

AGENDA
For
UNIVERSITY GRADUATE COUNCIL

Monday, January 27, 2014

9:00 a.m.

114 Sherrick Hall

Open Campus Forum – Comments from campus visitors

Approval of Minutes – November 12, 2013

Introduction – Dr. Karlene Hoo, Dean of the Graduate School

Governance

- UGC Bylaws Review – (Karlene)
- Completion of 2014 MSU catalog by departments

GS Report

- Spring 2014 Program Updates (Amanda Brown)

Curriculum

- New Graduate Course Request (Amanda/Karlene)

Policy and Procedures

- Video Conferencing policy review – (Amanda Brown)
- Graduate Committee policy review – (Amanda Brown)

Other

- Materials Science – PhD update (notice)
- Optics and Photonics MS update (Karlene)
- Graduate Faculty Research Membership - (Karlene)
- Minimum credit units to graduate (Karlene)
- Common Recruitment - (Karlene)
- Fulbright Scholarship Review – (Karlene)

Next meeting February, 24 9:00-11:00 am

Article II: Section 1

CURRENT

- @college at MSU: one council member/1 vote
 - Exception: L&S who has 2
- College Member:
 - Tenured or Tenure-track
- Grad Student
 - 2 in good standing
- Ex-officio
 - VP of the DOE
 - MSU faculty senate
- Voting member
 - Faculty member @college

PROPOSED

- Exception to include:
 - A&A
 - EHDD
- College Member:
 - Tenured
- Grad Student:
 - 1 in good standing
- Ex-officio
 - MSU faculty senate

Article II: Section 3

CURRENT

- One regulary scheduled meeting/month

PROPOSED

- Two regulary scheduled meeting/month

Article II: Section 3

CURRENT

- Mail vote: 7 days
- $\frac{2}{3}$ votes to amend bylaws

PROPOSED

- Mail vote: 5 days
- $\frac{1}{2}$ votes to amend bylaws

Article III: Section 1

CURRENT

- Chair serves 1-year term
- Vice-Chair serves 1-year term and is the Chair-elect
- Chair presides over the UGC meeting
 - In absence: Vice-Chair serves
 - In both Chair and Vice-Chair absences a member is selected to preside

PROPOSED

- A new officer: UGC Secretary
 - Elected from the College's representative
 - Serve 2-year term
 - Responsibilities
 - Meeting Agenda (working with GS staff member)
 - Meeting minutes
- Chair presides over the UGC meeting
 - In both Chair and Vice-Chair absences the Secretary of the UGC presides

Article V: Amendments

- Bylaws may be amended at any regular or special meeting of the UGC provided members receive at least 30 days written notice prior to such a meeting ...
- To approve an amendment to the Bylaws, a 2/3 votes of the UGC is required.
- Bylaws may be amended at any regular or special meeting of the UGC provided members receive at least 14 days written notice prior to such a meeting ...
- To approve an amendment to the Bylaws, 1/2 votes of the UGC is required.



NEW Materials Science Ph.D.

- **Collaborative with Montana State University and University of Montana**
 - Over 40 faculty from numerous science & engineering departments
 - Extensive & complementary facilities on all three campuses
 - Core courses and collaborations distance enabled
 - Approved by Montana Regents in May 2013
- **Primary research focus areas**
 - Biomaterials
 - Materials for energy storage, conversion, & conservation
 - Electronic, photonic, & magnetic materials
 - Materials synthesis, processing, & fabrication
- **Montana Tech's first Ph.D. program!**

LEVEL II BOARD OF REGENTS ITEMS

Curriculum Proposals

1. Overview

A Master of Science degree in *Optics* at MSU-Bozeman is sought

We propose a Master of Science degree in *Optics* at Montana State University – Bozeman. This is a cooperative, multi-department, cross-college degree that complements, integrates, and leverages ongoing graduate education and research activities in the departments of Electrical & Computer Engineering, Physics, and Chemistry & Biochemistry.

2. Need

a. To what specific need is the institution responding in developing the proposed program?

Since 1980, the Gallatin Valley has become home to an impressive and growing number of companies in technologies involving optics and lasers. Figure 1 is a timeline illustrating this exponential growth. Many of these companies were formed by MSU graduates or faculty, and others moved here for the quality of life or to become part of the growing Montana optics community. During this same time period, MSU-Bozeman transitioned from employing two faculty members who worked in optics in 1980 to more than two dozen in 2012. As part of the synergistic growth of the Montana optics community, MSU established the Regents-approved *Optical Technology Center* (OpTeC) in 1995. The activities undertaken through this center have strengthened public-private collaboration and increased the transfer of optical technology from the university to the private sector. The Bozeman area is increasingly recognized as an area of activity with international significance in the broad field of optics. Because of this growth, the local optics industry is now reaching the state of maturity where it needs an increased number of employees with highly technical training in optics. The proposed optics degree is an overdue step that will significantly improve the ability of MSU to train top talent for the growing Montana optics industry.

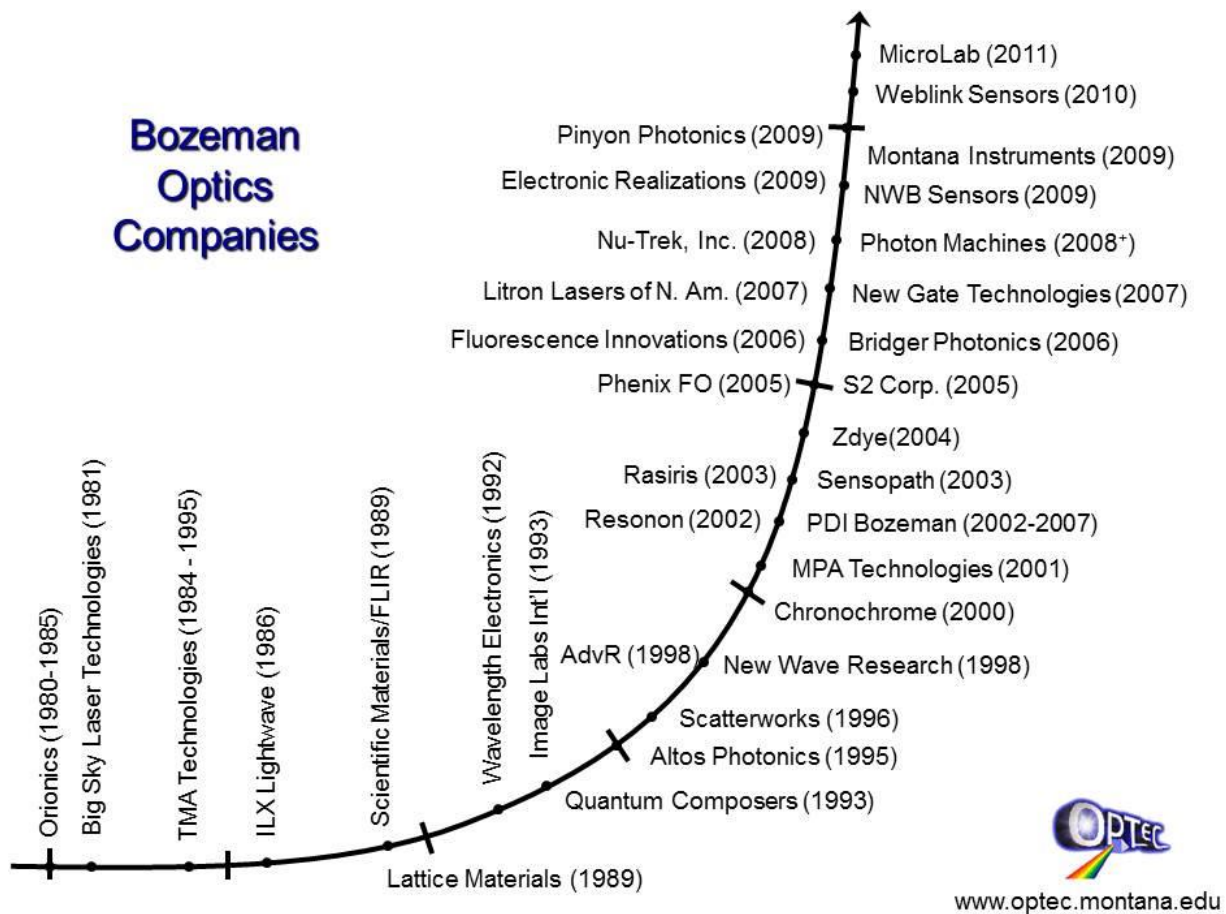


Figure 1. Exponential growth of Montana optics companies in the Gallatin Valley.

b. How will students and any other affected constituencies be served by the proposed program?

Optics has been called an “enabling technology” by the National Academy of Science (*Harnessing Light: Optical Science and Engineering for the 21st Century*, 1998; *Optics and Photonics: Essential Technologies for Our Nation*, 2012). These reports identified numerous ways that optical technologies benefit our nation and the world, including optical fiber communication networks that enable the Internet, tiny laser diodes that enable CD and DVD players and recorders, compact imaging modules that enable the world’s tiniest cell phones to the world’s largest telescopes, and infrared imagers that enable night-vision superiority for our military. This rapidly growing range of optical applications corresponds to a rapidly growing need for engineers and scientists who are ready to create tomorrow’s optical technologies. However, currently there are only a small number of universities that grant degrees tailored specifically to optics. Most employees of optics companies instead gather their training in related disciplines. The previously cited National Academy reports cite a critical national need for more cross-disciplinary training in optics.

The proposed Optics degree will allow students to focus on the discipline of optics while also exploring cross-disciplinary applications spanning traditional academic fields. The Optics degree will attract students who want an optics degree and would otherwise not come to MSU. Therefore, launching this degree program will diversify and expand the number of students we currently train through existing degree programs in Electrical Engineering, Physics, and Chemistry and Biochemistry. The program also will increase the number of students working on optics-related projects, and therefore increase the number of graduates qualified to secure and create new optics jobs in Montana.

c. What is the anticipated demand for the program? How was this determined?

We estimate that a fully operational optics program will enroll approximately 20 graduate students continually. At least 20% are likely to be employees of local optics companies, and many others will become employees of those companies upon graduation. The growing demand for graduates having an advanced degree in optics was identified in discussions with the leaders of more than one dozen local optics companies, such as Bridger Photonics, Resonon, Quantel USA, ILX Lightwave, S2 Corporation, and others. Many of these discussions have taken place over multiple years during our annual OpTeC meeting held at MSU each summer (attended by MSU faculty, students, and local optics company leaders and employees). A more recent discussion occurred in fall 2012 at a Bozeman meeting to discuss economic development opportunities in optics. Similar discussions have occurred in phone conversations between the OpTeC Director and leaders of local optics companies, and during our weekly OpTeC colloquia, attended regularly by company members as well as an academic audience.

Beyond Montana, strong demand for optics graduates exists throughout the western U.S. (and beyond), especially ones trained in the process of designing and building optical systems. This practical focus is, in fact, a feature of our program that will greatly increase demand for our graduates over those from schools that focus only on a few academic sub-areas of optics. For example, recent discussions have identified strong interest from large companies in Colorado (Ball Aerospace and Lockheed-Martin Coherent Technologies) for graduates trained in optical design, especially in one of our strongest specialty areas, optical sensor systems. Similar interest has been found in discussions with companies from Quebec to San Diego.

Rapidly growing demand for optics professionals with cross-disciplinary training also motivates establishing this new program at MSU. For example, MSU currently has faculty members who design state-of-the-art optical sensor systems and others who use such systems for research in fields including agriculture, ecology, biochemistry, space sciences, and other diverse applications. The new optics degree program will provide enhanced opportunities for these faculty members to work together with graduate students who are trained to work and communicate across these disciplines.

3. Institutional and System Fit

a. What is the connection between the proposed program and existing programs at the institution?

Current students work on optics-related research projects as they earn graduate degrees in Electrical Engineering, Physics, or Chemistry and Biochemistry. With the establishment of this new degree, we anticipate growth in the number of students pursuing optics-related topics because experience at the few universities who offer formal optics degrees (e.g., University of Arizona, University of Rochester, University of Central Florida) shows that many students prefer to pursue a degree in optics over one of the traditional disciplines such as physics or electrical engineering. This growth is expected to increase and diversify the number of cross-department projects at MSU. For example, in some cases, the Optics M.S. will provide a valuable technological base from which students will move into a Ph.D. program involving heavy use of optical methods in a conventional discipline such as chemistry and biochemistry, physics, or electrical engineering.

b. Will approval of the proposed program require changes to any existing programs at the institution? If so, please describe.

No changes are required for existing programs. The optics degree is designed to use existing courses, instructors, and lab facilities, as a cross-departmental degree option.

c. Describe what differentiates this program from other, closely related programs at the institution (if appropriate).

The Optics degree will draw on existing faculty and facilities within the departments of Physics, Electrical and Computer Engineering (ECE), and Chemistry and Biochemistry. The degree will be distinct from the other graduate degrees offered by these departments because it will require students to take courses from at least two of these departments, and it will allow students to emphasize their study of optics over other topics that are required by degrees in the traditional disciplines. Each optics student will be advised by a graduate advisor from the faculty of one of the three existing departments and a graduate supervisory committee made up of faculty from at least two of the three departments that participate in this cooperative program.

d. How does the proposed program serve to advance the strategic goals of the institution?

The previous discussion of this proposed optics degree directly addresses the following goals within the Montana University System (MUS) 2012 Strategic Plan:

Goal 2.1 Increase responsiveness to workforce development needs by expanding and developing programs in high-demand fields in the state.

Goal 2.2 Establish collaborative programs among institutions, the private sector, and the state to expand research, technology transfer, the commercialization of new technologies, and the development of our entrepreneurs.

Goal 2.3 Expand graduate education capacity and opportunities in order to increase educational attainment of Montanans, fuel economic development, grow the research and development enterprise, and contribute to the cultural and social fabric of Montana and the region.

The proposed Optics degree also directly addresses the following goals, objectives, and metrics in the Montana State University (MSU) 2012 Strategic Plan:

Goal (Learning): MSU prepares students to graduate equipped for careers and further education.

Objective L.2: Increase graduation rates at MSU

Metric L.2.2: By 2019, the number of graduate degrees awarded will increase from 548 to 625 per year. The number of doctoral degrees awarded will increase from 56 to 80 per year.

Objective L.3: Increase job placement and further education rates

Metric L.3.2: By 2019, the percent of graduates pursuing an advanced degree will increase from an average of 21% to 25%.

Goal (Discovery): MSU will raise its national and international prominence in research, creativity, innovation and scholarly achievement, and thereby fortify the university's standing as one of the nation's leading public research universities.

Objective D.3: Expand the scale, breadth, and quality of doctoral education.

Metric D.3.2: The graduate student population will increase 20% to approximately 2,350 by 2019, with an emphasis on increasing doctoral student enrollment.

Metric D.3.3: By 2019, the number of graduate degrees awarded will increase from 548 to 625 per year. Science, technology, engineering, and mathematics (STEM) master's and doctoral degrees will increase to 325. All doctoral degrees awarded will increase from 56 to 80 per year.

Goal (Integration): By integrating learning, discovery and engagement, and by working across disciplines, the MSU community will improve the world.

Objective I.1: Increase the integration of learning, discovery and engagement.

Metric I.1.4: By 2019, faculty scholarly products with undergraduate and

graduate students will increase 50%.

Objective I.2: Increase work across disciplines.

Metric I.2.1: By 2019, the number of students completing interdisciplinary programs will increase 30%.

Metric I.2.2: BY 2019, MSU will increase interdisciplinary research and creative projects on campus.

Furthermore, MSU's College of Engineering has three strategic areas in the 2009 five-year plan: 1) global connections, 2) cross-disciplinary collaboration, and 3) technological leadership. The proposed optics degree program addresses all these areas.

Based on the cooperative design of the optics degree program, and the enabling nature of optical technology, the proposed optics degree is in direct alignment with the cross-disciplinary goals at the College, University, and System level.

e. Describe the relationship between the proposed program and any similar programs within the Montana University System. In cases of substantial duplication, explain the need for the proposed program at an additional institution. Describe any efforts that were made to collaborate with these similar programs; and if no efforts were made, explain why. If articulation or transfer agreements have been developed for the substantially duplicated programs, please include the agreement(s) as part of the documentation.

There is no similar program in the Montana University System.

4. Program Details

a. Provide a detailed description of the proposed curriculum. Where possible, present the information in the form intended to appear in the catalog or other publications. NOTE: In the case of two-year degree programs and certificates of applied science, the curriculum should include enough detail to determine if the characteristics set out in Regents' Policy 301.12 have been met.

The Optics degree is an interdisciplinary, cooperative program managed by the Optics Program Committee on behalf of the three participating departments: Physics, Electrical and Computer Engineering, and Chemistry and Biochemistry. Students apply directly to the Optics Program and are admitted through one of the participating departments, selected based on advisor affiliation and student interest.

The Master of Science degree in Optics is earned by satisfying these requirements.

<u>Take two fundamentals courses (one PHSX and one EELE):</u>			6
PHSX 427	Advanced Optics	3	
PHSX 437	Laser Applications	3	
EELE 482	Electro-Optical Systems	3	
EELE 484	Laser Engineering	3	
<u>Take one specialty course:</u>			3
EELE 581	Fourier Optics & Imaging	3	
EELE 582	Optical Design	3	
PHSX 531	Nonlinear Optics & Spectroscopy	3	
CHMY 527	Optical Spectroscopy	3	
CHMY 560	Symmetry, Orbitals, & Spectroscopy	3	
<u>Take 6 credits of optics electives chosen from the following:</u>			6
EELE 432	Applied Electromagnetics	3	
EELE 482	Electro-Optical Systems	3	
EELE 484	Laser engineering	3	
EELE 538	Advanced Topics in EM & Optics	3	
EELE 581	Fourier Optics & Imaging	3	
EELE 582	Optical Design	3	
EELE 583	Remote Sensing Systems	3	
PHSX 427	Advanced Optics	3	
PHSX 437	Laser Applications	3	
PHSX 507	Quantum Mechanics II	3	
PHSX 515	Advanced Topics in Physics ¹	3	
PHSX 520	Electromagnetic Theory II	3	
PHSX 531	Nonlinear Optics & Spectroscopy	3	
CHMY 421	Advanced Instrument Analysis	3	
CHMY 527	Optical Spectroscopy	3	
CHMY 557	Quantum Chemistry	3	
CHMY 560	Symmetry, Orbitals, & Spectroscopy	3	
CHMY 564	Advanced Quantum Chemistry	3	
EELE, PHSX, CHMY 591	Special Topics ¹	1-3	
EELE, PHSX, CHMY 592	Independent Study ¹	1-3	
OPTI 594	Optics Seminar ²		
<u>Take at least 5 credits of technical electives at 400 level and above:</u>			
ECE, Physics, Math, Chemistry and Biochemistry, Biology, or Business, etc.			5
<u>Take at least 10 credits under Plan A or Plan B:</u>			10
Plan-A: 10 credits Master's Thesis (EELE, PHSX, CHMY 590)		10	
Plan-B: 3 credits Professional Paper (OPTI 575)		3	
7 additional technical elective credits		7	
TOTAL			30

Note: At least 20 credits must be at the 500 level

Optics graduate students are required to pass the optics qualifying examination at the end of their first year of enrollment. Students who fail the qualifying examination may have a second chance to pass the exam the second year, but in that case financial assistance may not be available the second year. Optics graduate students will defend their thesis or professional paper in an oral examination.

b. Describe the planned implementation of the proposed program, including estimates of numbers of students at each stage.

On approval of the degree program, advertisements will be placed in the leading magazines of the optical science and engineering communities. A new OPTI rubric will be established, along with the new support courses, OPTI 575 (Professional Paper), OPTI 590 (Master's Thesis), and OPTI 594 (Seminar). Existing courses that will become a core part of the optics curriculum will be cross-listed with the OPTI rubric, while maintaining their original home department (e.g., EELE, PHSX, CHMY). One faculty member from each of the three participating departments will be identified to serve on the Optics Program Committee that oversees curriculum design and student admissions.

The Optics MS program will be introduced with very low costs. During the first year of operation, it is expected that approximately six graduate students will be enrolled. This number is expected to grow to a dozen by the third year and to approximately twenty by the fifth year. If recent trends in the local optics industry continue, this enrollment could double within 5-10 years. These numbers are in addition to students who will continue to pursue optics-related degrees in Electrical Engineering, Physics, and Chemistry. This growth will require the establishment of dedicated Teaching Assistantship (TA) positions for the Optics program, dedicated administrative support, and financial support for program advertisement and recruiting. Financial support will be pursued both internally and externally. After the MS program is successfully established, we will determine if and how to establish an Optics Ph.D. program.

5. Resources

a. Will additional faculty resources be required to implement this program? If yes, please describe the need and indicate the plan for meeting this need.

No new faculty members are required for the initial implementation of the Optics M.S. degree program. Current tenure-track faculty who are anticipated to become part of the Optics program include five in Electrical and Computer Engineering, six in Physics, and three in Chemistry and Biochemistry (total = fourteen). An additional five existing research faculty members are expected to participate in the program.

Faculty members affiliated with the Optics program will have a modest amount of additional expectations to implement the program. For example, each year three Optics faculty members will be asked to serve on the Optics Program Committee, chaired

initially by the OpTeC Director. All Optics faculty members will be asked to submit and grade questions for the Optics Qualifying Exam, to be offered at the end of each academic year.

No new courses are required to implement the Optics M.S. degree. However, as the field and demand progress, courses will be added, dropped, or modified to maintain the highest level of relevance. These decisions will be made at the department level with input from the Optics program committee.

b. Are other, additional resources required to ensure the success of the proposed program? If yes, please describe the need and indicate the plan for meeting this need.

The program will require a half-time Administrative Assistant to manage graduate student recruitment, applications, and admissions, along with a modest sum for recruitment and operations. These funds will be pursued through internal and external proposals.

6. Assessment

How will the success of the program be measured?

All departments in the MSU College of Engineering use a systematic assessment plan (<http://www.montana.edu/wwwprov/assessment/assessmentplans.htm>) for all academic programs and courses. We continually assess objectives and outcomes at the program and course levels. This same assessment plan will be used for the Optics program.

In addition, we will provide annual assessment based on student, employer, and alumni satisfaction, and input provided by Montana optics industry leaders, including feedback provided during the annual OpTeC meeting. Student enrollment, graduation rates, and employment trends will be recorded by the Optics Program Administrative Assistant, and reviewed annually by the Optics Program Committee. The Optics Program initially will be directed by the OpTeC Director, who reports to the Vice-President for Research. An annual meeting of the OpTeC faculty will be held to discuss and review the annual assessment. Appropriate revisions will be determined from all these sources.

7. Process Leading to Submission

Describe the process of developing and approving the proposed program. Indicate, where appropriate, involvement by faculty, students, community members, potential employers, accrediting agencies, etc.

OpTeC faculty members (from ECE, Physics, and Chemistry & Biochemistry) have gathered several times in recent years to discuss national optics degree trends, existing

MSU optics course offerings, and needed courses. A working group, comprising one faculty member from each of the three participating departments designed the optics program. Input from local optics companies, including ILX Lightwave, Quantel Lasers, Bridger Photonics, S2 Corp., NWB Sensors, FLIR/Scientific Materials, AdvR, and Altos Photonics, was gathered during a fall 2012 economic development meeting. A public meeting was held in January 2013 during the weekly OpTeC Colloquium time for faculty and students to hear about and comment on the proposal. Finally, the program was reviewed and approved by the graduate curriculum committees and the department heads of the participating departments, the deans of the two colleges, and the university graduate committee.