Senate Reference No. 13-24

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

A&SCCD#12-49

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Proposal for a Concentration in Engineering Physics
Indiana University - Purdue University Fort Wayne

April 23, 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 Engineering Physics

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

Bachelor of Science

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

Engineering Physics/Physics, Department of Physics, COAS

4. **Objectives of the proposed concentration**

There are several objectives for this concentration:

a. Physics and Engineering are very closely related. Many of our graduates work in industry and are classified as "engineers." We believe that this concentration will help the students transition more smoothly into industrial careers, but also not hinder their ability to choose to go to graduate school.

Quoting directly from the University of Illinois at Chicago – one of the programs used as a prototype for this concentration - "Engineering Physics bridges the gap between science and tech by combining physics with fundamental engineering. It is based on recognition that most engineering disciplines are rooted in physics and that emerging technologies rarely fall neatly within a single discipline but straddle several."

Engineering Physics can give our students some advantages when applying for jobs or graduate because through this program the students will learn some of the engineering techniques that help them as experimental physicists in graduate school, or ease the path to a career in industry.

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**

approved at 4/29/13 CC mtg

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

The proposed concentration is clearly within this mission. Engineering Physics is a branch of physics that deals with applied problems. The Physics 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 Engineering Physics programs at IPFW. There are the Engineering Programs and the Physics Program. The closest is the dual degree Electrical Engineering and Physics program, but that resides with engineering and it is so difficult that no one has ever completed the program.

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

There are other campuses that have physics programs that are similar. In particular, PUWL has an Applied Physics Program that is almost identical to the proposed program when looking at the engineering specializations. IU also has an applied physics program but because IU does not have an engineering program, their students cannot take engineering courses. Rose Hullman also has an engineering physics program.

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

If we consider NE Indiana as our region, then IPFW Physics would be the only program of this nature.

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 increased demand for physical scientists. However the data does not provide fine details about physical scientists nor does it provide information about educational levels of these scientists. The outlook

for engineers is not as positive, with an indication of decreased demand. However, the numbers of needed engineers is still large.

There are a number of companies that hire our students such as Exelis and Raytheon. In these cases the engineering physics would be a significant assistance in getting that first job. Combining the engineering skills taught in engineering classes with the physics department's expertise in optics will yield a significant synergy opening new opportunities to our students.

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

The engineering physics concentration consists of core physics courses in combination with a variety of specified engineering courses and some free electives. Since engineering programs and the physics program already exist, we do not believe that any additional resources will be required.

12. **Proposed Curriculum**

The proposed curriculum starts with a physics core common to all specializations. There is an engineering core. There are three specializations: electrical engineering, mechanical engineering, and civil-environmental.

Please see attached draft Bingo sheet for details.

Meeting IPFW General Education requirements: approximately 24 credit hours.

COAS Requirements: 11 credit hours.
Writing 3 ch
Foreign Language 8 ch
General Education: 24 credit hours

Chemistry requirements: 4 credit hours (CHM 11500)

Core Physics courses: 30 credit hours
PHYS 15200 – Mechanics 5 ch
PHYS 25100 – Heat, Electricity and Optics 5 ch
PHYS 30500 - Mathematical Methods for physicists 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 34600 – Advanced Lab 1 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

Electrical Engineering Specialization 32-34 credit hours
ENGR 12000 (Autocad) 2ch
ENGR 12100 (Matlab) 2ch
CS 22700 (Intro to C) 2 ch
CS 22800 (C++) 1 ch
PHYS 31000 (Mechanics) 4ch
PHYS 41800 (Thermodynamics) 3ch
ECE 201 (Linear Circuit Analysis I) 3 ch
ECE 202 (Linear Circuit Analysis II) 3ch
ECE 293 (Measurements and Instrumentation) 2ch
ECE 301 (Signals and Systems) 3ch
ECE 311 or PHYS 312 (E&M) 3ch
Electives from ECE and PHYS 4-6ch
(total 119-121 credits – difficult to predict)

Mechanical Engineering Specialization 32-34 credit hours
ENGR 12000 (Autocad) 2ch
ENGR 12100 (Matlab) 2ch
CS 22700 (Intro to C) 2 ch
CS 22800 (C++) 1 ch
PHYS 31200 (E&M I) 3ch
PHYS 36100 (Electronics for Scientists)*4ch
ME 200 (Thermo 1) 3 ch
ME 250 (statics) 3ch
ME 251 (Dynamics) 3ch
ME 252 (Strength of materials) 3 ch
Electives from ME, ECE, or PHYS 6-8 ch

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

Civil - Environmental Specialization 32-34 credit hours
ENGR 12000 (Autocad) 2ch
ENGR 12100 (Matlab) 2ch
CS 22700 (Intro to C) 2 ch
CS 22800 (C++) 1 ch
PHYS 31200 (E&M I) 3 ch
PHYS 36100 (Electronics for Scientists) 4 ch
CE 20000 – Fundamentals of Surveying 3ch
CE 34500 – Transportation Engineering 3 ch
CE 36500 – Environmental Engineering 3 ch
CE 25000 and 25100 or PHYS 310 4 or 6ch
Free Electives 3-5 ch

PHYSICS Concentration in Engineerir 0

BACHELOR OF SCIENCE – 120 CREDITS

IPFW GENERAL EDUCATION REQUIR

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	

COAS REQUIREMENTS

WRITING

ENG W 140/W233	3	

FOREIGN LANGUAGE

	4	
	4	

MATHEMATICAL SCIENCES

MA 16500	4	
MA 16600	4	
MA 26100	4	
MA 35100	3	
MA 36300	3	

CHEMISTRY

CHM 11500	4	

PHYSICS CORE

PHYS 15200 (Intro I)	5	
PHYS 25100 (Intro 2)	5	
PHYS 32200 (optics)	3	
PHYS 34200 (modern)	3	
PHYS 34300 (Modern La	1	
PHYS 34500 (Optics Lab	1	
PHYS 34600 (Advanced I	1	
PHYS 52000 (Math Meth	3	
PHYS 55000 (QM)	3	
PHYS XXX (Senior Thesi	3	

ENGINEERING CORE

ME 12000 (Autocad)	2
ENGR 121 (Matlab)	2
CS 227 (Intro to C)	2
CS 228 (C++)	1

EE CONCENTRATION

PHYS 31000 (Mechanics)	4	
PHYS 51500 (Thermodyn	3	
ECE 201 (Linear Circuit A	3	
ECE 202 (Linear Circuit A	3	
ECE 293 (Measurements	2	
ECE 301 (Signals and Sy	3	
ECE 311 or PHYS 312 (E	3	
Students may want to take PHYS 413 (E&M II)		
7 credits of electives from ECE		

ME Concentration

PHYS 31200 (E&M I)	3	
PHYS 36100 (Electronics for S	4	
ME 200 (Thermo 1)	3	
ME 250 (statics)	3	
ME 251 (Dynamics)	3	
ME 252 (Strength of materials)	3	
Students may want to take PHYS 413 (E&M II)		
9 credits of electives from ME and ECE		

ECE 358 - VHDL seems very interesting while but requires 270 which requires 199

All Microprocessor courses require engr 199

Students in ME Concentration can take ECE 201 instead of PHYS 361 if they want to take ME293

PHYSICS Concentration in Engineerir

BACHELOR OF SCIENCE – 120 CREDITS

IPFW GENERAL EDUCATION REQUIR

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	

COAS REQUIREMENTS

WRITING

ENG W 140/W233	3	

FOREIGN LANGUAGE

	4	
	4	

MATHEMATICAL SCIENCES

MA 16500	4	
MA 16600	4	
MA 26100	4	
MA 35100	3	
MA 36300	3	

CHEMISTRY

CHM 11500	4	

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ENGINEERING CORE

ME 12000 (Autocad)	2	
ENGR 121 (Matlab)	2	
CS 227 (Intro to C)	2	
CS 228 (C++)	1	

PHYSICS CORE 31

PHYS 15200 (Intro I)	5	
PHYS 25100 (Intro 2)	5	
PHYS 32200 (optics)	3	
PHYS 32500 (computatio	3	
PHYS 34200 (modern)	3	
PHYS 34300 (Modern La	1	
PHYS 34500 (Optics Lab)	1	
PHYS 34600 (Advanced L	1	
PHYS 30500 (Math Meth	3	
PHYS 44200 (QM)	3	
PHYS 48000 (Senior The	3	

EE CONCENTRATION

PHYS 31000 (Mechanics)	4	
PHYS 41800 (Thermodyn	3	
ECE 201 (Linear Circuit A	3	
ECE 202 (Linear Circuit A	3	
ECE 293 (Measurements	2	
ECE 301 (Signals and Sy	3	
ECE 311 or PHYS 312 (E	3	
electives from ECE & phy	4	

ME Specification 25

PHYS 31200 (E&M I)	3	
PHYS 36100 (Electronics	4	
ME 200 (Thermo 1)	3	
ME 250 (statics)	3	
ME 251 (Dynamics)	3	
ME 252 (Strength of mate	3	
electives from ME and EC	6	

7 Students in ME Concentration can take ECE 201 instead of PHYS 361 if they want to take ME293

CE-Environmental Specification			25
PHYS 31200 (E&M I)	3		
PHYS 36100 (Electronics	4		
CE 20000 – Fundamental	3		
CE 34500 – Transportatio	3		
CE 36500 – Environmenta	3		
CE 25000 and 25100 or F	6		
Free Electives	3		

Sample Four Year Plan for a Bachelor of Science in Physics with Engineering 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) ENGR 12000 – AutoCAD (2) ENGR 12100 – Matlab (2)	Freshman Spring MA 16600 – Calculus II (4) PHYS 15200 – Mechanics (5) ENG W131 – Elementary Composition (3) CS 22700 (Intro to C) 2 ch CS 22800 (C++) 1 ch
Total Credit Hours (16)[16]	Total Credit Hours (15) [31]
Sophomore Fall MA 26100 – Multivariate Calculus (4) PHYS 25100 – Heat, Electricity and Optics (5) COAS Req. ENG W140 (3) ECE 20100 circuit analysis 1 (3)	Sophomore Spring MA 35100 – Linear Algebra (3) MA 36300 – Differential Equations (3) PHYS 34200 – Modern Physics (3) PHYS 34300 – Modern Physics Lab (1) ECE 31100/PHYS 31200 – Elect and Magnet I (3) General Education (3)
Total Credit Hours (15)[46]	Total Credit Hours (16)[62]
Junior Fall PHYS 31000 – Intermediate Mechanics (4) ECE 20200 – circuit analysis 2 (3) ECE 29300 – Measurements and Instrumentation (2) General Education (3) General Education (3) PHYS 34600 – Advanced Laboratory (1)	Junior Spring PHYS 41800 – Statistical Mechanics (3) PHYS 30500 – Mathematical Methods for Physicists (3) PHYS 32200 – Optics (3) PHYS 34500 – Optics Lab (1) ECE 30100 – Signals and Systems (3) General Education (3)
Total Credit Hours (16)[78]	Total Credit Hours (16)[94]
Senior Fall COAS Req. Foreign Language (4) PHYS 32500 – Computational (3) PHYS 44200 – Introduction to Quantum Mech. (3) PHYS 34600 – Advanced Laboratory (1) PHYS 48000 – Senior Thesis (3)	Senior Spring PHYS 48000 – Senior Thesis (0) COAS Req. Foreign Language (4) General Education (3) General Education (3) Elective (3)
Total Credit Hours (15)[108]	Total Credit Hours (13)[121]