The University Senate of Michigan Technological University

Proposal 9-12

(Voting Units: Academic)

"Proposal for a New Bachelor's Degree Program: Bachelor of Arts in Physics"

Department of Physics
Michigan Technological University

Contact: John Jaszczak, Professor, Department of Physics (jaszczak@mtu.edu)
Ravi Pandey, Professor and Chair, Department of Physics (pandey@mtu.edu)

1. General description and characteristics of program.
   The Bachelor of Arts in Physics is a liberal arts degree that is intended to provide students with a solid foundation in physics, while providing versatility in the degree requirements to allow students to also pursue other scholarly interests in the arts, humanities, social sciences, business, entrepreneurship, medicine, law, study abroad, or even in other areas of the natural sciences or engineering fields. Graduates will be well-informed of the methods of scientific inquiry in general, and more specifically be grounded in fundamental knowledge and understanding of the laws, principles and phenomena of physics in areas of classical mechanics, quantum mechanics, electricity and magnetism, thermal and statistical physics, modern physics, and experimental methods. Graduates will also have more advanced understanding in selected areas of their choice of study.
2. Rationale.
   Michigan Technological University currently offers three undergraduate degrees in physics:
   - Bachelor of Science in Physics
   - Bachelor of Science in Applied Physics
   - Bachelor of Science in Physics with a concentration in Secondary Education

   These first two of these degrees provide students with a rigorous foundation and advanced studies in physics and are primarily designed to give students excellent preparation for graduate studies in physics or closely related fields, or for a technical career with physics as its primary focus. The B.S. in Physics with Secondary Education concentration is designed for students seeking to become certified to teach physics in high school, and is also quite demanding.

   The motivation for offering a B.A. degree in physics is to offer students who are not planning to study physics in graduate school nor a physics-centered career after completing their undergraduate degrees a program that provides them with a strong foundation in physics but with significantly fewer course requirements in physics than our current B.S. programs. The resulting flexibility in the B.A. in Physics degree will allow students to also pursue other scholarly interests and career goals in the arts, humanities, social sciences, business, entrepreneurship, medicine, law, or even in other areas of the natural science or engineering fields. The study of physics can provide an excellent foundation for interdisciplinary endeavors in all of these fields. Students pursuing the B.A. in Physics will more easily be able to earn a second major, dual degree, or minor degree. Creation of this new program is also consistent with Michigan Tech's strategic plan by developing new undergraduate programs that give students increased ability to participate in international study experiences or pursue study in emerging interdisciplinary areas. This versatile degree program will diversify the university's undergraduate degree offerings and should further contribute to positive retention of students in our programs. With its increased number of free electives, the B.A. in Physics will be easier to enter after the first year. Furthermore, our current B.S. degree programs in physics are designed optimally for students who are able to enroll in calculus during their first semester. This presents scheduling

challenges for students who are unable to do so. The new B.A. in Physics degree program would also be more flexible for such students, making it easier for them to still graduate in four years.

This new degree program supports the Michigan Technological University Strategic Plan most directly in the following points:

Goal 1: Attract, retain, and support a world-class and diverse faculty, staff, and student population.

1.1: Provide an outstanding professional and cultural environment for all members of the Michigan Tech community.

- recruit, enroll, support, and recognize bright, motivated, and adventurous students.

1.2 Cultivate a diverse, inclusive, and collegial environment.

- develop and implement campus and unit initiatives to increase diversity;

Goal 2: Deliver a distinctive and rigorous discovery-based learning experience grounded in science, engineering, technology, sustainability, the business of innovation, and an understanding of the social and cultural contexts of our contemporary world.

2.1 Provide dynamic discovery-based learning that integrates instruction, research, and innovation in undergraduate and graduate programs.

- incorporate and expand discovery-based programs in all curricula;
- expand opportunities for, and encourage participation in, international experiences
- strengthen existing programs and develop undergraduate and graduate programs in new and emerging interdisciplinary areas;

2.2 Cultivate intellectual diversity and a worldview adapted to the needs and challenges of the 21st century.

- develop graduates with strong leadership and team-building capabilities, critical thinking skills, and ethical awareness.

3. Discussion of related programs within the institution and at other institutions.

The first two years of study in the BA Physics program will be very similar to our existing B.S. programs in physics, thus allowing maximum flexibility should students wish to change majors among any of the physics degree programs. A separate proposal for Bachelor of Arts in Physics with a concentration in Secondary Education will be particularly attractive for students seeking certification to teach physics in high school.

A summary of credit requirements for our current B.S. programs and our proposed B.A. programs in physics is given in Table 1 below. The B.A. in Physics will require 37-38 credits in physics courses. Of these required physics credits, 15 credits are to be physics electives subject to a restriction that 9 credits be at the 3000-level or higher. The proposed physics-credit requirement for the B.A. in Physics is comparable to that required for a B.A. in Physics at other universities, which typically range from 27 credits (e.g. Michigan State University[1]) to 36 credits (e.g. Case Western Reserve University[2]). In terms of required courses in physics, B.A. in Physics programs across the country vary from being relatively unstructured beyond a set of core introductory physics courses, to more highly regulated in terms of the types and level of courses taken beyond the introductory courses. Since our B.S. programs are already highly structured, the proposed B.A. in Physics is designed to be relatively unstructured beyond the core introductory courses up to and including modern physics.

Table 1. Summary of Credit Requirements for B.S. and B.A. Degrees in Physics at Michigan Tech

Degree Program	Required Physics	Free Elective	Total Credits for

	Credits	Credits	Graduation
B.S. in Physics	69	9	128
B.S. in Physics with Secondary Education Concentration	46	3-4‡	126
B.S. in Applied Physics	57	8	128
B.A. in Physics*	37-38	34-37	124
B.A. in Physics with Secondary Education Concentration*	37	11-13‡	126

* Proposed

‡ Free electives for students seeking concentration in secondary education use part or all of these free elective credits to fulfill the provisional certification requirement of completing a teaching minor. Additional credits may be required as the actual necessary credits required for a teaching minor will depend on the selected teaching minor.

The B.A. in Physics will have 34-37 credits of free elective credits (the spread depends on allowed variations in the major requirements), through which students can pursue other interests and career goals. This is comparable, for example to the 36 credits of free electives available in the General Mathematics B.S. degree at Michigan Tech. Regarding our B.S. physics programs, there are 9 and 8 credits of free electives in our Physics and Applied Physics B.S. programs, respectively. In comparison, the B.S. in Physics with Secondary Education Concentration has only 3 to 4 free elective credits available. More credits than this are typically necessary to satisfy the requirement for a teaching minor necessary for secondary education provisional certification.

The following B.A. in Physics or similar degree programs are offered at public universities in Michigan:

- Central Michigan University (B.A., B.S. in Physics)
  38 credits in physics required
- Eastern Michigan University (B.A./B.S. in Physics)
  31-33 credits in physics required
- Michigan State University (B.A. in Physics)
  27-32 credits in physics required; upper-level course choices are structured
- Northern Michigan University (B.A. Secondary Education Physics Major)
  32 credits in physics required
- University of Michigan-Flint (B.A. in Physics)
  32 credits in physics required
- University of Michigan (A.B. or B.S. in Interdisciplinary Physics)
  24 credits in physics required
  15 credits in cognate courses as part of interdisciplinary studies plan
- Wayne State University (B.A. in Physics)
  33 credits in physics required

4. Projected enrollment.
   We expect to have up to two new students join the program per year. As the program gains some visibility and prominence, we anticipate eventually reaching eight to ten students enrolled per year.
5. Scheduling plans (Extension, Evening, Regular).
   Regular

6. Curriculum design (refer to format of degree audit form). Indicate subject areas to be used for Departmental GPA calculation.
   Subject areas to be used for Departmental GPA calculation have a "›" mark before the Course Number; the 15 credits of physics electives are also to be included.

Major Requirements		
Course Number	**Course Name**	**Credits**

CH 1150	University Chemistry I	3
CH 1151	University Chemistry Lab	1
CH 1153	University Chem Recitation I	1
MA 1160/ 1161	Calculus with Technology I/ Calculus Plus w/ Technology I	4-5
MA 2160	Calculus with Technology II	4
MA 2320/ 2330	Elementary Linear Algebra/ Introduction to Linear Algebra	2-3
MA 3160	Multivariable Calculus with Technology	4
MA 3530	Introduction to Differential Equations	3
›PH 1160	Honors Physics I- Mechanics	4
›PH 1161	Introduction to Experimental Physics I	1
›PH 1360	Honors Physics II- Rotation and Vibration	2
›PH 1361	Introductory Experimental Physics II	1
›PH 2020	Introduction to Error Analysis and Scientific Programming	1
›PH 2260	Honors Physics III- Electricity and Magnetism	4
›PH 2261	Introductory Experimental Physics III	1
›PH 2300	University Physics III- Fluids and Thermodynamics	2
›PH 2400	University Physics IV- Waves and Modern Physics	3
One* of the following: ›PH 2230 Electronics for Scientists (4 cr) ›PH 3210 Optics (3 cr)		3-4
›Physics Electives *(minimum 9 credits at the 3000-level or higher, excluding PH 4010, PH4011, PH 4050, PH 4080, and no more than 3 credits of PH 4999)***		15
	Major Requirements Sub Total	(59-62)

*Students selecting both of these courses may count 3 credits here and 4 credits toward the 15 required credits of Physics Electives.

**These courses can count toward the total credit hours of Physics Electives, but not toward the 9 minimum credits at the 3000-level or higher.

General Education Requirements		
Course Number	**Course Name**	**Credits**
UN 1001	Perspectives on Inquiry	3
UN 1002***	World Cultures	4
UN 2001	Composition: Oral, Written and Visual	3
UN 2002	Institutions	3
HASS Distribution Courses: 15 total credits required. Six credits must be at the 3000- or 4000-level. • No more than 3 credits from the HASS Creative Endeavors List may be used to satisfy the HASS Distribution List requirements. • No more than 3 credits from the HASS Supplemental List may be used to satisfy the HASS Distribution List requirements.		
	General Education Requirements Sub Total	(28)

Co-Curricular Activities (3 units) Required for graduation, but not included in the calculation of the GPA, or in the overall credits required for the degree.	
Free Electives	34-37
Total Credits Required for Degree	**124**

***Two semesters of a single modern language (6 cr) in addition to UN1003 World Cultures Activities (1 cr) can substitute for UN1002 + 3 credits of distribution course requirements.

An alternate route for students to enter the program who may be changing from an non-engineering major, or, who may be entering the physics program without being ready for calculus would be to allow the following substitutions:

Substitute this course	**In place of this course**
PH 2100 University Physics I: Mechanics	PH 1160 Honors Physics I- Mechanics
PH 1100 Physics by Inquiry I	PH 1161 Introduction to Experimental Physics I
PH 2200 University Physics II: Electricity & Magnetism	PH 2260 Honors Physics II- Electricity & Magnetism
PH 1200 Physics by Inquiry II	PH 2261 Introduction to Experimental Physics III

PH 2100, PH 1100, PH 2200, and PH 1200 are offered every semester, including the summer, unlike the honors physics sequence above, which is only offered once per year each fall. Students in the alternate route would still take PH 1360 Honors Physics II and PH 1361 Introduction to Experimental Physics II as their schedules permit.

7. New course descriptions. (New Course Add Forms are needed for each course and will be processed upon final approval of program.)
   Since Michigan Tech already offers three B.S. degrees in physics, no new courses are necessary and none are proposed.
8. Library and other learning resources.
   Since Michigan Tech already offers three B.S. degrees in physics, no additional library or learning resources are required.
9. Computing Access Fee.
   No longer assessed by the university.
10. Faculty resumes (a web site link is sufficient).
    www.phy.mtu.edu/BA/facultyvitae.pdf
11. Description of available/needed equipment.
    The Physics Department at Michigan Technological University is well equipped with modern teaching laboratories for introductory as well as advanced physics laboratories. Computer resources are available for physics majors in the department computer laboratory as well as in shared resources across campus, including a campus-wide wireless network. The department of physics also supplies space for physics majors in the *Society of Physics Students* room, which acts as an undergraduate physics community meeting place, and which is also equipped with computers and a small physics library.
    Since Michigan Tech already offers three B.S. degrees in physics, and enrollment increases are expected to be modest, no additional equipment is required.
12. Program costs, years 1, 2, and 3. (Additional information may be requested by the Senate Finance Committee.)
    Because this degree program is a subset of our existing B.S. programs, because no new courses are necessary, and because the anticipated number of students expected to enroll is small, no additional costs are anticipated for this new degree program.
13. Space.

No additional space is required to accommodate the new degree program.

14. Policies, regulations and rules.
    None besides curricular requirements outlined above.
15. Accreditation requirements.
    Not applicable.
16. Internal status of the proposal.
    8/30/2011 - the physics undergraduate studies committee approved the proposal and recommended it to the physics department faculty for its consideration.
    9/12/2011- Physics faculty unanimously approve the proposal.
    9/15/2011- Submit proposal to Dean, College of Sciences and Arts; cc. Provost office.
    9/20/2011- Presentation to Sciences and Arts College Council.
    9/27/2011- Approved by the College Council, College of Sciences and Arts
    10/4/2011- Distributed for university Administrative Review
    10/12/2011- Approved by the Deans' Council and Provost; forwarded to the University Senate
17. Planned implementation date.
    Fall semester ~~2013~~ 2012.

---

[1] http://www.reg.msu.edu/academicprograms/ProgramDetail.asp?Program=3839 [last accessed July 26, 2011].

[2] http://www.phys.cwru.edu/undergrad/programs/ba_phys.php [last accessed July 26, 2011].

Introduced to Senate: 02 November 2011
Approved by Senate: 07 December 2011
Approved by Administration: 08 December 2011
Approved by BOC: 09 December 2011
Approved by State: 20 January 2012
Senate approved correction of a typo on the starting date: 01 February 2012