronics course or the two advanced laboratories and then adds classes from one of two specializations: mathematics or computer science.

Please see attached draft Bingo sheet for details.

Meeting IPFW General education requirements: 24 credit hours (I think).

COAS Requirements: 11 credit hours.
Writing 3 ch
Foreign Language 8 ch
General Education: 24 credit hours
Chemistry requirements: 4 credit hours (only CHM 11500)
Core Physics courses: 42 credit hours
PHYS 15200 – Mechanics 5 ch
PHYS 25100 – Heat, Electricity and Optics 5 ch
PHYS 31000 – Intermediate Mechanics 4 ch
PHYS 31200 - Intermediate Electricity and Magnetism 3 ch
PHYS 31300 - Intermediate Electricity and Magnetism II 3 ch
PHYS 32200 – Optics. 3 ch
PHYS 32500 – Computational Physics 3 ch
PHYS 34200 - Modern Physics 3 ch
PHYS 34300 – Modern Physics Laboratory 1 ch
PHYS 41800 – Statistical Mechanics 3 ch
PHYS 30500 - Mathematical Methods for physicists 3 ch
PHYS 44200 – Quantum Mechanics 3 ch
PHYS 48000 – Senior Thesis 3 ch (must be taken twice – 0 credits second time)

Core Math Courses: 18 credit hours
MA 16500 Calculus I 4 ch
MA 16600 Calculus II 4 ch
MA 26100 Calculus III 4 ch
MA 35100 Linear Algebra 3 ch
MA 36300 Differential Equations 3 ch

Mathematics Specialization 22 credit hours
MA 17500 - Introduction to Discrete (3)
CS 16000 – Intro to computer science (4)

MA 41700 – Mathematical Programming (3)
MA 31400 – Introduction to Math Modeling (3)
MA 51000 - Vector Calculus (3)
MA 52300 – Intro to Partial Differential Equations (3)
MA 52500 – Intro to complex analysis (3)

Computation Specialization 17 credit hours
MA 17500 - Introduction to Discrete (3)
CS 16000 – Intro to computer science (4)
CS 16100 – Intro to computer science II (4)
CS 26000 – Data Structures (3)
CS 33100 – Intro to C++ or CS32100 - Intro to computer graphics or CS 38400 – Numerical (3)
analysis with advice of advisor.
CS 48600 – Analysis of Algorithms (3)
1 credit free electives

Total required courses 119-121 credit hours – This is hard to predict with the change in general education.

PHYSICS Concentration in Computational/Mathematical Physics

BACHELOR OF SCIENCE – 120 CREDITS

IPFW GENERAL EDUCATION REQUIREMEN

I. LING & NUM FOUNDATIONS

ENG W131	3	
COM 11400	3	
MA 16500	X	
PHYS 15200	X	

II. NAT & PHYS SCIENCES

CHM 11500	X	
PHYS 15200	X	

III. THE IND, CULT, & SOC

	3	
	3	

IV. HUMANISTIC THOUGHT

	3	
	3	

V. CREATIVE & ARTISTIC EXPRESS

	3	

VI. INQUIRY & ANALYSIS

	3	

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COAS REQUIREMENTS

WRITING

ENG W 140/W233	3	

FOREIGN LANGUAGE

	4	
	4	

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MATHEMATICAL SCIENCES

MA 16500	4	
MA 16600	4	
MA 17500 (Intro Discrete)	3	
MA 26100	4	
MA 35100	3	
MA 36300	3	

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CHEMISTRY

CHM 11500	4	

4

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PHYSICS CORE 42

PHYS 15200	5	
PHYS 25100	5	
PHYS 30500	3	
PHYS 31000	4	
PHYS 31200	3	
PHYS 31300	3	
PHYS 32200	3	
PHYS 32500	3	
PHYS 34200	3	
PHYS 34300	1	
PHYS 41800	3	
PHYS 44200	3	
PHYS 48000 - Senior Thesis	3	

Must take either Computation or Mathematics specialization

COMPUTATION specialization

CS 16000 (Intro to Comp. Sci I)	4	
CS 16100 (Intro to Comp. Sci II)	4	
CS 26000 (Data Structures)	3	
CS 33100 (Intro to C++) or CS 32100 (Intro to computer graphics) or CS 38400 (Numerical Analysis)	3	
CS 48600 (Analysis of Algorithms)	3	

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MATHEMATICS specialization

CS 16000	4	
MA 41700 (Mathematical Prog.)	3	
MA 31400 (intro Math Model)	3	
MA 51000 (vector Calculus)	3	
MA 52300 (Intro to Partial)	3	
MA 52500 (Intro to Complex Ana)	3	

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ELECTIVES

61

Sample Four Year Plan for a Bachelor of Science in Physics with Computational Physics Concentration

Freshman Fall MA 16500 – Calculus I (4) PHYS 17000 – Freshman Seminar (1 – not req) COM 11400 – Communication (3) CHM 11500 – General Chemistry I (4) General Education Area (3)	Freshman Spring MA 16600 – Calculus II (4) PHYS 15200 – Mechanics (5) ENG W131 – Elementary Composition (3) CS 16000 – Intro to Computer Science (4)
Total Credit Hours (15)[15]	Total Credit Hours (16) [31]
Sophomore Fall MA 26100 – Multivariate Calculus (4) PHYS 25100 – Heat, Electricity and Optics (5) COAS Req. ENG W233 (3) CS 16100 – Intro Comp Sci II (4)	Sophomore Spring MA 35100 – Linear Algebra (3) PHYS 34200 – Modern Physics (3) PHYS 34300 – Modern Physics Lab (1) PHYS 31200 – Electricity and Magnetism I (3) General Education (3) General Education (3)
Total Credit Hours (16)[47]	Total Credit Hours (16)[63]
Junior Fall MA 36300 – Differential Equations (3) PHYS 31300 – Electricity and Magnetism II (3) CS 26000 – Data Structures (3) PHYS 32500 – Computational Physics (3) COAS Req. Foreign Language (4)	Junior Spring PHYS 41800 – Statistical Mechanics (3) PHYS 30500 – Mathematical Methods for Physicists (3) PHYS 32200 – Optics (3) CS 33100 – Intro to C++ (3) COAS Req. Foreign Language (4)
Total Credit Hours (16)[79]	Total Credit Hours (16)[95]
Senior Fall General Education (3) PHYS 44200 – Introduction to Quantum Mechanics (3) PHYS 48000 Senior Thesis (3) CS 48600 – Analysis of Algorithms (3)	Senior Spring PHYS 310 – Inter. Mech. (4) General Education (3) PHYS 48000 Senior Thesis (0) General Education (3) General Education (3)
Total Credit Hours (12)[106]	Total Credit Hours (13)[121 (remember the not req. phys 17000]