2014-2015 LONG SIGNATURE SHEET

RECEIVED 3/23/15

PHYS 03-19-2015

Proposal Number: ~~BPOS 03-03-15~~

UNC CHARLOTTE

Proposal Title: Revisions to the Ph.D. and M.S. Programs in Optical Science and Engineering

Originating Department: Physics and Optical Science

REVISED - RECEIVED 4/22/15

TYPE OF PROPOSAL: UNDERGRADUATE_____ GRADUATE__X___ UNDERGRADUATE & GRADUATE____
(Separate proposals sent to UCCC and Grad. Council)

DATE RECEIVED	DATE CONSIDERED	DATE FORWARDED	ACTION	SIGNATURES
3/19	3/19	3/20	*Approved*	**DEPARTMENT CHAIR** Glenn Boreman
			Approved	**COLLEGE CURRICULUM COMMITTEE CHAIR** Oscar Lansen
			Approved	**COLLEGE FACULTY CHAIR (if applicable)** Michael Turner
		4/22/15	*Approved*	**COLLEGE DEAN** for C. BRODY Nancy Gutierrez
			Approved	**GENERAL EDUCATION** (if applicable; for General Education courses) [print name here:]
			Approved	**HONORS COLLEGE** (if applicable; for Honors courses & programs) [print name here:]
			Approved	**UNDERGRADUATE COURSE & CURRICULUM COMMITTEE CHAIR** (for undergraduate content)
4-28-15	5-22-15 Special review	6-10-15	*Approved*	**GRADUATE COUNCIL CHAIR** (for graduate content) ALAN R. FREITAG
				FACULTY GOVERNANCE ASSISTANT (Faculty Council approval on Consent Calendar)
				FACULTY EXECUTIVE COMMITTEE (if decision is appealed)

Revised 05/06/14
OAA/mjw

UNC CHARLOTTE

LONG FORM
COURSE AND CURRICULUM PROPOSAL

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*To: Dr. Alan Freitag, Chair of Graduate Council

From: Dr. Angela Davies

Date: March 19, 2015

Re: Revisions to the Ph.D. and M.S. Programs in Optical Science and Engineering

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The Long Form is used for major curriculum changes. Examples of major changes can include:

Undergraduate: Major changes include new undergraduate degrees, minors, concentrations, certificates, and changes to more than 50% of an existing program (Note: changing the name of an academic department does not automatically change the name(s) of the degree(s). The requests must be approved separately by the Board of Governors.)

Graduate: Major changes include new graduate courses, major changes to an existing graduate course or major changes to an existing graduate program

Submission of this Long Form indicates review and assessment of the proposed curriculum changes at the department and collegiate level either separately or as part of ongoing assessment efforts.

*****Proposals for undergraduate courses and programs should be sent to the Undergraduate Course and Curriculum Committee Chair. Proposals related to both undergraduate and graduate courses, (e.g., courses co-listed at both levels) must be sent to both the Undergraduate Course and Curriculum Committee and the Graduate Council.

University of North Carolina at Charlotte PHYS 03-19-2015

Revised Graduate

Course and Curriculum Proposal from: Department of Physics and Optical Science

I. Revisions to the Ph.D. and M.S. Programs in Optical Science and Engineering

II. CONTENT OF PROPOSALS

A. PROPOSAL SUMMARY

The Department of Physics and Optical Science proposes to make the following changes to the curriculum, courses, and Graduate Catalog for the Ph.D. and M.S. Programs in Optical Science and Engineering:

i. Revise the Ph.D. admission and degree requirements:

a. Add the International English Language Testing System (IELTS) as an alternative to TOEFL for demonstrating English language proficiency.

b. Remove the TOEFL score minimum requirements from our program's section of the catalog in order to emphasize that it is a university policy rather than a departmental or program policy.

c. Change the evidence of competency in the core curriculum requirement from 15 credit hours (5 courses) to 18 credit hours, with a grade of B or above in each course.

d. Change the elective requirement of OPTI-prefix courses from 9 credit hours to 6 credit hours.

e. Renumber OPTI 8110 Seminar to OPTI 8610 Seminar and change the requirement to 1 credit hour during the fall of the first academic year in the program. Create OPTI 8611 Graduate Colloquium and set the requirement to 1 credit hour during the spring of the first academic year and 1 credit hour each subsequent academic year in the program.

f. Change Research Plan to Research Proposal.

g. Remove the GPA of 3.4 or above requirement for the core curriculum and replace with B or above in each course of the core curriculum.

h. Replace "core examination" with "core competency exam" to clarify that it is not a reference to the qualifying exam but rather an alternative method in which a student may demonstrate competency in a core course.

i. Add the requirement of GRAD 8002 Responsible Conduct of Research, according to Graduate School policy.

j. Revise and rename OPTI 8102 Principles of Geometrical and Physical Optics to OPTI 8102 Principles of Geometrical Optics (3 credits).

k. Create and add OPTI 8102L Geometrical Optics Lab (1 credit) as a core course.

l. Add OPTI 8103 Light Sources and Detectors (3 credits) as a core course.

m. Create and add OPTI 8106 Principles of Physical Optics (3 credits) as a core course.

n. Create and add OPTI 8106L Physical Optics Lab (2 credits) as a core course.

o. Remove OPTI 8211 Intro to Modern Optics as a core course.

p. Clarify that the minimum total number of dissertation committee members is 4, one of whom is the chair and one of whom is the Graduate Faculty Representative.

ii. Revise the M.S admission and degree requirements:

a. Add the International English Language Testing System (IELTS) as an alternative to TOEFL for demonstrating English language proficiency.

b. Remove the TOEFL score minimum requirements from our program's section of the catalog in order to emphasize that it is a university policy rather than a departmental or program policy.

c. Separate the Degree Requirements section into two sections, one for degree with non-thesis option and one for degree with thesis option.

d. Clarify the evidence of competency in the core curriculum requirement as 15 credit hours, with a grade of B or above in each course.

e. Renumber OPTI 6110 Seminar to OPTI 6610 Seminar and change the requirement to 1 credit hour during the fall of the first academic year in the program. Create OPTI 6611 Graduate Colloquium and set the requirement to 1 credit hour during the spring of the first academic year in the program.

f. Change Research Plan to Research Proposal.

h. Replace “comprehensive qualifying examination” with “core competency exam” to clarify that it is not the qualifying exam but rather an alternative method in which a student may demonstrate competency in a core course.

i. Revise and rename OPTI 6102 Principles of Geometrical and Physical Optics to OPTI 6102 Principles of Geometrical Optics (3 credits).

j. Create and add OPTI 6102L Geometrical Optics Lab (1 credit) as a core course.

k. Add OPTI 6103 Light Sources and Detectors (3 credits) as a core course.

l. Create and add OPTI 6106 Principles of Physical Optics (3 credits) as a core course.

m. Create and add OPTI 6106L Physical Optics Lab (2 credits) as a core course.

n. Remove OPTI 6211 Intro to Modern Optics as a core course.

o. Clarify that the minimum total number of thesis committee members is 3, one of whom is the chair.

p. Clarify admission to candidacy for a master’s student according to Graduate School definition.

iii. Revise OPTI courses:

a. Revise the following OPTI courses:

1. OPTI 6/8101 Math Methods of Optical Science and Engineering

2. OPTI 6/8102 Principles of Geometrical and Physical Optics (current course)

Split the content of this current course into two courses (3 credits each, keep 6/8102 for one) and create a lab for each:
OPTI 6/8102 Principles of Geometrical Optics (3 credits)
OPTI 6/8102L Geometrical Optics Lab (1 credit)
OPTI 6/8106 Principles of Physical Optics (3 credits)
OPTI 6/8106L Physical Optics Lab (2 credits)

3. OPTI 6/8103 Light Sources and Detectors
4. OPTI 6/8104 Electromagnetic Waves
5. OPTI 6/8105 Optical Properties of Materials
6. OPTI 6/8110 Seminar
7. OPTI 6/8691 Research Seminar

b. Create the following OPTI courses (new course numbers indicated with yellow highlight):

1. OPTI 6/8106 Principles of Physical Optics (3 credits)
2. OPTI 6/8102L Geometrical Optics Lab (1 credit)
3. OPTI 6/8106L Physical Optics Lab (2 credits)
4. OPTI 6/8400 Industrial Internship (1-3 credits)
5. OPTI 6/8611 Graduate Colloquium (1 credit)

c. Transition the following special topics courses into regular OPTI elective courses (new course numbers indicated with yellow highlight):

1. OPTI 5371 Waves and Optics (3 credits)
2. OPTI 5392 Solid State Microelectronic Devices (3 credits)
3. OPTI 6/8203 Metamaterials (3 credits)
4. OPTI 6/8206 Physical Optics Design and Simulation (3 credits)
5. OPTI 6/8301 Introduction to Instrumentation and Processing at the Nanoscale (3 credits)
6. OPTI 6/8302 Nanoscale Phenomena (3 credits)
7. OPTI 6/8303 Collaborative Research Proposal (3 credits)
8. OPTI 6/8341 Applied Quantum Mechanics (3 credits)
9. OPTI 6/8371 Solid State Materials (3 credits)
10. OPTI 6/8381 Engineering Metrology (3 credits)
11. OPTI 6/8384 Advanced Surface Metrology (3 credits)

B. JUSTIFICATION

1. Identify the need addressed by the proposal and explain how the proposed action meets the need.

The last OSE program assessment was in 2004. That assessment resulted in significant changes which were implemented in 2005. The program has changed significantly since that time. The reputation of the program has grown and the qualifications of applicants have significantly improved. However, the qualifying exam committee has been increasingly underwhelmed with student performance. It was proposed that one of the core courses in particular (OPTI 6/8102 Introduction to Geometrical and Physical Optics) attempted to cover too much material and was not serving the students well. The proposal was to consider breaking this 3-credit course up into two 3-credit courses. A curriculum committee was

formed in the Fall of 2012 to review the program and make recommendations for improvement. The results of the faculty-approved changes are presented here. The need addressed by this proposal is to improve the PhD and MS programs in Optical Science and Engineering. The faculty serving the OSE program (the Optics Faculty) feel the changes proposed will enhance student learning by strengthening the curricula, revising the coursework, and fine-tuning the catalog text to align with academic policy and for clarity.

i. Revise the Ph.D. admission and degree requirements:

Revising the PhD admission and degree requirements will align the program of study, degree requirements, and course numbering to Graduate School and academic policy, strengthen the core curriculum, enhance student learning, and clarify catalog text.

ii. Revise the M.S admission and degree requirements:

Revising the M.S. admission and degree requirements will align the programs of study, degree requirements, and course numbering to Graduate School and academic policy, strengthen the core curriculum, enhance student learning, and clarify catalog text. For consistency, some sections of text will be relocated so that the format and chronological presentation of information for the MS program in the catalog is similar to the PhD program's format and presentation in the catalog.

iii. Revise OPTI courses:

Revising, creating, and transitioning courses will align course numbers with academic policy, clarify content, strengthen and streamline the core curriculum.

a. Revise courses:

1. OPTI 6/8101 Math Methods of Optical Science and Engineering. This core course has not changed significantly but the catalog description is being fine-tuned to more clearly describe current content and objectives.

2. OPTI 6/8102 Principles of Geometrical and Physical Optics will be separated into two different courses: (1) OPTI 6/8102 Principles of Geometrical Optics and (2) OPTI 6/8106 Principles of Physical Optics. This will allow for the appropriate coverage of these two foundational principles of optics.

3. OPTI 6/8103 Light Sources and Detectors. This regular elective course is being designated as a core course which was the original intent for the course. The catalog description is being fine-tuned to more clearly describe current content and objectives.

4. OPTI 6/8104 Electromagnetic Waves: This core course has not changed significantly but the catalog description is being fine-tuned to more clearly describe current content and objectives.

5. OPTI 6/8105 Optical Properties of Materials. This core course has not changed significantly but the catalog description is being fine-tuned to more clearly describe current content and objectives.

6. OPTI 6/8110 Seminar will be separated into two different courses: (1) OPTI 6/8610 Seminar and (2) OPTI 6/8611 Graduate Colloquium. OPTI 6/8610 will retain the name Seminar and OPTI 6/8611 will be created and named Graduate Colloquium. This will appropriately partition the two separate roles this one course currently fulfills. The courses will be renumbered according to academic policy

7. OPTI 6/8691 Research Seminar is currently being used as an independent study course. It will be appropriately renumbered according to academic policy as OPTI 6/8800 and renamed Independent Study in order to align its name with its existing role.

b. Create courses:

1. OPTI 6/8106 Principles of Physical Optics will be created as part of separating OPTI 6/8102 Principles of Geometrical and Physical into two separate courses.

2. OPTI 6/8102L Geometrical Optics Lab will be created and offered as an option to complement OPTI 6/8102 Principles of Geometrical Optics.

3. OPTI 6/8106L Physical Optics Lab will be created and offered as an option to complement OPTI 6/8106 Principles of Physical Optics.

4. OPTI 6/8400 Industrial Internship will be created because there is no existing OPTI internship course for students who have attained this accomplishment.

5. OPTI 6/8611 Graduate Colloquium will be created as part of separating OPTI 6/8110 Seminar into two separate courses.

c. Transition special topics courses into regular OPTI elective courses:

The program has looked to cross-list with existing optics-related courses on campus where possible to maximize student learning options and economize on instructor workload. Changes in research directions within the program have also led to the establishment of new elective classes which were initially tested and offered as special topics courses. At the same time, student interest has dropped in some existing elective courses, therefore instruction workload has remained steady.

2. Discuss prerequisites/corequisites for course(s) including class-standing, admission to the major, GPA, or other factors that would affect a student's ability to register.

The proposed courses to be created do not have prerequisite or corequisite requirements that would affect a student's ability to register.

We propose to reduce the GPA requirement on the core course curricula from 3.4 to a B or better. The program originated in 2003 and initially did not have a qualifying exam. The original 3.4 GPA requirement was the primary quality control mechanism. The qualifying exam was instituted in 2005 and now serves as a strong quality control mechanism. The optics faculty have concluded that a grade of B or better in the core, in addition to passing the qualifying exam, is sufficient.

3. Demonstrate that course numbering is consistent with the level of academic advancement of students for whom it is intended.

Alignment to course numbering policy has been a goal and often an impetus for the changes proposed herein, and has been followed for revised, created, and transitioned courses.

4. In general, how will this proposal improve the scope, quality and/or efficiency of programs and/or instruction?

Separating OPTI 6/8102 Principles of Geometrical and Physical Optics into two courses, one covering geometrical optics and one covering physical optics, will directly benefit students and increase learning outcomes by building a stronger core foundation through a more in-depth study of these two fundamental principles.

Additionally, a Geometrical Optics Lab and a Physical Optics Lab will be added as an option to provide students a tangible and visual application of

theory and principle through hands-on examples and demonstration, reinforcing the learning process.

5. If course(s) has been offered previously under special topics numbers, give details of experience including number of times taught and enrollment figures.

1. OPTI 5000 Waves and Optics
   Taught: 9 times; Enrollment: 11, 38, 36, 20, 39, 30, 27, 23, 44
2. OPTI 5000 Solid State Microelectronics II
   Taught: 2 times; Enrollment: 6, 6
3. OPTI 6/8000 Metamaterials
   Taught: 1 time; Enrollment: 4
4. OPTI 6/8000 Physical Optics Design and Simulation
   Taught: 2 times: Enrollment: 12, 4
5. OPTI 6/8000 Intro to Instrum. & Proc. at the Nanoscale
   Taught: 3 times; Enrollment: 4, 6, 5
6. OPTI 6/8000 Nanoscale Phenomena
   Taught: 5 times; Enrollment: 5, 10, 7, 3, 6
7. OPTI 6/8000 Collaborative Research Proposal
   Taught: 4 times; Enrollment: 10, 3, 5, 8
8. OPTI 6/8000 Applied Quantum Mechanics
   Taught: 4 times; Enrollment: 4, 10, 11, 8
9. OPTI 6/8000 Advanced Solid State Materials
   Taught: 4 times; Enrollment: 3, 3, 9, 20
10. OPTI 6/8000 Engineering Metrology
    Taught: 4 times; Enrollment: 11, 17, 6, 12
11. OPTI 6/8000 Advanced Surface Metrology
    Taught: 3 times; Enrollment: 9, 4, 12

C. IMPACT. Changes to courses and curricula often have impacts both within the proposing department as well as campus-wide. What effect will this proposal have on existing courses and curricula, students, and other departments/units? Submit an Impact Statement that fully addresses how you have assessed potential impacts and what the impacts of this proposal might be. Consider the following:

1. What group(s) of students will be served by this proposal? (Undergraduate and/or graduate; majors and/or non-majors, others? Explain). Describe how you determine which students will be served.

Graduate students in the Optical Science and Engineering PhD and MS programs are the group of students served by this proposal. The PhD program currently includes approximately 45 full time students and the MS program currently includes approximately 15 students. Many of the OSE PhD candidates secure an MS in OSE along the way to the PhD.

As an interdisciplinary program, some courses may be taken as electives by students in other graduate programs on campus, such as students in Electrical Engineering, Mechanical Engineering, Applied Physics, Nanoscale Science, Mathematics, and other STEM programs of study.

2. What effect will this proposal have on existing courses and curricula?

a. When and how often will added course(s) be taught?

A majority of the proposed courses will be taught on a regular schedule, once per academic year during either the fall or spring semester. A few will be offered on demand. Graduate Colloquium will be offered every semester.

b. How will the content and/or frequency of offering of other courses be affected?

Most of the added courses are cross-listed, meaning the teaching commitment and plan already exists in another department on campus. There are two course requests that are for new courses: (1) OPTI 6/8203 Metamaterials and (2) OPTI 6/8206 Physical Optics Design and Simulation. These do not represent an increased teaching commitment due to a lack of student interest in recent years in other traditionally offered courses.

c. What is the anticipated enrollment in course(s) added (for credit and auditors)?

Enrollment in the proposed courses is anticipated to be 8 to 20 students.

d. How will enrollment in other courses be affected? How did you determine this?

Enrollment in other courses is not expected to be greatly affected. Most of the proposed changes involve transitioning special topics courses to regular courses, and since most have seen steady enrollment when offered as special topics, it is anticipated those enrollment numbers will remain stable while showing a gradual increase over time and not affect other courses immediately or substantially.

e. Identify other areas of catalog copy that would be affected, including within other departments and colleges (e.g., curriculum

outlines, requirements for the degree, prerequisites, articulation agreements, etc.)

Most of the new OPTI courses that are proposed are special topics courses that need to migrate to a permanent title and course number, and have been (as a Special Topics courses) and proposed to be cross-listed with existing courses in other departments.

As a cross-list, the OPTI version of the course will follow the existing course schedule and instructor assignment defined by the other department.

The catalog copy of the new OPTI course to be cross-listed and the catalog copy of the existing course in the other department needs to reflect the new cross-list. This is reflected for the OPTI version of the course in this proposal and the short forms have been started in the other departments to request the changes to the catalog description for the existing course (see section 4.B and Attachment 4: Cross-Listing Consultation)

The proposed new OPTI courses that will be cross-listed and the existing-course that they will be cross-listed with are as follows:

1. OPTI 5371 Waves and Optics (3 credits) to be cross-listed with PHYS 4271/5271. The Physics Department is processing a short form to request changes to the existing catalog descriptions.

2. OPTI 5392 Solid State Microelectronic Devices (3 credits) to be cross-listed with ECGR 4132/5192. The Electrical Engineering Department is processing a short form to request changes to existing catalog descriptions.

3. OPTI 6/8301 Introduction to Instrumentation and Processing at the Nanoscale (3 credits) to be cross-listed with NANO 8101. The Chemistry Department is processing a short form to request changes to the existing catalog description.

4. OPTI 6/8302 Nanoscale Phenomena (3 credits) to be cross-listed with NANO 8102. The Chemistry Department is processing a short form to request changes to the existing catalog description.

5. OPTI 6/8303 Collaborative Research Proposal (3 credits) to be cross-listed with NANO 8203. The Chemistry Department is processing a short form to request changes to the existing catalog description.

6. OPTI 6/8341 Applied Quantum Mechanics (3 credits) to be cross-listed with PHYS 6141. The Physics Department is processing a short form to request changes to the existing catalog description.

7. OPTI 6/8371 Solid State Materials (3 credits) to be cross-listed with PHYS 6271. The Physics Department is processing a short form to request changes to the existing catalog description.

8. OPTI 6/8381 Engineering Metrology (3 credits) to be cross-listed with MEGR 6181/8181. The Mechanical Engineering Department is processing a short form to request changes to the existing catalog descriptions.

9. OPTI 6/8384 Advanced Surface Metrology (3 credits) to be cross-listed with MEGR 7284/8284. The Mechanical Engineering Department is processing a short form to request changes to the existing catalog descriptions.

III. RESOURCES REQUIRED TO SUPPORT PROPOSAL

When added resources are not required, indicate "none". For items which require "none" explain how this determination was made.

A. **PERSONNEL**. Specify requirements for new faculty, part-time teaching, student assistants and/or increased load on present faculty. List by name qualified faculty members interested in teaching the course(s).

None. No new personnel are required to meet the proposed changes. The following faculty are qualified and interested in teaching the proposed courses:

1. OPTI 6/8106 Principles of Physical Optics - Dr. Michael Fiddy

2. OPTI 6/8102L Geometrical Optics Lab and OPTI 6/8106L Physical Optics Lab - Dr. Awad Gerges

B. **PHYSICAL FACILITY.** Is adequate space available for this course?

None. OPTI 6/8102L Geometrical Optics Lab and OPTI 6/8106L Physical Optics Lab will utilize existing laboratory space.

C. **EQUIPMENT AND SUPPLIES:** Has funding been allocated for any special equipment or supplies needed?

None. No special equipment or supplies are needed to implement the proposed changes.

D. **COMPUTER.** Specify any computer usage (beyond Moodle) required by students and/or faculty, and include an assessment of the adequacy of software/computing resources available for the course(s).

None. No special/additional computer software and no special/additional computers are needed to implement the proposed changes.

E. AUDIO-VISUAL. If there are requirements for audio-visual facilities beyond the standard classroom podiums, please list those here.

None. There are no audio-visual requirements beyond the standard lab/classroom facilities.

F. OTHER RESOURCES. Specify and estimate cost of other new/added resources required, e.g., travel, communication, printing and binding.

None. There are no other new/added resources required to implement the proposed changes.

G. SOURCE OF FUNDING. Indicate source(s) of funding for new/additional resources required to support this proposal.

None.

IV. CONSULTATION WITH THE LIBRARY AND OTHER DEPARTMENTS OR UNITS

A. LIBRARY CONSULTATION. Indicate written consultation with the Library Reference Staff at the departmental level to ensure that library holdings are adequate to support the proposal prior to its leaving the department. (Attach copy of ***Consultation on Library Holdings***).

B. CONSULTATION WITH OTHER DEPARTMENTS OR UNITS. List departments/units consulted in writing regarding all elements outlined in IIC: Impact Statement, including dates consulted. Summarize results of consultation and attach correspondence. Provide information on voting and dissenting opinions (if applicable).

Several of the proposed new courses have been special topics courses that have been previously cross-listed with an existing course in an outside department. This cross-list has always been done in agreement with the outside department. The impacted departments have agreed to begin the short form process to request a formal catalog copy change for their course that reflects the proposed cross-list with a new OPTI version of the course. See Attachment 4: Cross-Listing Consultation.

C. HONORS COUNCIL CONSULTATION. In the case of Honors courses or Honors programs indicate written consultation with the Honors Council (if applicable).

V. INITIATION, ATTACHMENTS AND CONSIDERATION OF THE PROPOSAL

A. ORIGINATING UNIT. Briefly summarize action on the proposal in the originating unit including information on voting and dissenting opinions.

The last OSE program assessment was in 2004. That assessment resulted in significant changes which were implemented in 2005. The program has changed significantly since that time. The reputation of the program has grown and the qualifications of applicants had significantly improved. Further, the qualifying exam committees had been increasingly underwhelmed with student performance. It was proposed that one of the core courses in particular (OPTI 6/8102 Introduction to Geometrical and Physical Optics) attempted to covered too much material and was not serving the students well. The proposal was to consider breaking this 3-credit course up into two 3-credit courses.

A curriculum committee was formed in the Fall of 2012 to review the program. The committee was chaired by Dr. Faramarz Farahi (Physics and Optical Science, POS), and additionally included Dr. Aba Ebong (Electrical Engineering, EE), Dr. Chris Evans (Mechanical Engineering, ME), Dr. Pat Moyer (POS), and Dr. Glenn Boreman (POS). The committee member distribution well represented the interdisciplinary nature of the program. The OSE Faculty, the Program Director, and the OSE Program Committee charged the committee with the following objectives:

1. seek input from all OSE faculty
2. seek input from OSE instructors, standing committee members
3. assess curriculum deficiencies
4. compare curriculum to our peer graduate programs
5. consider informal tracks to facilitate core and elective discussion (‘tracks’ ≈ general research areas and job opportunities)
6. articulate goals of the core courses and of the electives
7. recommend changes to the core curriculum
8. recommend electives for the informal tracks
9. make recommendations with observation of

- OSE entering student demographics: Physics, EE and ME with minimal optics incoming experience
- desirable minimal requirements to maximize program flexibility that accommodates student and scholarship diversity
- additional core course goals that are to transition students to an aptitude for independent learning and critical thinking

The Program Director and Chair of the Curriculum Committee presented the initial recommendations to the Optics Faculty in February of 2013. Slight modifications were considered and a final formal voting by the Optics Faculty on a final proposed group of changes occurred February 2014. The results of this voting are represented in the changes proposed in this long form proposal.

B. CREDIT HOUR. (Mandatory if new and/or revised course in proposal)

Review statement and check box once completed:

☒ The appropriate faculty committee has reviewed the course outline/syllabus and has determined that the assignments are sufficient to meet the University definition of a credit hour.

C. ATTACHMENTS.

1. CONSULTATION: Attach relevant documentation of consultations with other units.

SEE ATTACHMENT 1.
CONSULTATION ON LIBRARY HOLDINGS

2. COURSE OUTLINE/SYLLABUS: For undergraduate courses attach course outline(s) including basic topics to be covered and suggested textbooks and reference materials with dates of publication. For Graduate Courses attach a course syllabus. Please see Boiler Plate for Syllabi for New/Revised Graduate Courses.

SEE ATTACHMENT 2.
COURSE OUTLINE/SYLLABUS

3. PROPOSED CATALOG COPY: Copy should be provided for all courses in the proposal. Include current subject prefixes and course numbers, full titles, credit hours, prerequisites and/or corequisites, concise descriptions, and an indication of when the courses are to be offered as to semesters and day/evening/weekend. Copy and paste the current catalog copy and use the Microsoft Word "track changes" feature (or use red text with "~~strikethrough~~" formatting for text to be deleted, and adding blue text with "underline" formatting for text to be added).

SEE ATTACHMENT 3.
PROPOSED CATALOG COPY

a. For a new course or revisions to an existing course, check all the statements that apply:

_X_ This course will be cross listed with another course.
_X_ There are prerequisites for this course.

____ There are corequisites for this course.
_X_ This course is repeatable for credit.
_X___ This course will increase/decrease the number of credits hours currently offered by its program.
____This proposal results in the deletion of an existing course(s) from the degree program and/or catalog.

For all items checked above, applicable statements and content must be reflected in the proposed catalog copy.

b. If overall proposal is for a new degree program that requires approval from General Administration, please contact the facultygovernance@uncc.edu for consultation on catalog copy.

4. ACADEMIC PLAN OF STUDY **(UNDERGRADUATE ONLY)**: Does the proposed change impact an existing Academic Plan of Study?

☐ Yes. If yes, please provide updated Academic Plan of Study in template format.
☐ No.

5. STUDENT LEARNING OUTCOMES (UNDERGRADUATE & GRADUATE): Does this course or curricular change require a change in Student Learning Outcomes (SLOs) or assessment for the degree program?

☐ Yes. If yes, please provide updated SLOs in template format.
☒ No.

6. TEXTBOOK COSTS: It is the policy of the Board of Governors to reduce textbook costs for students whenever possible. Have electronic textbooks, textbook rentals, or the buyback program been considered and adopted?

☒ Yes. Briefly explain below.
☐ No. Briefly explain below.

The OSE program encourages consideration of electronic textbooks, textbook rentals, and the buyback program during course creation and revision.

7. Cross-Listing Consultation

SEE ATTACHMENT 4
CROSS-LISTING CONSULTATION

IMPORTANT NOTE: A Microsoft Word version of the final course and curriculum proposal should be sent to facultygovernance@uncc.edu upon approval by the Undergraduate Course and Curriculum Committee and/or Graduate Council chair.

ATTACHMENT 1.

CONSULTATION ON LIBRARY HOLDINGS

Revised 10/29/08
OAA jdp

UNC CHARLOTTE

J. Murrey Atkins Library

Consultation on Library Holdings

To: **Dr. Angela Davies**

From: **Jeff McAdams**

Date: **03/18/15**

Subject: **Revisions to the Ph.D. and M.S. Programs in Optical Science and Engineering**

Summary of Librarian's Evaluation of Holdings:

Evaluator: **Jeff McAdams** **Date: 03/18/15**

Check One:

1. Holdings are superior _____
2. Holdings are adequate __x__
3. Holdings are adequate only if Dept. purchases additional items. _____
4. Holdings are inadequate _____

Comments:
Library holdings should be adequate to support student research for this program (see list of items held by subject heading below). Students will have access to relevant databases including *Compendex, Inspec, Web of Science, Science Direct, IEEE Xplore, SPIE Digital Library, Institute of Physics, Optics InfoBase, SpringerLink, Wiley*, and many others.

LC Subject Heading	Books	Journals
Geometrical Optics	47	0
Physical Optics	769	13
Optical Instruments	1012	10
Electromagnetic Waves	305	7
Materials – Optical Properties	225	0
Nanotechnology	994	50
Solid State Electronics	230	20
Engineering Measurement	814	21
Optical Measurements	572	2
Surfaces (Technology) Measurement	21	0

Because this program's revisions include minor changes to many classes and additions of previously held classes, we currently hold many library resources for the content of these classes in almost all cases. We have the complete e-book package from *Springer*, which accounts for much of our recent holdings in these areas. We also have substantial content from *Wiley*, as well. In addition, our journal and index content is at a high level for these areas.

Evaluator's Signature

03/18/15

Date

ATTACHMENT 2. COURSE OUTLINE/SYLLABUS

SYLLABUS - OPTI 5371 WAVES AND OPTICS (3)

OPTI 5371
Cross-listed with PHYS 4271/5271
Waves and Optics
Instructor: A. Davies, adavies@uncc.edu, Grigg 235, 7-8135

TEXT: Introduction to Optics, 3rd Edition, Pedrotti[3] (available in bookstore).

COURSE CONTENT: This is a one semester introductory study of optics taught at the intermediate level. Successful completion of the equivalent of PHYS 2101 and 2102 is assumed. We will cover topics such as geometrical optics, optical instruments, wave optics (interference and diffraction), Fourier analysis, and polarization. We will make use of mathematics such as vector calculus, differential equations, linear algebra, and complex variable analysis.

GRADING:

Homework (assigned approximately weekly)	25%
Exam 1	25%
Exam 2	25%
Final Comprehensive Exam	25%

Grades will be assigned using: A = 85-100, B = 70-84, C = 50-69, U = <50. Working together on homework is encouraged. **NO LATE HOMEWORK IS ACCEPTED. NO MAKE UP TESTS WILL BE GIVEN**. You will receive a score of 0 on a missed exam. The score on the final exam will be substituted for the lowest exam score. You must take the final exam.

GRADUATE/UNDERGRADUATE DISTINCTION:
Students taking the graduate level version are held to a higher expectation. The primary learning objective for the undergraduate is to gain a working knowledge of basic geometric optics and physical optics principles to provide foundational knowledge to be used when faced with practical optical system questions. The primary learning objective for the graduate students is to gain the same working knowledge and to develop a solid theoretical understanding. This is assessed by assigning graduate students additional homework problems and grading their exam solutions more rigorously.

CLASS ATTENDANCE: There will be material presented in class that is not in the text. Handouts may be given when appropriate. You are responsible for material discussed in class, in the homework assignments, and in the assigned reading.

ACADEMIC INTEGRITY: Students have the responsibility to know and observe the requirements of The UNCC Code of Student Academic Integrity. This code forbids cheating, fabrication or falsification of information, multiple submission of academic work, plagiarism, abuse of academic materials, and complicity in academic dishonesty. Any special requirements or permission regarding academic integrity in this course will be stated by the instructor, and are binding on the students. Academic evaluations in this course include a judgment that the student's work is free from academic dishonesty of any type; and grades in this course therefore should be and will be adversely affected for academic dishonesty. Students who violate the code can be expelled from UNCC. The normal penalty for first offense is zero credit on the work involving dishonesty and further substantial reduction of the course grade. In almost all cases the course grade is reduced to F. Students are expected to report cases of academic dishonesty to the course instructor.

SYLLABUS - OPTI 5392 Solid State Microelectronic Devices (3)

OPTI 5392
Cross-listed with ECGR 4134/5192
Solid State Microelectronic Devices

Text: An Introduction to Semiconductor Devices by Donald Neamen – 2006.

Professor: Abasifreke Ebong – Office: EPIC 2162 – aebong1@uncc.edu

Office hours (in EPIC 2162): Monday and Wednesday: 9:30-10:30 and or by appointment

Catalog: ECGR4134/5192_OPTI500: Solid State Microelectronics II. (3) Prerequisites: ECGR 3121 and PHYS 3141, or permission of the department. Simple crystal structures, energy bands, and charge carriers in semiconductors, distribution functions for photons and electrons, optical and electrical properties, carrier diffusion, generation, and recombination.

Grading: Six Quizzes 20%, six exams 20% (at the end of each chapter), and homework 20% and final exam 40%. Grades will be assigned using: A = 85-100, B = 70-84, C = 50-69, U = <50.

Homework: Homework problems will be mixed – problem solving and theory to foster understanding of the material. You need to spend some time to read text book to be able to answer the questions correctly.

Class rules: (1) Exams are closed book and closed notes. Critical formulas, constants, etc will be given. (2) Bring to all classes: textbook, notebook, pen or pencil, and calculator (3) Study groups are very helpful, even encouraged, but (4) For best success, each student should independently solve every homework problem Lecture

Lecture #	Date	Topics	Reading	HW Reading	Note
1	Mon Aug 19	MOSFET Scaling & Non ideal scaling	7.1 – 7.2	Chapter 7 – HW #1	
2	Wed Aug 21	Threshold voltage modifications & Additional Elec. Characteristics	7.3 – 7.4	Quiz #1	
3	Mon Aug 26	Device Fabrication Techniques: Specialized Devices	7.5		
4	Wed Aug 28	Revision of Chapter 7.0		Exam 1 Collect HW #1	
5	Wed Sept 04	Carrier Generation & Recombination Analysis of excess carriers	8.1-8.2	Chapter 8 HW #2	
6	Mon Sept 09	Ambipolar Transport	8.3	Quiz #2	
7	Wed Sept 11	Quasi-Fermi Energy Levels & Excess carrier lifetime	8.4-8.5		
8	Mon	Surface Effects	8.6	Exam #2	

	Sept 16			Collect HW #2	
9	Wed Sept 18	The pn & Schottky Barrier junction Revisited; The pn junction – ideal current-voltage relationship	9.1 – 9.2	HW #3	
10	Mon Sept 23	The Schottky barrier junction – ideal current – voltage relationship	9.3 – 9.4	Quiz #3	
11	Wed Sept 25	Generation – Recombination currents & Junction Breakdown	9.5-9.6		
12	Mon Sept 30	Charge storage & diode transients	9.7	Exam #3 Collect HW #3	
13	Wed Oct 02	The Bipolar Transistor Action	10.1	Homework #4	
X	Mon Oct 07	No Class			Spring Break
14	Wed Oct 09	Minority Carrier Distribution	10.2		
15	Mon Oct 14	Low frequency common base current gain	10.3	Quiz #4	
16	Wed Oct 14	Non Ideal Effects	10.4		
17	Wed Oct 16	Hybrid PI equivalent circuit model & Frequency limitations	10.5-10.6		
18	Mon Oct 21	Large signal switching & Device Fabrication technique	10.7-10.8	Exam #4 Collect HW-#4	
19	Wed Oct 23	The junction field effect transistor	11.1	HW #5	
20	Mon Oct 28	Hetero junctions	11.2	Quiz #5	
21	Wed Oct 30	The Thyristor	11.3		
22	Mon Nov 04	Additional MOSFET concepts & Micromechanical systems (MEMS)	11.4-11.5	Exam #5 Collect HW-#5	
23	Wed Nov 06	Optical Absorption	12.1	HW #6	
24	Mon Nov 11	Solar Cells	12.2		
25	Wed Nov 13	Photodetectors	12.3	Quiz #6	
26	Mon Nov 18	Light Emitting Diodes	12.4		
27	Wed Nov 20	Laser Diodes	12.5		
28	Mon Nov 25	Revision		Exam #6 Collect HW #6	
29	Wed Nov 27	Review for Exam			
30	Mon	Exam #3			

	Dec 02				
31	Wed Dec 04	Final Review			
32	Mon Dec 09	Final Exam			

Academic Dishonesty

All provisions of the University code of academic integrity apply to this course. Your signature on any test or assignment means that you neither gave nor received unauthorized aid. For homework, while discussion with other students is allowed and encouraged, direct copying is not, and students must turn in individual submissions. Mastery of the homework is essential for good performance on the exams!

All UNC Charlotte students have the responsibility to be familiar with and to observe the requirements of The UNC Charlotte Code of Student Academic Integrity (see the Catalog). This Code forbids cheating, fabrication or falsification of information, multiple submission of academic work, plagiarism, abuse of academic materials (such as Library books on reserve), and complicity in academic dishonesty (helping others to violate the Code). Any further specific requirements or permission regarding academic integrity in this course will be stated by the instructor, and are also binding on the students in this course. Students who violate the Code can be punished to the extent of being permanently expelled from UNC Charlotte and having this fact recorded on their official transcripts. The normal penalty is zero credit on the work involving dishonesty and further substantial reduction of the course grade. In almost all cases, the course grade is reduced to "F." If you do not have a copy of the Code, you can obtain one from the Dean of Students Office or access it online at www.legal.uncc.edu/policies/ps-105.html. Standards of academic integrity will be enforced in this course. Students are expected to report cases of academic dishonesty they become aware of to the course instructor.

Course Calendar: Refer to the web page: http://www.registrar.uncc.edu/calendar.htm for the academic calendar.

• Syllabus Revisions: This syllabus may be modified at any time by the course instructor. Notice of such changes will be by announcement in class and/or in moodle.

• Disability Services/Special Needs: If you have a documented disability and require accommodation in this course, contact the Disability Services office, located in Fretwell building, room 230. Phone
704/687.4355
(voice/TDD).

Information about available services can be found at: http://www.ds.uncc.edu . Students in this course seeking accommodations to disabilities must first consult with the Office of Disability Services and follow the instructions of that office for obtaining accommodations. Please initiate this process and inform me during the first week of class.

• Diversity: UNC Charlotte strives to create an academic climate in which the dignity of all individuals is respected and maintained. Therefore, we celebrate diversity that includes, but is not limited to

ability/disability, age, culture, ethnicity, gender, language, race, religion, sexual orientation, and socioeconomic status.

• Cell Phones, PDAs and Such: Please note that portable phones, pagers, and late arrivals are disruptive to the instructor and to your peers. The use of cell phones, beepers, or communication devices is disruptive and is therefore absolutely prohibited during class. Turn off your cell phone while in class.

• Laptop Computers: Please feel free to take notes directly on your computer. Computer usage in class should be restricted to taking notes.

• Communication: I will try and answer emails within 24 hours. When communicating with me via email, please put "4134" in the subject so I can readily identify who you are

SYLLABUS - OPTI 6/8102 Principles of Geometrical Optics (3)

OPTI 6102/8102
OPTI Introduction to Geometrical Optics,
Instructor: A. Davies, adavies@uncc.edu, Grigg 235, 7-8135
Office Hours Fridays 1-3 pm

TEXT: Geometrical Optics and Optical Design, Mouroulis and Macdonald.

Supplemental Reading Material:

Field Guide to Geometrical Optics, John E. Geivenkamp, SPIE Field Guides, 2004. Modern Optical Engineering, Warren Smith, various editions 1967-2007. Aberrations of Optical Systems, W.T. Welford, 1991 (out of print, pdf on Moodle).
Principles & Methods of Geometrical Optics, James Southall, 1910, (out of print. pdf on Moodle).
The Theory of Optical Instruments, E. T. Whittaker, 1907, (out of print. pdf on Moodle). Applied Optics and Optical Design, Conrady, 1957, Dover reprint 1992.
A Treatise on Geometrical Optics, Heath, 1887. (out of print. pdf on Moodle) Theorie der Optischen Instrumente, Czapski, 1893, (out of print. pdf on Moodle).

Highly recommend for back up

reading: Introduction to Optics,

Pedrotti[3] or Optics, Hecht

COURSE CONTENT:
* Facility in 1st-order layout and analysis of an optical system consisting of lenses &/or mirrors.
* Find location of image plane, principal planes, entrance & exit pupils.
* Evaluate magnification, field of view, F/#, image-plane irradiance, Lagrange invariant.
* Evaluate image quality resulting from diffraction, monochromatic aberrations, chromatic aberrations, for given constructional data of the optical system.

GRADING:
Homework (assigned approximately weekly)30%
Midterm Exam 35%
Final Comprehensive Exam35%

Grades will be assigned using: A = 85-100, B = 70-84, C = 50-69, U = <50. Working together on homework is encouraged. **NO LATE HOMEWORK IS ACCEPTED. NO MAKE UP TESTS WILL BE GIVEN**. The lowest homework grade will be dropped. You will receive a score of 0 on a missed exam. If higher, the score on the final exam will be substituted for the midterm exam score. You must take the final exam.

CLASS ATTENDANCE: There will be material presented in class that is not in the text. Handouts may be given when appropriate. You are responsible for material discussed in class, in the homework assignments, and in the assigned reading.

ACADEMIC INTEGRITY: Students have the responsibility to know and observe the requirements of The UNCC Code of Student Academic Integrity. This code forbids cheating, fabrication or falsification of information, multiple submission of academic work (copying), plagiarism, abuse of academic materials, and complicity in academic dishonesty. Any special requirements or permission regarding academic integrity in this course will be stated by the instructor, and are binding on the students. Academic evaluations in this course include a judgment that the student's work is free from academic dishonesty of any type; and grades in this course therefore should be and will be adversely affected for academic dishonesty. Students who violate the code can be expelled from UNCC. The normal penalty for first offense is zero credit on the work involving dishonesty and further substantial reduction of the course grade. In almost all cases the course grade is reduced to F. Students are expected to report cases of academic dishonesty to the course instructor.

SYLLABUS - OPTI 6/8102L Geometrical Optics Lab (1)

OPTI 6/8102L: Geometrical Optics Laboratory

Instructor:

Dr. Awad Gerges

Email: **agerges@uncc.edu**

Phone: (704) 687-7559
Office: 342 Grigg Hall

Course website: http://moodle2.uncc.edu

Meeting Times and Place:

Optics laboratories, Grigg 271 and Grigg 277

Consultations and Office Hours:

- E-mail contact: Any time during the semester.
- In Campus: Wed. 12 - 1:45 pm.

Course Resources:

1- Lab Manual: Will be loaded on moodle2.
2- Any Geometrical optics text book.

Course Policy:

- A group of 2students work together in conducting the experiments.
- During the semester every student should complete 8 experiments.
- Each two experiments should be completed within three weeks otherwise you will be behind schedule.
- Each student should have his/her lab notebook.
- Student should study related concepts, prepare his/her lab notebook and be ready for pre-lab discussion before doing each experiment.
- Unprepared student will not be allowed to do the experiment.
- After the completion of each experiment your lab notebook should be seen and signed.
- The objectives, theoretical back-ground, necessary equations, figures, tables, graphs, conclusion and discussion should be written, in your lab notebook, for each experiment.
- Each student will be asked to submit one complete lab report about any of the experiments studied. The report should be written in the form of a scientific paper (Instructions are given in lab manual appendix),
- An oral lab exam will be during the last two weeks of the semester. Each student will be asked to professionally present his/her lab report, submit the completed lab notebooks and be ready to answer any questions about all the 8 experiments.

GRADING:

Lab notebook and conducting experiments: 80%
Oral presentation: 10%

Professional report (Formality, completion): 10%

Grades are assigned using: A = 85.0-100.0, B = 75.0-84.9, C = 55.0-74.9, U = <55.0.
The course is not graded on a curve.

ACADEMIC INTEGRITY:

Academic honesty and integrity are essential to the existence and growth of an academic community. Without maintenance of high standards of honesty, members of the instructional faculty are defrauded, students are unfairly treated, and society itself is poorly served. Maintaining the academic standards of honesty and integrity is ultimately the formal responsibility of the instructional faculty; and this responsibility is shared by all members of the academic community. UNC Charlotte strives to create an academic climate in which the dignity of all individuals is respected and maintained. Therefore, we celebrate diversity that includes, but is not limited to ability/disability, age, culture, ethnicity, gender, language, race, religion, sexual orientation, and socio-economic status.

All UNC Charlotte students have the responsibility to be familiar with and to observe the requirements of The UNC Charlotte Code of Student Academic Integrity (see the Catalog, p 275). This Code forbids cheating, fabrication or falsification of information, multiple submission of academic work, plagiarism, abuse of academic materials (such as Library books on reserve), and complicity in academic dishonesty (helping others to violate the Code). Any further specific requirements or permission regarding academic integrity in this course will be stated by the instructor, and are also binding on the students in this course. Academic evaluations in this course include a judgment that the student's work is free from academic dishonesty of any type; and grades in this course therefore should be and will be adversely affected for academic dishonesty. Students who violate the Code can be punished to the extent of being permanently expelled from UNC Charlotte and having this fact recorded on their official transcripts. The normal penalty is zero credit on the work involving dishonesty and further substantial reduction of the course grade. In almost all cases, the course grade is reduced to "F." Students are expected to report cases of academic dishonesty they become aware of to the course instructor.
A copy of the Code can be accessed online at www.legal.uncc.edu/policies/ps-105.html .

Course Schedule

Weeks	Date	Experiments
1-3	**M. Aug 18 - Sun. Sep 7**	**Exp 1:** Index of refraction measurement(Abbe's Refractometer) **Exp 2:** Dispersing and reflecting prisms
4-6	**M. Sep 8 - Sun. Sep 28**	**Exp 3:** Spherical mirrors and thin Lenses **Exp 4:** Imaging
7-9	**M. Sep 29 - Sun. Oct 20**	**Exp 5:** Optical Instruments **Exp 6:** Lens Aberration
10-12	**M. Oct 21 - Sun. Nov 16**	**Exp 7:** Fiber Optics **Exp 8:** Fringe Projection Profilometry
13-15	**M. Nov 17 - Wed Dec 3**	**Exams**

SYLLABUS - OPTI 6/8106 Principles of Physical Optics (3)

Catalog Description:

OPTI 6/8106. Principles of Physical Optics. (3) The Fourier transform and its role in wave optics; wave properties of light, superposition of waves, angular spectrum of plane waves, diffraction, interference, polarization, coherence, holography, imaging and resolution. Three lecture hours per week. *(Spring)*

Detailed syllabus:

Text: B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, Wiley, 2nd Edition, (2007); ISBN: 978-0-471-35832-9. (*Materials from chapters 2 to 7 and 11*).

Grading: 35% for homework assignments; 25% mid-term and 40% final exam. Grades are assigned using: 100 – 85 A: 84 – 70 B: 69 – 50 C: < 50 U

The important topics to be covered are the *Fourier transform and its properties; the postulates of wave optics, superposition; angular plane wave spectra, relation to ray optics, Gaussian beams; waves and obstacles; spherical waves and diffraction; Fresnel diffraction and the Fourier optics; paraxial approximation; periodic structures and surfaces; spatial and temporal coherence; interference and interferometers (two, multibeam, Fabry-Perot); spatial filtering, holography, imaging and resolution.*

Class topics:

1. Introduction and the Fourier transform
2. Convolution and correlation
3. EMAG essentials
4. Waves and interference
5. Gaussian beams
6. Poynting vector, irradiance and interference
7. Basics of coherence
8. Interfering waves and spatial frequencies
9. Angular spectra and linear systems
10. Scattering from masks and apertures
11. Huygen's wavelets and Fourier optics
12. Angular spectrum of a spherical wave
13. Fraunhofer and Fresnel diffraction
14. Spatial filters
15. Holography and importance of phase
16. The Fourier optical correlator
17. Thick holograms
18. Introduction to gratings and their applications
19. Thin films and interferometers
20. Mutual coherence function; consequences of Van Cittert Zernike theorem
21. Images and resolution

SYLLABUS - OPTI 6/8106L Physical Optics Lab (2)

OPTI 6/8106L: Physical Optics Laboratory

Instructor:

Dr. Awad Gerges

Email: **agerges@uncc.edu**

Phone: (704) 687-7559
Office: 342 Grigg Hall

Course website: http://moodle2.uncc.edu

Meeting Times and Place:

Optics laboratories, Grigg 271 and Grigg 277

Consultations and Office Hours:

- E-mail contact: Any time during the semester.
- In Campus: Wed. 12 - 1:45 pm.

Course Resources:

3- *Lab Manual: Will be loaded on moodle2.*
4- *Any Physical optics text book.*

Course Policy:

- A group of 2students work together in conducting the experiments.
- During the semester every student should complete 6 experiments.
- Each experiment should be completed within two weeks otherwise you will be behind schedule.
- Each student should have her/his lab notebook.
- Student should study related concepts, prepare his/her lab notebook and be ready for pre-lab discussion before doing each experiment.
- Unprepared student will not be allowed to do the experiment.
- After the completion of each experiment your lab notebook should be seen and signed.
- The objectives, theoretical back-ground, necessary equations, figures, tables, graphs, conclusion and discussion should be written, in your lab notebook, for each experiment.
- A mini-project should be studied by each group.
- Mini-projects may be about any practical applications of geometrical/physical optics (in metrology, control, communication, etc).Each mini-project should include theoretical study, design, and prototype fabrication (implementation).
- A professional project report should be submitted by each group.
- An oral lab exam will be held during the last two weeks of the semester.

- Each group will be asked to present their mini-project, submit one professional project report, show their lab notebooks and answer any questions about the experiments.
- A small budget is available to each group purchasing any components they need for their mini-project.

GRADING:

Lab notebook and conducting experiments:	60%
Mini-project design and implementation:	20%
Oral presentation and test:	15%
Project report (Formality, completion):	5%

Grades are assigned using: A = 85.0-100.0, B = 75.0-84.9, C = 55.0-74.9, U = <55.0.
The course is not graded on a curve.

ACADEMIC INTEGRITY:

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A copy of the Code can be accessed online at www.legal.uncc.edu/policies/ps-105.html .

Course Schedule

Weeks	Experiments
1-4	**Exp 1:** Interference in Thin Films **Exp 2:** Measuring Sodium doublet using Fabry-Perot Interferometer
5-8	**Exp 3:** Measuring the coherence length of light using Michelson interferometer **Exp 4:** Twayman-Green Interferometer
9	**Spring Recess**
10-13	**Exp 5:** Polarization **Exp 6:** Diffraction
14-16	**Mini-Project implementation.**
17-18	**Oral Presentations**

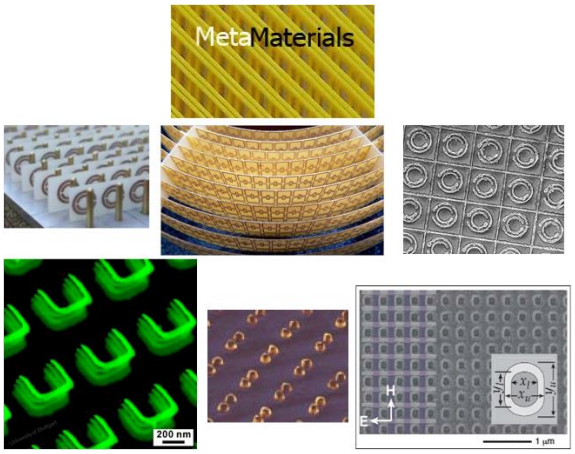
SYLLABUS - OPTI 6/8203 Metamaterials (3)

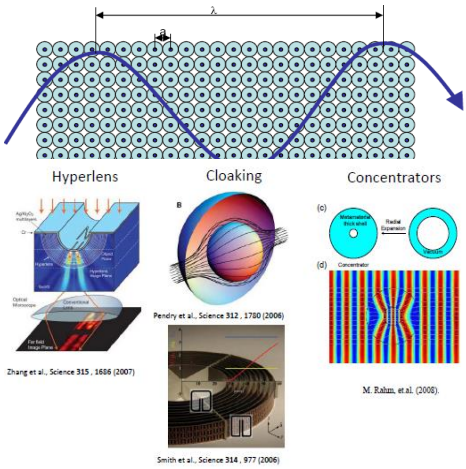
OPTI 6/8203 Fundamentals of Metamaterials

M. A. Fiddy mafiddy@uncc.edu

Prerequisites: background in circuits and/or electromagnetics highly desirable…check with instructor.
Grading: 50% for homework assignments; 15% mid-term and 35% final exam. Grades are assigned using: 100 – 85 A: 84 – 70 B: 69 – 50 C: < 50 U

1. Overview of course and properties of metamaterials
2. Basic concepts and equations: Maxwell's equations, conductivity, dispersion, effective permittivity, permeability and refractive index.
3. Resonances, resonant scattering, scaling laws, Drude model; supplement Clausius-Mossotti, relaxation and nonlinear effects.
4. Polarizabilities, artificial dielectrics and energy flow
5. Negative index materials, mixing formulae and scattering
6. Dielectric resonators vs metallic resonators, the LCR circuit abstraction.
7. Split ring resonators, plasma frequency of wires and other resonant elements
8. Properties of periodic structures
9. Interpreting dispersion diagrams and significance of density of states.
10. Backward waves, negative refraction and negative index
11. Spatial frequencies, evanescent waves and the so-called perfect lens; phase, group, energy and signal velocities: slow and fast light in metamaterials
12. Plasmon-polaritons: metal-dielectric-metal and periodic structures
13. Bulk polaritons, penetration depths and losses; boundaries and coupling into metamaterials.
14. Fabrication of optical metamaterials: effective medium theory, homogenization, anisotropic and isotropic materials, active materials
15. Subwavelength imaging, hyperlens vs superlens
16. Transformation optics and applications of metamaterials: cloaking, concentrators, corner cubes, etc





SYLLABUS - OPTI 6/8206 Physical Optics Design and Simulation (3)

OPTI 6206/8206: Physical Optics Design and Simulation

YOU ARE RESPONSIBLE FOR THE INFORMATION ON THESE SHEETS. PLEASE READ THEM CAREFULLY AND KEEP THEM FOR REFERENCE.

Instructor: Dr. Tom Suleski

Office: Grigg Hall, Room 208-A

Office Phone: 704-687-8159

Email: tsuleski@uncc.edu

Office hours: MW 2:00 – 3:00 or by appointment. This may change during the semester.

Moodle: The course website is accessible through your 49er Express account.

Pre-Requisites: OPTI 6102/8102 and OPTI 6000/8000 (Optical Wave Phenomena), or permission of instructor.

Course Content:

This is a one-semester course taught at the graduate level on the design and simulation of optical components and systems using scalar and vector wave propagation, diffraction, and interference. We will make use of mathematics such as vector calculus, differential equations, linear algebra, Fourier transforms, and complex variable analysis as appropriate. The course is intended to compliment OPTI 6241/8241, which focuses on optical lens and system design using geometrical ray-tracing methods.

Course Materials:

No single source will be used for the topics to be covered. Reading and reference materials will be provided as needed in lectures and/or on the course website. You will need to use Matlab™ for some assignments. The commercial software package VirtualLab™ by LightTrans will be introduced and used heavily in the course (http://www.lighttrans.com/687.html).

Class Attendance:

There will be material presented in class that is not in the references. You are responsible for all material discussed in class, in the homework assignments, and in the assigned reading. A portion of each class will usually be dedicated to 'hands-on' work in one of the software packages. If possible, it will benefit you to bring a computer with you for use in class. You will need access to a Windows computer for VirtualLab™.

Grades:

You will have multiple homework assignments throughout the semester that may range from assigned problems to small projects and reports as appropriate. You will also be performing an individual research project (on a topic to be approved by the instructor). The results of this project will be summarized in a comprehensive written research report, as well as in an oral presentation on the project at the end of the term. Your final grade will be determined using the following weighting:

Grades:

Homework	60%
Final Project Report	30%
Final Project Presentation	10%
TOTAL	**100%**

Grades will be assigned using: A = 85-100, B = 70-84, C = 50-69, U = <50.

Academic Integrity:

Students have the responsibility to know and observe the requirements of The UNCC Code of Student Academic Integrity (see Catalog or http://legal.uncc.edu/policies/up-407). This code forbids cheating, fabrication or falsification of information, multiple submission of academic work, plagiarism, abuse of academic materials, and complicity in academic dishonesty.

SYLLABUS - OPTI 6/8301 Introduction to Instrumentation and Processing at the Nanoscale (3)

OPTI 6/8301
Cross-listed with NANO 8101
Introduction to Instrumentation and Processing at the Nanoscale

Instructor: Dr. Tom Schmedake
Email: tschmeda@uncc.edu
Office: Burson 264
Phone: 7-5177

This syllabus contains the policies and expectations I have established for NANO 8101. Please read the entire syllabus carefully before continuing in this course. These policies and expectations are intended to create a productive learning atmosphere for all students. Unless you are prepared to abide by these policies and expectations, you risk losing the opportunity to participate further in the course.

Course Description: Methods of manipulating, engineering, and characterizing nanoscale materials are introduced; applications and principles of their operation are discussed. Students acquire hands-on experience with selected laboratory methods in preparation for dissertation research. Topics this term will include dynamic light scattering, BET surface area analysis, atomic force microscopy, scanning electron microscopy, nuclear magnetic resonance, and spectroscopy (IR, Raman,UV-Vis, Near-IR, and fluorescence).

This 3-credit course requires 3 hours of classroom or direct faculty instruction and 6 hours of out-of-class student work each week for approximately 15 weeks. Out-of-class work may include but is not limited to: [required readings, library research, laboratory work and write-ups, written assignments, and preparing presentations].

Grades: Grading will be based on lab reports and exercises (75%) lab notebooks (10%) and a final presentation (15%). Grades will be assigned using: A = 85-100, B = 70-84, C = 50-69, U = <50.

Lecture and lab time: regular lecture time is 2:00 – 3:15 M/W. In addition, students will be required to perform laboratory exercises (typically ~ 3 hours/week).

Lab notebook: Students are expected to take proper notes during all laboratory exercises. Note that students are responsible for knowing and observing the UNCC Code of Student Academic Integrity.

Lab Safety: Students need to follow safety procedures at all times in all of the labs. Students must wear safety glasses or goggles at all times.

Performing Experiments Together: For some labs, students will need to work together.

In this instance, it is acceptable for students working together to collect the same data and turn in joint reports**.** Guidance will be provided with each lab. Please note your collaborators in your notebook and report.

Academic Honesty: All students are required to read and abide by the Code of Student Academic Integrity. Violations of the Code of Student Academic Integrity, including plagiarism, will result in disciplinary action as provided in the Code. Definitions and examples of plagiarism are set forth in the Code. The Code is available from the Dean of Students Office or online.

Faculty may ask students to produce identification at examinations and may require students to demonstrate that graded assignments completed outside of class are their own work.

Tardiness/Attendance: Students are expected to attend every class and remain in class for the duration of the session. Failure to attend class or arriving late may impact your ability to achieve course objectives which could affect your course grade. An absence, excused or unexcused, does not relieve a student of any course requirement. Regular class attendance is a student's obligation, as is a responsibility for all the work of class meetings, including tests and written tasks. Any unexcused absence or excessive tardiness may result in a loss of participation points.

Diversity: UNC Charlotte strives to create an academic climate in which the dignity of all individuals is respected and maintained. Therefore, we celebrate diversity that includes, but is not limited to ability/disability, age, culture, ethnicity, gender, language, race, religion, sexual orientation, and socio-economic status.

If you have a disability that qualifies you for academic accommodations, please provide a letter of accommodation from Disability Services in the beginning of the semester. For more information regarding accommodations, please contact the Office of Disability Services at 704-687-0040 or stop by their office in 230 Fretwell.

University Withdrawal Policy: Students are expected to complete all courses for which they are registered at the close of the add/drop period. If you are concerned about your ability to succeed in this course, it is important to make an appointment to speak with me as soon as possible. The University policy on withdrawal allows students only a limited number of opportunities available to withdraw from courses. It is important for you to understand the financial and academic consequences that may result from course withdrawal.

Syllabus revisions: The standards and requirements set forth in this syllabus may be modified at any time by the course instructor. Notice of such changes will be by announcement in class and by changes to this syllabus posted on the course Moodle site.

Course Schedule (tentative)

1. Particle sizing (DLS) and Zeta Potential
2. BET surface area analysis
3. AFM (Lou Deguzman)
4. SEM
5. X-ray diffraction

6. Spectroscopy (UV-vis, IR, Raman, Fluorsce

SYLLABUS - OPTI 6/8302 Nanoscale Phenomena (3)

OPTI 6/8302
Cross-listed with NANO 8102
Nanoscale Phenomena

Instructor: Dr. Jordan Poler Email: jcpoler@uncc.edu
Office: 143 Burson
Office Hours: R 11:00 a.m. (143 Burson), or by appointment

Textbook: "Introduction to Nanoscale science and technology" edited by Di Ventra, Evoy and Heflin, Springer 2004.

Other useful information at http://www.nanohub.org/

Grading: 100 – 85 A: 84 – 70 B: 69 – 50 C: < 50 U

Your assignments for this course consists of : 5 projects, a midterm exam, and an end of term paper and presentation

1. Literature Search Project: due T 9/2 10%
2. AFM/STM Project: one week from end of unit 10%
3. Molecule/particle interactions in solution Project one week from end of unit 10%
4. In Class Mid term Exam 20%
4. Transport in nanostructured carbons Project one week from end of unit 10%
5. Quantum Dots, colloidal crystals Project one week from end of unit 10%
6. End of term Presentation in class, 10 min pres. and 5 min Q&A 10%
7. End of term Paper due during final exam Content and grammar 20%

100%

A 10% per day late penalty will be applied to all assignments.

Withdraw Policy: From our new policy: "Students are expected to complete all courses for which they are registered at the close of the Add/Drop Period. . . . Undergraduate students may receive a grade of W for no more than 16 credit hours over their academic careers." For fall 2014, the add/drop deadline is Wednesday, August 27 and the withdrawal deadline is Monday, October 20. Withdrawal is a tool that should be used sparingly—always do your best to keep up with your coursework.

Academic Honesty: Students are responsible for knowing and observing the UNC Charlotte Code of Student Academic Integrity (http://www.legal.uncc.edu/policies/ps-

105.html). If you are caught violating the Code of Academic Integrity, you will receive the maximum penalty of an U in the course. A U in a graduate course will result in suspension from your graduate program and loss of your assistantship.

Religious Accommodation: North Carolina law requires state universities to accommodate students having religious obligations that conflict with scheduled class meeting times, including exam periods. If you have any such conflicts this semester, please complete a "Request for Religious Accommodations" form and submit it to your instructor as soon as possible. Requests for the entire semester must be submitted prior to the census date, or at least a week prior to any planned absence that would occur before the census date. The census date for fall 2014 is August 30.

Introduction and Scaling Theory Chapter 1
Moore's law and Lithography Chapter 1
NanoLithography Chapter 1
STM/AFM Chapter 3
SPSpectroscopyChapter 3
SPLithography Chapter 3
Molecular Interactions Chapter 2
Self-assembly Chapter 2
DLVO Chapter 2
Intro to Crystallography/Surfaces
Nanostructured Carbon Materials Chap 4-6
Intro/Review SS Physics
Ele & phonon transport in CNT's Chapter 6
Nanoscale electronics Chapter 9
Quantum Dots Chapter 7
QDot Optoelectronics Chapter 18
Molecular Electronics Chapter 10
Molecular Optoelectronics Chapter 19
Student Presentations

SYLLABUS - OPTI 6/8303 Collaborative Research Proposal (3)

OPTI 6/8303
Cross-listed with NANO 8203
Collaborative Proposal Writing

M. A. Fiddy Grigg 142 mafiddy@uncc.edu X78594

The objective of this class is to understand how to identify funding opportunities, study grant writing techniques and respond to funding agencies' review criteria.

Each student will contribute to the development of a research proposal but within an interdisciplinary group. The proposal/proposals will be directed towards a common collaborative theme. In other words, draft proposal content will be developed with the intent to combine these into a single collaborative but multifaceted proposal which we will submit to agencies for comment. Previous classes have submitted proposals to NSF, ARO and AFRL and the intention is to submit your proposal to an agency. You will have the opportunity to work together on this unified proposal and hopefully the experience will develop an appreciation of both the challenges and opportunities that result from working together in interdisciplinary collaborative research.

In addition to actually writing the technical portion of a proposal there are many other aspects to the process we will consider. Some agencies require direct contact with the program manager, white papers, quad charts, certain budget restrictions, statements about intellectual merit, broader impact, facilities, previous accomplishments and intellectual property protection. We will meet administrators on campus whose jobs are to assist with proposal development, addressing often stringent formatting expectations, budget development and management plans. Agencies no longer give money for open-ended investigative research, but require detailed plans, Gantt charts, detailed goals and milestones.

Our proposals with evolve over the semester but hopefully remain partially grounded in some particular research topic that you can each feel some ownership of and excitement about. There will be opportunities to critique each other's contributions as a reviewer and present the proposal to a panel of faculty for their constructive feedback, later in the semester. Each student will be graded individually based on their efforts.

Week	
1	Organizational meeting and overview of class and objectives
2	Discuss technical concepts/ideas for collaborative proposals and review them in the context of funding agencies' expectations, processes, etc
3	During this week, teams (or individuals) establish a COS profile and begin searching for appropriate agencies that to support proposed work.
4	Director of Proposal Development: what makes a good proposal?
5	Director of Technology Transfer presentation; protecting your ideas
6	Identify and discuss specific funding opportunities and agency / program manager requirements; e.g. for NSF, DoD (http://www.nsf.gov/funding/pgm_list.jsp?type=xcut),

7	Review of project ideas and synergies for collaboration
8	Pre-proposal due this week in format following guidelines and format below.
9	Present and critique of proposal ideas, structure, budgets and common themes
10	Develop unified proposal (or white paper) and identify faculty advisors/panel members to review proposal.
11	Preproposal deadline
12	Prepare presentation and review talks
13	Review process and review panel discussion with faculty: Budgets, management, facilities, CVs
14	Post-mortem on feedback from panel discussion and revise proposal; complete NSF LIFE forms for each sub-proposal
15	Last class: turn in LIFE forms and critique each other's forms in class; summarize comments and conclusions.

Grading:

There are various milestones in the class and the work the students perform is graded/assessed in an on-going process both on individual effort as well as evidence of their collaborative/team efforts.

i) Active participation 15%
ii) Signing up for and analysis of funding opportunities 5%
iii) Development of project ideas: hand in documents related to i) highly speculative proposal concepts and ii) more down to earth projects tied to their current research: 20%
iv) Critiques of each others' proposal ideas 10%
v) Ability to synthesize collaborative project concepts from materials submitted by class members 5%
vi) Draft white papers and quad charts 15%
vii) Presentation of proposal concept with budget details etc. 10%
viii) Final version of white paper/proposal for submission 20%

Grades are assigned using: 100 – 85 A: 84 – 70 B: 69 – 50 C: < 50 U

SYLLABUS - OPTI 6/8341 Advanced Quantum Mechanics (3)

Syllabus
OPTI 6/8341
Cross-listed with PHYS 6141

Advanced Quantum Mechanics

General information:
Instructor: Dr. Yong Zhang, Ph.D in physics, Bissell Distinguished Professor, Electrical and Computer

Engineering Dept; Adjunct Professor of Dept. of Physics and Optical Science, faculty member of Optical Science and Engineering Ph.D Program and Nanoscale Sciences Ph.D Program.

Office: Grigg Hall 215, where you can turn in assignments if you are not able to do so in class

Office hour: by approximant. Feel free to email for questions and suggestions: yong.zhang@uncc.edu (effort will be made to respond within one business day) Feel free to call my office number: (704) 687 8652

Prerequisites:
Undergraduate Physics or equivalent (e.g., Classic Mechanics and Atomic Physics) and Calculus

Technology Requirements:
Software like Mathematica, Maple, MatLab could be helpful for your homework, but not required. They are available on Mosaic.

Course Calendar/Schedule:
Home assignment – approximately once a week, given after the lecture, and due at the same time next week.
Mid-term Exam – approximately in the middle of the semester (take home).
Final Exam – time set by the school (take home).

Course Policies:
Cell phones/electronic devices - do not use in the class.
Computer use – for note taking and class related work only.
Missed exams or assignments: made-up is allowed, if you have an acceptable reason.

References:

(1) Applied quantum mechanics (Walter A. Harrison, World Scientific) – Primary
(2) Quantum mechanics for scientists and engineers (David A. B. Miller, Cambridge)
(3) Quantum mechanics applied to semiconductor devices (ECSE-6968, RPI): http://www.ecse.rpi.edu/~schubert/Course-ECSE-6968%20Quantum%20mechanics/
(4) Introduction to Quantum Mechanics (2^{nd} edition) (David J. Griffiths, Pearson Education)
(5) Quantum Theory (David Bohm, Dover)

Catalog Data This is a special topic course that was first time offered for the ECE graduate students in Fall Semester of 2010. The level of the course is similar to the Quantum Theory I in a typical Physics Graduate

Program, but with a somewhat different emphasis. For instance, emphasizing on the concepts, applications of quantum mechanics in materials and optics, and connections with other subjects (e.g., atoms, molecules, crystals, optics), but less mathematical derivation.

Goals The students are expected after finishing this course to (1) be able to understand the basic concepts and principles of the Q. M. (e.g., uncertainty principle, wave-particle duality), (2) solve simple Schrodinger's equations for real world problems, (3) understand and use the perturbation theories, (4) understand the evolution of the electronic structure from a single atom, to a molecule and further to a nanostructure or a crystal, and (5) the basics for photon, electronic excitation and phonon in solids, and their interaction.

Grading The students are assigned homework problems from the text. There is a mid-term exam, and a final exam. Homework 50%, Mid-term test: 20%, Final test: 30%. Grades will be assigned using: A = 85-100, B = 70-84, C = 50-69, U = <50.

Follow-up Courses Advanced Solid State Materials (to be offered in the next semester), Optical properties of materials

SYLLABUS - OPTI 6/8371 Solid State Materials (3)

Syllabus
OPTI 6/8371
Cross-listed with PHYS 6271

Solid State Materials

General information:
Instructor: Dr. Yong Zhang, Bissell Distinguished Professor, ECE Dept

Office: Grigg Hall 215, where you can turn in assignments if you are not able to do so in class

Class Location and Times: Grigg 131, 5:00 – 7:45 pm, Thursday

Office hours: by approximant

Feel free to request a meeting with me in person or email me for questions and suggestions:
yong.zhang@uncc.edu (effort will be made to respond within one business day)

Feel free to call my office number: (704) 687 8652

Emergency phone number: (704) 906 7159

Prerequisites:
Undergraduate Quantum Mechanics or equivalent, basic knowledge of semiconductor materials and devices, and basic calculus

Technology Requirements:
Software like Mathematica, Maple, MatLab, Origin could be helpful for your homework and project, but not required. They are available on Mosaic.

Course Calendar/Schedule:
Home Work Assignment – approximately once a week distributed at the end of the lecture, and due at the lecture time of the following week. Always turn in your homework, you will at least get partial credit.
Mid-term exam – approximately in the middle of the semester. Take-home (one week)
Final exam – the final exam time set by the school. Take-home (one-week).

Course Policies:
Cell phones/electronic devices - do not use in the class.
Computer use – for note taking and class related work only.
Missed exams: made-up is allowed, if you have an acceptable reason.

References:

(1) ***Introduction to Solid State Physics*** *(8^{th} edition)* by Charles Kittel – Primary (you should have)
(2) ***Solid State Physics*** by Neil W. Ashcroft and N. David Mermin

Goals After finishing this one semester course, the students are expected to understand the key materials covered in a typical Solid State Physics textbook such as the first reference. The materials to be covered are approximately those of Chapters 1-9, 14-18 of the primary reference with possible supplements and replacements from other sources.

Grading The students are assigned homework problems from the text. There is a mid-term exam (take-home), and a final exam (take-home). Homework 50%, Mid-term test 20%, Final test 30%. Grades will be assigned using: A = 85-100, B = 70-84, C = 50-69, U = <50.

Class lectures Roughly following the primary references.

SYLLABUS - OPTI 6/8381 Engineering Metrology (3)

Syllabus
OPTI 6/8381
Cross-listed with MEGR 6181/8181
Engineering Metrology

Course: **Engineering Metrology (Basics of Metrology)**
Professor: Gert Goch
Office: Duke Hall 163
Email: fgoch@uncc.edu

Office hours: To be announced, or by appointment.
Also, any time the office is open – please feel free to stop in.

Prerequisite: MEGR 3282 and

- Fundamentals of experimental physics
- Fundamental knowledge about electrical engineering
- Basic knowledge about mechanics and manufacturing techniques
- Mathematics, namely statistics

note: these prerequisites [including MEGR3282] are strongly recommended, but not enforced.

You will be responsible for all information presented in class, sent by email or posted using Banner and/or Moodle.

Topics (detailed outline will be presented during the first lecture):

Part A: General aspects of metrology:

- Basic terms, definitions and features of measuring processes
- Deviations, errors, uncertainties
- SI base units and limits / state-of -the-art of measurement uncertainty

Part B: Electrical principles in measurement

- Analogue measuring methods and measuring circuits
- Measuring bridges
- Digital metrology; digital-analogue-(D/A)-converters and analogue-digital-(A/D)-converters

Part C: Introduction to production metrology:

- Importance of metrology for production techniques
- Measurement of geometrical quantities
  - Fundamental laws, measuring principles and sensors for geometry measurements
  - Device technology, scales, tactile and non-contacting probing systems
  - Surface measuring instruments, scanning probe microscopes (SPMs)
- Measurement of thermal quantities
  - Temperature scales, calibration and fixed points, types of thermometers
  - Contacting thermometers
  - Pyrometers

Grading:	Homework assignments (several)	20-30% of grade
	Intermediate Exams (1 or 2)	20-30% of grade
	Final Exam	about 50% of grade

Grades will be assigned using: A = 85-100, B = 70-84, C = 50-69, U = <50.

Conduct: Each student is expected to perform her or his own work, and behave in accordance with the university conduct guidelines (url below). If there are any doubts about this policy, please ask.
http://provost.uncc.edu/Catalogs/2010-2011/PDF/11-student%20conduct.pdfhttp://www.legal.uncc.edu/policies/ps-105.html

Final Exam: December 2015, (to be discussed and decided in class)

SYLLABUS - OPTI 6/8384 Advanced Surface Metrology (3)

OPTI 6/8384
Cross-listed with MEGR 7284/8284
Advanced Surface Metrology – Syllabus

Instructor: Chris Evans Office: DUKE 108B Phone: (704) 687-5869

Office hours: open door or e-mail for an appointment (wiser); cevans52@uncc.edu

Catalog description

Constituents of surface texture, stylus, optical, atomic force microscope and other advanced methods of measuring surface texture. Two and three dimensional measurement of surfaces. Separation of form, waviness and roughness. Random process analysis techniques, use of transforms for filtering. Numerical evaluation of surface texture. Use of surface texture as fingerprint of the process. Relationship between function and surface texture.

Class objective:

To provide a broad overview of methods for the specification and characterization of surfaces, with a focus on man-made surfaces. By the end of the class, students will:

- understand the important specifications of surfaces in current ISO standards, their use and limitations;
- be familiar with the operating principles behind a range of surface metrology instruments and how to select an appropriate instrument for a given measurement task;
- know how to specify surface texture and how to demonstrate conformance, or otherwise, of a surface to a specification

Grading:

25% -- mid-term exam – take home.

25% -- assignments, including the weekly paper.

50%-- term paper

Grades are assigned using: A = 85.0-100.0, B = 70.0-84.9, C = 60-69.9, U = <60.0.

Note:

- **There will be no Make-Up exam.**
- **No credit will be given for answers in the mid-term or other assignments where the work is not clearly shown.**
- **Any queries on grades must be presented within 1 week of receiving the grade.**

Weekly paper

Most weeks, there will be an assigned "weekly paper", assigned on Mondays. All students should read the paper and submit a 5 sentence/5 bullet point summary (points deducted for more than 5). The summary will be due the following Monday. One student will be picked, at random --the following Wednesday -- to present the key points to the class and hence to open discussion of the paper.

Term paper

A key feature of the class (and grade) will be an individual term paper which, ideally, should be related to the student's research (if this is not possible, the instructor will have topics available). The topic should relate to the measurement of surface texture and roughness, not form. The term paper should be of the general form of a conference or journal paper (or thesis chapter), with one required (additional) section discussing how the measurement method, filtering, parameters, etc relate to current ISO standards. Students are expected to write their own filters, detrending routines, etc. in MatLab and .m files should be included as appendices to the term paper.

Examples of topics:

"Evaluation of diamond micro-milled surface topography";

"Roughness evolution in vortex machining of silicon surfaces";

"Uncertainty in calibration of standard roughness specimens measured on Form Talysurf"

"Calibration of a confocal microscope for surface finish metrology"

"Surface finish evolution of MRF finished diamond turned surfaces"

"Electronics noise as a bias in spatial parameters"

Term paper schedule:

Students should meet with their supervisor and the instructor to develop the topic for their term paper. An outline and project plan is due on Monday 9/8/2014 in class. Topics will be presented and discussed in class on Wednesday 9/10/2014.

The literature review for the term paper is due on Wednesday 10/8/2014 at 11:00 am. And will be presented in class on Monday 10/13/2014

The final term paper is due on 12/3/2014. The allotted period of the final exam (Monday, Dec 8th, 2:00 - 4:30 pm) will be used for oral presentations to the class (in random order); Powerpoint presentations must be turned in.

The grade for the term paper will be based on the deliverables noted above plus the oral presentation.

Some class periods will be assigned as time to work on term papers.

ISO standards

Class members have on-line access to selected ISO standards related to surface roughness. Students have the responsibility to read and understand the license conditions for their free use of these standards, and to download them for use in assignments.

Academic Integrity:

Students have the responsibility to know and observe the requirements of the UNCC Code of Student Academic Integrity, policy 105, http://www.legal.uncc.edu/policies/ps-105.html . This code forbids cheating, fabrication or falsification of information, multiple submission of academic work, plagiarism, abuse of academic materials, and complicity in academic dishonesty.

An additional resource addressing plagiarism in detail is:

https://www.indiana.edu/~istd/definition.html

The standard discussed on this web site will be applied for all assignments in this class

Syllabus outline (subject to change):

Introduction/overview. What is a surface?
Survey of metrology methods for man-made surface.
Basic approach to selecting a measurement method;
the Stedman diagram.
Stylus profilometers.
Filters and parameters.
ISO standards.
Optical methods (interferometers, confocal microscopes, Nomarski, near-field, scattering, … etc).
Scanning probe microscopy.
Structured, textured, and engineered surfaces.
Sub-surface damage.
Finish and function.
Process control.

SYLLABUS - OPTI 6/8400 Industrial Internship (1 - 3)

Course:

OPTI 6/8400. Industrial Internship. (1-3)

Catalog Description:

Full- or part-time academic year internship in optical science/optical engineering complementary to the major course of studies and designed to allow theoretical and course-based practical learning to be applied in a supervised industrial experience. Requires a mid-term report and final report to be graded by the supervising faculty. (On demand)

Prerequisite:

Completion of 9 hours of graduate coursework and permission of program director.

Course description:

As indicated in the job description determined by the employer.

Course Objective:

Optical science/optical engineering practical job experience and skills acquired in an industrial setting.

Grading:

The student must complete a Request for Graduate Industrial Internship for Credit form (see attached) and submit it to the optics program director for approval. This form includes a syllabus from the advisor that defines scope of the work and the grading policy, which will be based on a mid-term report and final report.

Academic Integrity:

Students have the responsibility to know and observe the requirements of The UNCC Code of Student Academic Integrity (Catalog p. 275). This code forbids cheating, fabrication or falsification of information, multiple submission of academic work, plagiarism, abuse of academic materials, and complicity in academic dishonesty. Any special requirements or permission regarding academic integrity in this course will be stated by the instructor, and are binding on the students. Academic evaluations in this course include a judgment that the student's work is free from academic dishonesty of any type; and grades in this course therefore should be and will be adversely affected for academic dishonesty. Students who violate the code can be expelled from UNCC. The normal penalty for first offense is zero credit on the work involving dishonesty and further substantial reduction of the course grade. In almost all cases

the course grade is reduced to F. Students are expected to report cases of academic dishonesty to the course instructor.

Request for Graduate Industrial Internship for Credit

Graduate students are allowed to count up to (3) credit hours toward their degree by taking OPTI 6400 or OPTI 8400 Industrial Internship. The industrial experience must be supportive of the major course of study. Anything outside of your course of study may not be taken for course credit.

Your advisor must justify the usefulness of this internship and its relation to your research. The internship effort will be evaluated and graded by your advisor. Your advisor must provide a syllabus for this course that defines the scope of the work and the grading policy that will be based on a mid-term report and final report (attach a copy to this form).

Both your advisor and industrial supervisor are expected to monitor your progress by evaluating both your midterm and final reports.

Please complete the information below and attach the letter of support from your industrial supervisor. Once completed, the application should be submitted to the Optics Program office.

In addition, all international students are required to contact the International Student Scholar Office (ISSO) regarding additional rules governing industrial training.

Student Name:_____ Student ID#:_____

Name of Company/Organization:_____

Location/Address: _____

Anticipated Start Date:_____ End Date:_____

Student

By signing this form, I agree to all terms set forth above and obtained all required documentation.

Student signature:_____ Date:_____

Advisor

Number of Credits Approved by Advisor for the internship:_____

Print Name:_____ Signature:_____ Date:_____

Request for Graduate Industrial Internship for Credit

Description of Internship (attach letter from Industrial Supervisor):

Departmental Approval

Program Director signature:_____ Date:_____

SYLLABUS - OPTI 6/8610 Seminar (1)

OPTI 6610/8610 Seminar
Syllabus
First Year Fall Semester

Instructor: Yuri Nesmelov, Office: 337 Bioinformatics
704 687 5886, ynesmelo@uncc.edu

CLASS LOCATION AND TIME:

- 133 Grigg Hall
- Tuesdays 12:30-1:30

RECOMMENDED MATERIAL:

- **The Craft of Scientific Writing**
  by Michael Alley
- **Data Reduction and Error Analysis for the Physical Sciences**
  by Philip Bevington, D. Keith Robinson .
- **The Craft of Scientific Presentations: Critical Steps to Succeed and Critical Errors to Avoid (Paperback)**
  by Michael Alley
- **The Elements of Style, Fourth Edition (Paperback) *** A Classic Writing Reference ***
  by William Strunk Jr., E.B. White, Roger Angell

COURSE OBJECTIVES:

- Understand resources and research tools available through the Atkins Library
- Develop presentation skills and use of Microsoft PowerPoint
- Develop writing skills
- Understand the role of ethics in engineering and science
- Understand Intellectual Property at UNC Charlotte

GRADING:

Attendance (% attendance scales to 40%)	40%
Faculty Visitation and Ranking Assignment	15%
Writing Exercise	10%
Literature Search Presentation	10%

Evaluation Presentation	10%
OSE Graduate Colloquium Attendance (attend 50%)	15%
	100%

COURSE POLICY:

- Grades will be assigned using: A = 85-100, B = 70-84, C = 50-69, U = <50.
- **LATE ASSIGNMENTS WILL NOT BE ACCEPTED**.

You must do your own work on all assignments. Copying the work of others without giving proper credit is plagiarism and a violation of the **UNCC Code of Student Academic Integrity**. This includes copying information found on the internet.

ACADEMIC INTEGRITY: Students have the responsibility to know and observe the requirements of **The UNCC Code of Student Academic Integrity** (Catalog p. 275). This code forbids cheating, fabrication or falsification of information, multiple submission of academic work, plagiarism, abuse of academic materials, and complicity in academic dishonesty. Any special requirements or permission regarding academic integrity in this course will be stated by the instructor, and are binding on the students. Academic evaluations in this course include a judgment that the student's work is free from academic dishonesty of any type; and grades in this course therefore should be and will be adversely affected for academic dishonesty. Students who violate the code can be expelled from UNCC. The normal penalty for first offense is zero credit on the work involving dishonesty and further substantial reduction of the course grade. In almost all cases the course grade is reduced to F. Students are expected to report cases of academic dishonesty to the course instructor.

SYLLABUS - OPTI 6/8611 Graduate Colloquium (1)

OPTI 6611/8611 Graduate Colloquium Syllabus

Instructor: Yuri Nesmelov, Office: 337 Bioinformatics
Phone: 7-5886, Email: ynesmelo@uncc.edu

COURSE OBJECTIVES:

Spring and fall semesters, OPTI 6611/8611 may be taken for participation in the Graduate Colloquium. The Grad Colloquium meets every Thursday from 12:30-1:30 in room 132, Grigg.

New OSE students must take this course the first spring in the program and give a colloquium talk. PhD students are required to give one colloquium talk each year in the program. Therefore, PhD students must enroll in OPTI 8611 at least once per year and give a talk.

For students enrolled in OPTI 6611/8611 in the spring or in the fall, after their first year in the program, the following criteria apply:

You can earn your grade for the course 1 of 2 ways:

1. Attend the OSE Grad Colloquium, Thursdays 12:30-1:30. There will be ~12 total colloquia.
   - 10 attendances and one written report summarizing one of the colloquia attended = A
   - 8 attendances and one written report summarizing one of the colloquia attended =B
   - 6 attendances and one written report summarizing one of the colloquia attended = C

OR

2. Give a technical presentation (required for a grade of A, B or C). You will receive a 'U' in the class if you do not give a presentation. You also must attend a certain number of Grad Colloquia (times other than when you present):
   - 6 attendances (not counting when you present) = A
   - 4 attendances (not counting when you present) = B
   - 2 attendances (not counting when you present) = C

ATTACHMENT 3. PROPOSED CATALOG COPY

2014-2015 Graduate Catalog:
Ph.D. in Optical Science and Engineering

Programs of Study

The M.S. and Ph.D. programs in Optical Science and Engineering is interdisciplinary, involving primarily five science and engineering departments and two centers (Departments of Physics & Optical Science, Chemistry, Mathematics & Statistics, Electrical & Computer Engineering, and Mechanical Engineering & Engineering Science; the Center for Optoelectronics & Optical Communications; and the Center for Precision Metrology). The program is administered through the Department of Physics and Optical Science. The purpose of the program is to educate scientists and engineers who will develop the next generation of optical technology. The program emphasizes basic and applied interdisciplinary education and research in the following specialties of optics:

- Micro-optics and nanophotonics
- Fiber and integrated optics
- Optoelectronic materials and devices
- Biomedical optics
- Optical interferometry and metrology
- Optical fabrication
- Nanoscale imaging and spectroscopy
- Adaptive optics
- Optical communication
- Novel light-matter interactions
- Quantum optics
- Optical sensors and measurements

A complete description of the research activity within the Optical Science and Engineering program can be accessed online.

Documents to be Submitted for M.S or Ph.D. Admission

- UNC Charlotte online application for graduate admission.
- Official GRE scores.
- Official TOEFL or IELTS score~~s~~ from international applicants whose native language is not English, unless ~~(if~~ the previous college degree was from a country where English is ~~not~~ the official language~~)~~.
- Unofficial transcripts from all colleges and universities attended should be uploaded to the application. (Applicants offered admission will be required to submit official transcripts.)
- A minimum of three letters of reference.
- A Statement of Purpose essay detailing the applicant's motivation and career goals.

Additional Admission Requirements

All applicants seeking admission into the Optical Science and Engineering Ph.D. program must fulfill the university's general requirements for graduate admission at the Ph.D. level. Additional requirements for admission into the program are:

- A baccalaureate or master's degree in Physics, Chemistry, Mathematics, Engineering, Optics, or a related field with a minimum undergraduate GPA of 3.0 overall and 3.2 (A = 4.0) in the major. In the case a candidate presents a master's degree at application, a minimum graduate GPA of 3.2 (A = 4.0) on all graduate work is required.
- A minimum~~al~~ combined score of 1100 on the verbal and quantitative portions of the GRE General Test (tests taken prior to August 1, 2011). A minimum combined score of 301 on the verbal and quantitative portions of the GRE revised General Test (tests taken on or after August 1, 2011).
- ~~A minimum score of 557 (paper-based test) or 83 (Internet-based test) on the TOEFL if the previous degree was from a country where English is not the official language.~~
- Positive letters of recommendation.
- Students may be required to take undergraduate courses determined by the Interdisciplinary Optics Program Committee on an individual basis. Such courses will be specified at the time of admission into the program.

Degree Requirements

The degree of Doctor of Philosophy in Optical Science and Engineering is awarded for completion of scholarly research that advances the knowledge base in the field ~~of that research. Evidence of this~~ and is demonstrated by a successful dissertation defense. Additionally, recipients of this degree should demonstrate mastery of relevant subject matter and a potential for success in future research and teaching.

The minimum requirement for the Ph.D. degree in Optical Science and Engineering is 72 credit hours beyond the baccalaureate degree.

Each candidate for the Ph.D. degree in Optical Science and Engineering must complete the following:

- Present evidence of competency in the ~~C~~core ~~C~~curriculum by successfully completing ~~15~~ 18 credit hours ~~(5 courses)~~ of core courses with a grade of B or above in each course ~~in the Core Curriculum~~
- Complete a minimum of ~~9~~ 6 credit hours ~~(3 courses) in formal~~ of elective courses having an OPTI prefix in addition to the ~~C~~core ~~C~~curriculum
- ~~Complete 2 semesters (2 credit hours)of Seminar (OPTI 8110) during the first 2 semesters of residency and complete 1 semester (1 credit hour) of Seminar (OPTI 8110) during each academic year of residency in the program~~

- Complete 1 credit hour of OPTI 8610 Seminar during the fall of the first academic year in the program
- Complete 1 credit hour of OPTI 8611 Graduate Colloquium during the spring of the first academic year in the program and complete 1 credit hour of OPTI 8611 Graduate Colloquium each subsequent academic year in the program
- Complete a minimum of 24 credit hours of OPTI 8991 Ddissertation Rresearch ~~(OPTI 8991)~~
- The remaining credit hours may be dissertation research credits, coursework credits or a combination
- Successfully complete the written and oral qualifying examination
- Select a dissertation advisor and form an advisory committee
- ~~Present~~ Prepare a ~~P~~plan of ~~S~~study detailing how you intend to satisfy the 72 credit hour requirement ~~all course and examination requirements~~
- ~~Successfully complete the written and oral qualifying exam~~
- ~~Present~~ Successfully submit a Ph.D. ~~R~~research proposal ~~Plan~~
- Successfully defend the Ph.D. dissertation

PhD Students should enroll in 8000-level courses when possible.

~~The remaining credit hours must be approved on a case-by-case basis by the student's Advisory Committee and the Optics Program Director.~~

A student in the Ph.D. program must maintain a minimum cumulative GPA of 3.0 in all coursework attempted for the degree. An accumulation of two C grades will result in suspension from the program. A grade of U earned in any course will result in suspension from the program. An accumulation of three C grades or two U grades will result in termination from the program.

Core Curriculum

All graduates of the program must demonstrate competency in the ~~C~~core ~~C~~curriculum. Students may do so by completing 18 credit hours of ~~the 5~~ ~~C~~core ~~C~~courses with a grade of B or above in each course. ~~and a GPA of 3.4 or above in those courses. Failure to demonstrate competency in this manner will result in termination from the program. Well-prepared students may demonstrate competency in the Core Curriculum by earning a grade of Pass on one or more of the five sections of a Core examination. In those cases, credit hours that would have been earned in the courses may be replaced by credit hours in OPTI 8991 (Dissertation Research) and/or other electives approved by the student's Advisory Committee and the Optics Program Director.~~ Competency is typically demonstrated by the end of the 3rd semester in the program. With program director approval, students may demonstrate competency by passing a core competency exam. Credit hours that would have been earned if the student had taken the course may be replaced by dissertation research or an approved elective.

Core Courses

Fall

OPTI 8101 Mathematical Methods of Optical Science and Engineering (3)
OPTI 8102 Principles of Geometrical ~~and Physical~~ Optics (3)
OPTI 8102L Geometrical Optics Lab (1)
OPTI 8105 Optical Properties of Materials (3)
~~OPTI 8110 Seminar~~

Spring

OPTI 8103 Light Sources and Detectors (3)
OPTI 8104 Electromagnetic Waves (3)
OPTI 8106 Principles of Physical Optics (3)
OPTI 8106L Physical Optics Lab (2)
~~OPTI 8110 Seminar~~
~~OPTI 8211 Intro to Modern Optics~~

Responsible Conduct of Research

UNC Charlotte is committed to ensuring that doctoral students understand their obligations as researchers. All first year doctoral students in science, math, engineering or technology are required to enroll in GRAD 8002 - Responsible Conduct of Research. This two credit course prepares students for a range of research related issues. Class times to be announced.

Qualifying Exam

~~After successful completion of the Core Curriculum,~~ Ph.D. students will participate in a written and oral qualifying examination administered by the ~~O~~optics ~~F~~faculty no later than the semester following the successful demonstration of competency in the core curriculum. If a student fails the qualifying examination, it may be retaken once. If a student fails the exam a second time, the student's enrollment in the Ph.D. program will be terminated.

Dissertation Advisor and Advisory Committee

Each student in the program must have a ~~D~~dissertation ~~A~~advisor and an ~~A~~advisory ~~C~~committee. ~~before being admitted to candidacy.~~ The student should select ~~a dissertation~~ the advisor before the end of the second year of residency. The student and ~~the dissertation~~ advisor ~~jointly~~ determine the ~~advisory~~ committee by agreement. The ~~Dissertation~~ ~~A~~advisor serves as ~~C~~chair of the ~~Advisory~~ ~~C~~committee and must be a member of the Optics Faculty and a regular member of the Graduate Faculty at UNC Charlotte. The Dean of the Graduate School will appoint a committee member to serve as the Graduate Faculty Representative. The committee must have at least 4 members, one of whom is the chair and one of whom is the Graduate Faculty Representative. ~~the majority of which must be members of the Optics Faculty. All members of the advisory committee must be members of the Graduate Faculty.~~ All members of the committee must be members of the Graduate Faculty and a majority must be members of the

Optics Faculty. Composition of the ~~A~~advisory ~~C~~committee must be approved by the Optics Program Director and the Dean of the Graduate School.

Plan of Study

All students ~~must~~ should prepare a ~~P~~plan of ~~S~~study before the end of their fourth semester following admission to the program. The ~~P~~plan of ~~S~~study ~~should~~ shows in detail how the student ~~will~~ intends to meet the ~~72 credit hour minimum~~ degree requirements. The ~~P~~plan of ~~S~~study must be approved by the ~~A~~advisory ~~C~~committee and the optics program director.

Research ~~Plan~~ Proposal

After successful ~~completion of~~ demonstration of competency in the ~~C~~core ~~C~~curriculum ~~requirement~~ and approval of the ~~P~~plan of ~~S~~study, the student will prepare a written ~~R~~research proposal ~~Plan~~ and present an oral defense of the proposal ~~that Plan presented in a public seminar~~ to their advisory committee. This should be completed within three years following admission to the program. The research proposal, also called the dissertation topic proposal, must be approved by the advisory committee. The research proposal demonstrates the student's knowledge of the relevant literature and the specific research problems and methods of study that, if successfully completed, will lead to an acceptable dissertation. ~~The Research Plan must be approved by the Advisory Committee. The Research Plan must demonstrate: (a) the student's knowledge of the relevant literature base, (b) knowledge of the specific research problems and methods of studies, and (c) a research plan that, if successfully completed, will lead to an approved dissertation.~~

Admission to Candidacy

~~Students are admitted to candidacy upon completion of the Core Curriculum with a GPA of 3.4 or above, appointment of a Ph.D. advisor, formation of an Advisory Committee, presentation of the Plan of Study, successful completion of the Qualifying Exam, and approval of the Research Plan.~~ A student formally advances to candidacy and is considered a PhD candidate after successful demonstration of competency in the core curriculum, passing the qualifying exam, appointment of a dissertation advisor, formation of an advisory committee, completion of the plan of study, and approval of the research proposal. These steps to candidacy ~~must~~ should be completed within three years following admission to the program.

Dissertation

Each student will complete a minimum of 24 credit hours of dissertation research. The student must ~~present~~ submit a written dissertation for final review to the ~~A~~advisory ~~C~~committee three weeks before the defense date. The student must defend the dissertation before the advisory committee at a presentation which is open to the university community ~~at a presentation before the Optics Faculty~~. Upon approval of the written dissertation and oral presentation by the ~~A~~advisory ~~C~~committee, the student has successfully completed the dissertation requirement. The dissertation must be written using a format acceptable to the Graduate School.

Residency Requirement

The student must satisfy the residence requirement for the program by completing 20 credit hours of continuous enrollment in coursework/dissertation credit. Residence is considered continuous if the student is enrolled in one or more courses in successive semesters until 20 credit hours are earned.

~~Time Limit for Completion of Program Requirements~~

~~All program requirements must be completed within 7 calendar years from the date the student is admitted into the program.~~

Transfer Credit Accepted

Up to 30 credit hours of approved coursework may be transferred from other accredited master's and/or doctoral programs. Only courses in which the student earned a grade of B or above (or its equivalent) can be transferred. No more than 6 credit hours of approved coursework taken as a post-baccalaureate student may be applied toward the degree. Credit for dissertation research cannot be transferred.

Assistantships

Support for beginning graduate students is usually a teaching assistantship. Continuing students are usually supported by research assistantships.

Application for Degree

Students should submit an Application for Degree at the beginning of the term in which they anticipate defending their dissertation. Adherence to Graduate School deadlines is expected. Degree requirements are completed when students successfully defend their dissertation and file the final copy of the dissertation in the Graduate School.

~~Comprehensive Examination~~

~~The dissertation defense is the final examination.~~

~~Language Requirement~~

~~The program has no language requirement.~~

~~Core Curriculum~~

~~A student in the Ph.D. program should plan to complete the core curriculum, shown below, during the first year of residence. Courses taken after completion of the core curriculum are~~

~~elective, but must be approved by the student's Advisor and Advisory Committee. Courses in the core curriculum are prerequisites to elective OPTI courses. Students in the Ph.D. program are to enroll in courses having an 8XXX number.~~

~~Fall~~

- ~~OPTI 8101 Mathematical Methods of Optical Science and Engineering~~
- ~~OPTI 8102 Principles of Geometrical and Physical Optics~~
- ~~OPTI 8105 Optical Properties of Materials~~
- ~~OPTI 8110 Seminar~~

~~Spring~~

- ~~OPTI 8104 Electromagnetic Waves~~
- ~~OPTI 8211 Introduction to Modern Optics~~
- ~~OPTI 8110 Seminar~~

2014-2015 Graduate Catalog:
M.S. in Optical Science and Engineering

Programs of Study

The M.S. and Ph.D. programs in Optical Science and Engineering is interdisciplinary, involving primarily five science and engineering departments and two centers (Departments of Physics & Optical Science, Chemistry, Mathematics & Statistics, Electrical & Computer Engineering, and Mechanical Engineering & Engineering Science; the Center for Optoelectronics & Optical Communications; and the Center for Precision Metrology). The program is administered through the Department of Physics and Optical Science. The purpose of the program is to educate scientists and engineers who will develop the next generation of optical technology. The program emphasizes basic and applied interdisciplinary education and research in the following specialties of optics:

- Micro-optics and nanophotonics
- Fiber and integrated optics
- Optoelectronic materials and devices
- Biomedical optics
- Optical interferometry and metrology
- Optical fabrication
- Nanoscale imaging and spectroscopy
- Adaptive optics
- Optical communication
- Novel light-matter interactions
- Quantum optics
- Optical sensors and measurements

A complete description of the research activity within the Optical Science and Engineering program can be accessed online.

Documents to be Submitted for M.S or Ph.D. Admission

- UNC Charlotte online application for graduate admission.
- Official GRE scores.
- Official TOEFL or IELTS score~~s~~ from international applicants whose native language is not English, unless ~~(if~~ the previous college degree was from a country where English is ~~not~~ the official language~~)~~.
- Unofficial transcripts from all colleges and universities attended should be uploaded to the application. (Applicants offered admission will be required to submit official transcripts.)
- A minimum of three letters of reference.
- A Statement of Purpose essay detailing the applicant's motivation and career goals.

Additional Admission Requirements

All applicants seeking admission into the M.S. in Optical Science and Engineering program must fulfill the University's general requirements for graduate admission at the Master's level. Additional requirements for admission into the program are:

- A baccalaureate or master's degree in Physics, Chemistry, Mathematics, Engineering, Optics, Computer Science, or a related field with a minimum undergraduate GPA of 3.0 overall and 3.0 (A = 4.0) in the major.
- A minimum~~al~~ combined score of 1000 on the verbal and quantitative portions of the GRE General Test (tests taken prior to August 1, 2011). A minimum combined score of 293 on the verbal and quantitative portions of the GRE revised General Test (tests taken on or after August 1, 2011).
- ~~A minimum score of 220 (computer-based test) or 557 (paper-based test) or 83 (Internet-based test)) on the TOEFL if the previous degree was from a country where English is not the official language.~~
- Positive letters of recommendation.
- Students may be required to take undergraduate courses determined by the Optics Program Committee on an individual basis. Such courses will be specified at the time of admission into the program.

Degree Requirements for M.S. With Non-Thesis Option

The Master of Science degree with non-thesis option in Optical Science and Engineering is awarded for completion of formal coursework and demonstration of competency in the core curriculum.

The minimum requirement for the M.S. degree with non-thesis option ~~in Optical Science and Engineering~~ is 32 credit hours beyond the baccalaureate degree.

Each candidate for the M.S. degree with non-thesis option must complete the following:

- Present evidence of competency in the core curriculum by successfully completing 15 credit hours of core courses with a grade of B or above in each course
- Complete a minimum of 15 credit hours of elective courses in addition to the core curriculum
- Complete 1 credit hour of OPTI 6610 Seminar during the fall of the first academic year in the program
- Complete 1 credit hour of OPTI 6611 Graduate Colloquium during the spring of the first academic year in the program
- Prepare a plan of study detailing how you intend to satisfy the 32 credit hour requirement

Electives must be approved by the optics program director. M.S. students should enroll in 6000-level courses when possible.

A student in the M.S. program must maintain a minimum cumulative GPA of 3.0 in all coursework attempted for the degree. An accumulation of two C grades will result in suspension from the program. A grade of U earned in any course will result in suspension from the program. An accumulation of three C grades or two U grades will result in termination from the program.

Degree Requirements for M.S With Thesis Option

The Master of Science degree with thesis option in Optical Science and Engineering is awarded for completion of scholarly research that advances the knowledge base in the field and is demonstrated by a successful thesis defense.

The minimum requirement for the M.S. degree with thesis option ~~in Optical Science and Engineering~~ is 32 credit hours beyond the baccalaureate degree.

Each candidate for the M.S. degree with thesis option must complete the following:

- Present evidence of competency in the core curriculum by successfully completing 15 credit hours of core courses with a grade of B or above in each course
- Complete a minimum of 6 credit hours of elective courses in addition to the core curriculum
- Complete 1 credit hour of OPTI 6610 Seminar during the fall of the first academic year in the program
- Complete 1 credit hour of OPTI 6611 Graduate Colloquium during the spring of the first academic year in the program
- Complete a minimum of 9 credit hours of OPTI 6991 Thesis Research
- Select a thesis advisor and form an advisory committee
- Prepare a plan of study detailing how you intend to satisfy the 32 credit hour requirement
- Successfully submit an M.S. research proposal
- Successfully defend the M.S. thesis

Electives must be approved by the optics program director. M.S. students should enroll in 6000-level courses when possible.

A student in the M.S. program must maintain a minimum cumulative GPA of 3.0 in all coursework attempted for the degree. An accumulation of two C grades will result in suspension from the program. A grade of U earned in any course will result in suspension from the program. An accumulation of three C grades or two U grades will result in termination from the program.

~~**Degree Requirements**~~

~~The degree of Master of Science in Optical Science and Engineering with the thesis option is awarded for completion of scholarly research that advances the knowledge base in the field of that research. Evidence of this is demonstrated by a successful thesis defense. The degree of~~

~~Master of Science in Optical Science and Engineering with the non-thesis option is awarded for completion of formal coursework. Additionally, recipients of this degree should demonstrate mastery of relevant subject matter and a potential for success, usually in a position with government or industry.~~

~~The minimum requirement for the M.S. in Optical Science and Engineering degree is 32 credit hours beyond the baccalaureate degree. For the thesis option, the requirement includes a minimum of 21 credit hours of formal coursework, a minimum of 9 credit hours of thesis research, and 2 credit hours of seminar (OPTI 6110). For the non-thesis option, the requirement includes a minimum of 30 credit hours of formal coursework and 2 credit hours of seminar (OPTI 6110). Both options must include at least 15 credit hours in approved courses having an OPTI prefix.~~

~~All graduates of the program must demonstrate competency in the Core Curriculum. Students may demonstrate competency in the subject matter of the Core Curriculum by earning a grade of Pass on each of the five sections of a comprehensive qualifying examination. Each section of the comprehensive examination is based on subject matter in one of the five courses comprising the Core Curriculum. Students who do not receive a grade of Pass on a given section of the comprehensive examination must enroll in the corresponding Core Curriculum course. Students demonstrate competency in the Core Curriculum by passing the comprehensive examination or by earning a grade of B or above in those core courses not passed during the comprehensive examination.~~

~~Well-prepared students may earn a grade of pass on one or more of the five sections of the comprehensive examination. In those cases, credit hours that would have been earned in the courses, upon which the sections passed were based, may be replaced by credit hours in other electives approved by the student's Advisory Committee and the Optics Program Director.~~

~~A student in the M.S. program must maintain a minimum GPA of 3.0 in all coursework attempted for the degree. An accumulation of two C grades will result in suspension from the program. A grade of U earned in any course will result in suspension from the program. An accumulation of three C grades or two U grades will result in termination from the program.~~

~~Thesis Option~~

~~After successful completion of the Core Curriculum requirement and approval of the Plan of Study, the student will prepare a Research Plan for the thesis that is approved by the Advisory Committee. The Research Plan must demonstrate: (a) the student's knowledge of the relevant literature base, (b) knowledge of the specific research problems and methods of studies, and (c) a research plan that, if successfully completed, will lead to an approved thesis. The student must present a written plan to the Advisory Committee. The student must also make an oral defense of the Research Plan at a presentation before the Advisory Committee.~~

~~After successfully demonstrating competency in the Core Curriculum, preparation of an approved Plan of Study, and approval of the Research Plan by the Advisory Committee, the~~

~~student is admitted to candidacy. The qualifier, as described, must be completed within two years following admission to the program. A full-time student is normally expected to complete the qualifier prior to the end of the third semester following admission to the program.~~

~~**Non-Thesis Option**~~

~~After successfully demonstrating competency in the Core Curriculum, the student is admitted to candidacy. All courses used to satisfy the degree requirements must be approved by the Optics Program Director.~~

Core Curriculum

All graduates of the program must demonstrate competency in the core curriculum. Students may do so by completing 15 credit hours of core courses with a grade of B or above in each course. Competency is typically demonstrated by the end of the 3rd semester in the program. With program director approval, students may demonstrate competency by passing a core competency exam. Credit hours that would have been earned if the student had taken the course may be replaced by approved credits.

Core Courses

Fall

OPTI 6101	Mathematical Methods of Optical Science and Engineering (3)
OPTI 6102	Principles of Geometrical ~~and Physical~~ Optics (3)
OPTI 6102L	Geometrical Optics Lab (1)
OPTI 6105	Optical Properties of Materials (3)
~~OPTI 6110~~	~~Seminar~~

Spring

OPTI 6103	Light Sources and Detectors (3)
OPTI 6104	Electromagnetic Waves (3)
OPTI 6106	Principles of Physical Optics (3)
OPTI 6106L	Physical Optics Lab (2)
~~OPTI 6110~~	~~Seminar~~
~~OPTI 6211~~	~~Intro to Modern Optics~~

Thesis Advisor and Advisory Committee

Each student in a program of study with the thesis option must have a thesis advisor and an advisory committee. ~~the program must have a Thesis Advisor and an Advisory Committee before being admitted to candidacy.~~ The student should select ~~a thesis~~ the advisor before the end of the first year of residency. The student and ~~the thesis~~ advisor ~~jointly~~ determine the advisory committee by agreement. The ~~Thesis~~ ~~A~~advisor serves as ~~C~~chair of the ~~Advisory~~ ~~C~~committee and must be a member of the Optics Faculty and a regular member of the Graduate Faculty at UNC Charlotte. The advisory committee must have at least 3 members, one of whom is the chair. ~~the~~

~~majority of which must be members of the Optics faculty.~~ All members of the ~~advisory~~ committee must be members of the Graduate Faculty and a majority must be members of the Optics Faculty. Composition of the ~~A~~advisory ~~C~~committee must be approved by the ~~O~~optics ~~P~~program ~~D~~director.

Plan of Study

After successful demonstration of competency in the core curriculum, students should prepare a plan of study which shows in detail how the student will meet the degree requirements. The plan of study must be approved by the optics program director.

Research Proposal

After successful demonstration of competency in the core curriculum, a student in a program of study that includes the thesis option will prepare a written research proposal. This should be completed within two years following admission to the program. The research proposal, also called the thesis topic proposal, must be approved by the advisory committee. The research proposal demonstrates the student's knowledge of the relevant literature and the specific research problems and methods of study that, if successfully completed, will lead to an acceptable thesis.

~~Qualifier and~~ Admission to Candidacy

An M.S. student files for admission to candidacy no later than the beginning of the semester in which they expect to complete all degree requirements and graduate. The candidacy application lists the selection of coursework offered for the degree, including transferred, completed, and courses in progress. The program director approves the candidacy form which must be received in the Graduate School by the eighth instructional day of the semester. ~~All graduates of the program must demonstrate competency in the Core Curriculum. Students in the thesis program must prepare a Plan of Study before the end of the second semester following admission to the program. The Plan of Study must be approved by the Advisory Committee.~~

Thesis

Each student in a program of study that includes a thesis option will complete a minimum of 9 credit hours of thesis research. The student must ~~present~~ submit a written thesis for final review to the ~~A~~advisory ~~C~~committee three weeks before the defense date. The student must defend the thesis before the advisory committee at a presentation which is open to the university community. ~~before the Optics Faculty.~~ Upon approval of the written thesis and oral presentation by the ~~A~~advisory ~~C~~committee, the student has successfully completed the thesis requirement. The thesis must be written using a format acceptable to the Graduate School.

Residency Requirement

The student must satisfy the residence requirement for the program by completing 12 credit hours of continuous enrollment in coursework/thesis credit. Residence is considered continuous if the student is enrolled in one or more courses in successive semesters until 12 credit hours are earned.

~~**Time Limit for Completion of Program Requirements**~~

~~All program requirements must be completed within 5 calendar years from the date the student is admitted into the program.~~

Transfer Credit Accepted

Up to 6 credit hours of approved coursework may be transferred from other accredited master's and/or doctoral programs. Only courses in which the student earned a grade of B or above (or its equivalent) can be transferred. ~~No more than 6 credit hours of approved coursework taken as a post-baccalaureate student may be applied toward the degree.~~ Credit for thesis research cannot be transferred.

Assistantships

Support for beginning graduate students is usually a teaching assistantship. Continuing students are often supported by research assistantships.

~~**Language Requirement**~~

~~The program has no language requirement.~~

~~**Comprehensive Examination**~~

~~The thesis defense is the final examination.~~

Application for Degree

Students should submit an Application for Degree at the beginning of the term in which they anticipate graduating. Adherence to Graduate School deadlines is expected.

2014-2015 Graduate Catalog:

Courses in Optical Science and Engineering (OPTI)

M.S. Degree

OPTI 5000. Selected Topics in Optics. (3) Prerequisite: Permission of Optics Program Director. Selected topics in optics from areas such as medical optics, adaptive optics, all optical networks, etc. *May be repeated for credit with change of topic.(Fall, Spring, Summer)*

OPTI 5371. Waves and Optics. (3) Cross-listed as PHYS 4271/5271 Waves and Optics. The mathematics of wave motion, light as an example of an electromagnetic wave, the superposition of periodic and non-periodic waves, and selected topics from geometrical and physical optics. *(Fall, Spring)*

OPTI 5392 Solid State Microelectronic Devices (3) Cross-listed as ECGR 4131/5192 Solid State Microelectronic Devices. PN-junctions and Schottky junctions. Bipolar and field effect transistors. Optoelectronic and heterojunction devices. Lithography and integrated circuits. Microwave devices. Light emitting devices and detectors. Quantum devices using superlattices. Quantum wells and quantum dots. Material preparation and characterization. Measurement techniques. *(Fall)*

OPTI 6000. Selected Topics in Optics. (3) Cross-listed as OPTI 8000. Prerequisite: Permission of Optics Program Director. Selected topics in optics from areas such as medical optics, adaptive optics, all optical networks, etc. *May be repeated for credit with change of topic. (Fall, Spring, Summer)*

OPTI 6101. Mathematical Methods of Optical Science and Engineering. (3) Cross-listed as OPTI 8101. A comprehensive look at those mathematical techniques important to the understanding of optical phenomena. ~~Topics include:~~ Includes vector algebra and calculus, matrix theory, Fourier series and transforms, complex analysis, ~~Frobenius methods of solutions to ordinary differential equations, separation of variables techniques for~~ solution of boundary value problems in partial differential equations, and special functions. ~~Fourier series, and transform methods.~~ Topical coverage will emphasize applications specific to the field of optics. ~~Three lecture hours per week.~~ *(Fall)*

OPTI 6102. Principles of Geometrical ~~and Physical~~ Optics. (3) Cross-listed as OPTI 8102. ~~Ray analysis of common optical elements (mirrors, lenses and systems of lenses, prisms).~~ Law of ~~R~~reflection and refraction, reflection and refraction at plane ~~and spherical~~ surfaces, paraxial imagery, mirrors, ~~thin and~~ thick lenses, thin lenses, lens systems, stops, principle planes, the optical invariant, vignetting, paraxial radiometry, analysis of common optical systems, real ray tracing, introduction to aberrations and image resolution in the context of the modulation transfer function. ~~lensmaker's equation, field of view, and numerical aperture. Wave properties of~~

~~light, superposition of waves, diffraction, interference, polarization, and coherence. Optics of thin films.~~ ~~Three lecture hours per week.~~ *(Fall)*

OPTI 6102L. Geometrical Optics Lab. (1) Cross-listed as OPTI 8102L. Selected experiments in areas of geometrical optics such as index of refraction measurement, dispersing and reflecting prisms, spherical mirrors and thin lenses, imaging, optical instruments, aberration, fiber optics, and fringe projection profilometry. *(Fall)*

OPTI 6103. Light Sources and Detectors. (3) Cross-listed as OPTI 8103. ~~The nature of light, blackbody radiation. Optical sources, including discharge lamps, light-emitting diodes, gas and solid state lasers. Quantum wells. Continuous wave and pulsed (mode-locked, Q-switched) lasers. Selected solid-state laser systems. Light detection, including thermal and quantum detectors, photomultiplier tubes, diode detectors. Noise in light sources and detectors.~~ Photon statistics and thermal light. Interactions of photons with atoms. Population inversion, lasing threshold, and resonator modes. Mode-locked and Q-switched lasers. Semiconductor photon sources including light-emitting diodes (LEDs) and laser diodes. Quantum-confined structures, materials, and devices. Thermal sources. Light extraction. Light detectors including photoconductive, photovoltaic and avalanche photodiodes. Noise in light sources and detectors. ~~Three lecture hours per week.~~ *(~~Fall~~ Spring)*

OPTI 6104. Electromagnetic Waves. (3) Cross-listed as OPTI 8104. Course covers those optical phenomena that are explicitly associated with the electromagnetic nature of light. Includes an introduction to Maxwell's equations~~, the~~ and electromagnetic waves. Polarization and the Jones calculus. Energy and momentum conservation, boundary conditions and Fresnel equations. Waves in anisotropic (birefringent) and complex media. Modulation and deflection of optical beams (principles of acousto-optics and electro-optic devices). Propagation at interfaces, ~~equation, and electromagnetic wave functions. Waves in dielectric and conducting media, dispersion. Reflection, refraction, transmission, internal reflection, and evanescent waves at an interface. Intensity. Introduction to guided waves.~~ waveguides, and plasmons. Electromagnetic potentials and multipole radiation, scattering of light, and interaction with metallic nanoparticles. ~~Three lecture hours per week.~~ *(Spring)*

OPTI 6105. Optical Properties of Materials. (3) Cross-listed as OPTI 8105. ~~Photophysical and photochemical processes in materials. Linear and nonlinear optical properties of materials. Optical properties of semiconductors and crystals. Optical transmission, absorption, and reflection. Fluorescence of organic and inorganic materials. Chiral molecular systems.~~ Electromagnetic wave propagation in dielectrics, semiconductors and metals. Dipole oscillator model, complex dielectric constants, and Kramers-Kronig relationship. Crystal structures and optical anisotropy. Reciprocal space and density of states. Electronic band structure. Quantum theory of radiative absorption and emission, selection rules. Direct and indirect interband absorption. Free-carrier absorption in metals and doped semiconductors. Free excitons and Frenkel excitons. Photo- and electroluminescence in semiconductors. Optical absorption and emission in quantum wells and quantum dots, and quantum Stark effect. Second and third-order optical nonlinearities. ~~Three lecture hours per week.~~ *(Fall)*

OPTI 6106. Principles of Physical Optics (3) Cross-listed as OPTI 8106. The Fourier transform and its role in wave optics. Wave properties of light, superposition of waves, angular

spectrum of plane waves, relation to ray optics, Gaussian beams, periodic structures and surfaces, Fresnel diffraction, spatial filtering diffraction, interference and interferometers (two, multibeam, Fabry-Perot), polarization, temporal and spatial coherence, holography, imaging and resolution.

OPTI 6106L. Physical Optics Lab. (2) Cross-listed as OPTI 8106L. Selected experiments in areas of physical optics such as interference in thin films, Fabry-Perot, Michelson & Twyman-Green interferometers, polarization and diffraction of light. By the end of this course students are asked to design and implement a mini project that includes geometrical and physical optics concepts. *(Spring)*

~~**OPTI 6110. Seminar. (1)** Prerequisite: Admission to Optics M.S. program. Topics include: discussion and analysis of topics of current interest in optics; effective techniques for making presentations and utilizing library materials; ethical issues in science and engineering. *May be repeated for credit up to 4 credits.* One semester of seminar is required of all students in the Optics M.S. program during each of their first two semesters of residence. After the first two semesters, students are required to attend a minimum number of designated lectures. One to two hours per week. *(Fall, Spring)*~~

OPTI 6201. Fourier Optics and Holography. (3) Cross-listed as OPTI 8201. Prerequisites: OPTI 6102 and OPTI 6104. Principles of scalar, Fresnel, and Fraunhofer diffraction theory. Coherent optical data processing. Optical filtering and data processing. Holography. Three lecture hours per week. *(Fall, Even years)*

OPTI 6202. Fundamentals of Biomedical Optics. (3) Cross-listed as OPTI 8202 and PHYS 6202. Basic principles underlying tissue optics, laser-tissue interactions, and optical imaging, microscopy, and spectroscopy for medical applications. (*Spring*)

OPTI 6203. Metamaterials. (3) Cross-listed as OPTI 8203. Metamaterials describes a new field of engineered materials having subwavelength structures, and which have electromagnetic properties not found in nature. Examples include zero and negative index materials which lead to some new applications. Metamaterials are made from "meta-atoms" which are much smaller than the wavelength of the radiation. Meta-atoms are LCR circuits having strong resonant behavior over some chosen bandwidth. The distribution of many such atoms and their mutual interaction determine the bulk metamaterial's properties. Describing these properties draws from electromagnetics, antenna design, atomic and molecular physics and condensed matter physics. At increasingly small scales, i.e. at the nanoscale, both quantum and plasmonic phenomena can play a role. *(Fall)*

OPTI 6205. Advanced Optical Materials. (3) Cross-listed as OPTI 8205. Prerequisites: OPTI 6104 and OPTI 6105 or ECGR 6133/8133. Molecular optical materials including fabrication methods. Luminescence centers; quenching. Nonlinear optics, including higher order terms of the susceptibility tensor. Photonic crystals. Three lecture hours per week. *(Fall, Odd years)*

OPTI 6206. Physical Optics Design and Simulation. (3) Cross-listed as OPTI 8206. Prerequisite: OPTI 6106 or permission of instructor. Design and simulation of optical

components and systems using scalar and vector wave propagation, diffraction, and interference. The course is intended to compliment OPTI 6/8241, which focuses on optical lens and system design using geometrical ray-tracing. *(Spring)*

OPTI 6211. **Introduction to Modern Optics. (3)** Cross-listed as OPTI 8211. Prerequisite: OPTI 6102 or permission of instructor. Fourier analysis and holography, Coherence. Introduction to light production and detection. Optical modulation, including EO effect, Kerr effect, amplitude modulation, magnetooptic effect, photoelastic effect, and acousto-optic effect. Introduction to nonlinear optics. Photonic switching. Three lecture hours per week. *(Spring)*

OPTI 6212. Integrated Photonics. (3) Cross-listed as OPTI 8212. Prerequisites: OPTI 8102 and OPTI 8104. Theory and application of optical waveguides, free-space micro-optics, and integrated photonic devices. Fabrication and integration techniques, including motivations for choice of approach (hybrid vs. monolithic, materials, size, performance, etc). Modeling and simulation. Students will be required to work with mathematical packages such as Matlab and/or Mathematica to illustrate key concepts and to implement beam propagation/optical modeling simulations. Three lecture hours per week. *(Spring, Odd years)*

OPTI 6221. **Optical Communications. (3)** Cross-listed as OPTI 8221. Prerequisites: OPTI 6102 and OPTI 6103. Introduction to optical communications and basic communication block such as lasers, optical modulators, and optical transceivers. Review of fibers (attenuation, dispersions, etc.). Optical amplifiers. Passive and active photonic components such as tunable lasers and filters. Coherent and incoherent detection. Signal processing, photonic switching, and point-to-point links / connections. Three lecture hours per week. *(Spring)*

OPTI 6222. **Optical Communication Networks. (3)** Cross-listed as OPTI 8222. Prerequisite: OPTI 6221 or graduate standing in ECE, CS, or IT. Optical signal coding, multiplexing and de-multiplexing. Time-domain medium access (TDM (SONET) and TDMA), wavelength-division multiplexing (WDM and WDMA). Optical networks, add-drop multiplexing (OADM), switching and routing technologies, Dispersion management. Optical clock and timing recovery. Optical amplification, wavelength conversion, transport, and networking protocols. Broadband ISDN concepts. Access, metro, and long-haul network topologies. Three lecture hours per week. *(Fall)*

OPTI 6241. Optical System Function and Design. (3) Cross-listed as OPTI 8241. Prerequisite: OPTI 6102. Advanced study of telescopes, microscopes, cameras, off-axis imaging systems, stops, apertures, multiple lenses, use and selection of ray trace computer codes. Three lecture hours per week. *(Spring)*

OPTI 6242. Optical Propagation in Inhomogeneous Media. **(3)** Cross-listed as OPTI 8242. Prerequisites: OPTI 6102 and OPTI 6104. Advanced study of free space propagation, scattering, and scintillation of Gaussian and uniform beam waves. Random processes, weak fluctuation theory, propagation through complex paraxial optical systems *(Spring, Odd years)*

OPTI 6244. High Speed Photonics and Optical Instrumentation. (3) Cross-listed as OPTI 8244. Prerequisites: OPTI 6103 and OPTI 6104. Study of instrumentation used for generation, detection, and manipulation of light in optical circuits. Topics include: ultrashort pulse

generation, photon-phonon interactions, 2nd & 3rd harmonic generation, squeezed light, optical tweezers, OPO, electro-optic modulators, selective polarizers, optical switches, amplifiers, multiplexing and mixing schemes, and application of CCD and CMOS cameras and detectors. Three lecture hours per week. *(Spring, Odd years)*

OPTI 6261. Modern Coherence Theory. **(3)** Cross-listed as OPTI 8261. Prerequisites: OPTI 6102 and OPTI 6104. Stochastic processes. Second order coherence of scalar and vector wavefields, radiation and states of coherence. Quantum wavefields. *(Fall, Odd years)*

OPTI 6271. Advanced Physical Optics. (3) Cross-listed as OPTI 8271. Prerequisites: OPTI 6101, OPTI 6102, and OPTI 6104. Advanced study of electromagnetic wave propagation, stratified media, physics of geometrical optics, polarization and crystal optics, absorption and dispersion, interference, propagation and diffraction. Three lecture hours per week. *(Spring, Odd years)*

OPTI 6281. Modern Optics Laboratory. (3) Cross-listed as OPTI 8281. Prerequisite: OPTI 6102. Selected experiments in areas of modern optics such as fiber optics, interferometry, spectroscopy, polarization, optical metrology, and holography. Six laboratory hours per week. *(Spring)*

OPTI 6301. Introduction to Instrumentation and Processing at the Nanoscale. (3) Cross-listed as OPTI 8301 and NANO 8101 Introduction to Instrumentation and Processing at the Nanoscale. Methods of manipulating, engineering, and characterizing nanoscale materials are introduced; applications and principles of their operation are discussed. Students acquire hands-on experience with selected laboratory methods in preparation for dissertation research. Topics include, but are not limited to, scanning probe and electron microscopy methods, cleanroom technology, nanoscale optical and e-beam lithography, nuclear magnetic resonance, mass spectrometry, luminescence methods, interferometry, gel permeation chromatography, surface area analysis, and small-angle x-ray and neutron scattering. *(Fall)*

OPTI 6302. Nanoscale Phenomena. (3) Cross-listed as OPTI 8302 and NANO 8102 Nanoscale Phenomena. Scaling phenomena. Nano-optics (near-field optics, limits of lithography masks, nano-dots and nanoscale optical interactions). Nanoscale mechanics. Nanotribology. Biological and biologically-inspired machines. *(Fall)*

OPTI 6303. Collaborative Research Proposal. (3) Cross-listed as OPTI 8303 and NANO 8203 Collaborative Research Proposal. Effective strategies for designing and writing research proposals are presented by program faculty members, and staff from proposal development offices on campus. Students work in teams of 2-3 to prepare an original, interdisciplinary research proposal on a topic in nanoscale science. The proposal conforms to regulations of a selected funding agency and must address a topic that is supported by that agency. Each team consults regularly with a panel of 2-3 faculty members who collectively approve the proposal topic, provide feedback during the development of the proposal, and ultimately evaluate the proposal. The course is designed to increase the ability of students to relate research ideas to fundamental concepts in science and engineering, to help students learn to develop effective

methods of presenting ideas and defending them, to help students develop self confidence in their abilities to present and defend ideas, and to improve oral and written communication skills. *(Spring)*

OPTI 6341. Applied Quantum Mechanics. (3) Cross-listed as OPTI 8341 and PHYS 6141 Quantum Theory I. Principles of non-relativistic wave mechanics. The Schrodinger equation, linear harmonic oscillator and WKB approximation. Central forces and angular momentum. The hydrogen atom. Applications of quantum mechanics in materials and optics.*(Fall)*

OPTI 6371. Solid State Materials (3) Cross-listed as OPTI 8371 and PHYS 6271 Advanced Solid State Physics. Crystal structure. Electromagnetic, electron, mechanical, and elastic wave interactions with crystals. Theory of X-ray diffraction. Energy band theory of metals and semiconductors. Optical properties of solids, phase transitions, and amorphous solids. Quantum mechanics of covalent bonding, phonon excitation, and thermal energy. *(Spring)*

OPTI 6381. Engineering Metrology. (3) Cross-listed as OPTI 8381 and MEGR 6181/8181 Engineering Metrology. Introduction to metrology and standards. Uncertainty, precision and accuracy in metrology. Measurement of size and form, computational methods in measurement of form. Measurement of surface texture and out of roundness. Machine tool and robot accuracy and calibration. Evaluation of screw threads and gears. Introduction to design of precision instruments. *(Fall)*

OPTI 6384. Advanced Surface Metrology. (3) Cross-listed as OPTI 8384 and MEGR 7284/8284 Advanced Surface Metrology. Prerequisite: OPTI 6/8381 or permission of instructor. Constituents of surface texture, stylus, optical, atomic force microscope and other advanced methods of measuring surface texture. Two and three dimensional measurement of surfaces. Separation of form, waviness and roughness. Random process analysis techniques, use of transforms for filtering. Numerical evaluation of surface texture. Use of surface texture as fingerprint of the process. Relationship between function and surface texture. *(Spring, Alternate years)*

OPTI 6400. Industrial Internship. (1-3) Cross-listed as OPTI 8400. Prerequisite: Completion of nine hours of graduate coursework and permission of program director. Full- or part-time academic year internship in optical science/optical engineering complementary to the major course of studies and designed to allow theoretical and course-based practical learning to be applied in a supervised industrial experience. Requires a mid-term report and final report to be graded by the supervising faculty. *May be repeated for credit. (On demand)*

OPTI ~~6110~~ 6610. Seminar. (1) Cross-listed as OPTI 8610. ~~Prerequisite: Admission to Optics M.S. program. Topics include: discussion and analysis of topics of current interest in optics; effective techniques for making presentations and u~~Utilizing library resources, materials, and research tools. Using presentation software and developing presentation skills for effective technical presentations. Patents and technology transfer. E~~e~~thical issues in science and engineering. Current topics in optics. ~~*May be repeated for credit up to 4 credits.* One semester of seminar is required of all students in the Optics M.S. program during each of their first two~~

~~semesters of residence. After the first two semesters, students are required to attend a minimum number of designated lectures. One to two hours per week.~~ *(Fall~~, Spring~~)*

OPTI 6611. Graduate Colloquium. (1) Cross-listed as OPTI 8611. Students present seminars on current topics in optical science and engineering. May be repeated for credit. *(Fall, Spring)*

OPTI 6800~~691~~. Independent Study. ~~Research Seminar.~~ (1-3) Cross-listed as OPTI 8800~~691~~. Prerequisite: Permission of the Optics Program Director. ~~A seminar in which I~~independent study ~~may be~~ pursued by the student, or a group of students, under the direction of a professor. *May be repeated for credit up to 6 credits. (Fall, Spring, Summer)*

OPTI 6991. Thesis Research. (1-3) Prerequisite: Admission to candidacy. Research for the thesis. *May be repeated for credit up to 18 credits. Graded on a Pass/Unsatisfactory basis. (Fall, Spring, Summer)*

Ph.D. Degree

OPTI 8000. Selected Topics in Optics. (3) See OPTI 6000 for course description.

OPTI 8101. Mathematical Methods of Optical Science and Engineering. (3) See OPTI 6101 for course description.

OPTI 8102. Principles of Geometrical ~~and Physical~~ Optics. (3) See OPTI 6102 for course description.

OPTI 8102L. Geometrical Optics Lab. (1) See OPTI 6102L for course description.

OPTI 8103. Light Sources and Detectors. (3) See OPTI 6103 for course description.

OPTI 8104. Electromagnetic Waves. (3) See OPTI 6104 for course description.

OPTI 8105. Optical Properties of Materials. (3) See OPTI 6105 for course description.

OPTI 8106. Principles of Physical Optics. (3) See OPTI 6106 for course description.

OPTI 8106L Physical Optics Lab (2) See OPTI 6106L for course description.

~~**OPTI 8110. Seminar. (1)** See OPTI 6110 for course description.~~

OPTI 8201. Fourier Optics and Holography. (3) See OPTI 6201 for course description.

OPTI 8202. Fundamentals of Biomedical Optics. (3) See OPTI 6202 for course description.

OPTI 8203. Metamaterials. (3) See OPTI 6203 for course description.

OPTI 8205. Advanced Optical Materials. (3) See OPTI 6205 for course description.

OPTI 8206. Physical Optics Design and Simulation. (3) See 6206 for course description.

OPTI 8211. **Introduction to Modern Optics. (3)** See OPTI 6211 for course description.

OPTI 8212. Integrated Photonics. (3) See OPTI 6212 for course description.

OPTI 8221. **Optical Communications. (3)** See OPTI 6221 for course description.

OPTI 8222. **Optical Communication Networks. (3)** See OPTI 6222 for course description.

OPTI 8241. Optical System Function and Design. (3) See OPTI 6241 for course description.

OPTI 8242. Optical Propagation in Inhomogeneous Media. **(3)** See OPTI 6242 for course description.

OPTI 8244. High Speed Photonics and Optical Instrumentation. (3) See OPTI 6244 for course description.

OPTI 8261. Modern Coherence Theory. **(3)** See OPTI 6261 for course description.

OPTI 8271. Advanced Physical Optics (3) See OPTI 6271 for course description.

OPTI 8281. Modern Optics Laboratory. (3) See OPTI 6281 for course description.

OPTI 8301. Introduction to Instrumentation and Processing at the Nanoscale. (3) See OPTI 6301 for course description.

OPTI 8302. Nanoscale Phenomena. (3) See OPTI 6302 for course description.

OPTI 8303. Collaborative Research Proposal. (3) See OPTI 6303 for course description.

OPTI 8341. Applied Quantum Mechanics. (3) See OPTI 6341 for course description.

OPTI 8371. Solid State Materials (3) See OPTI 6371 for course description.

OPTI 8381. Engineering Metrology. (3) See OPTI 6381 for course description.

OPTI 8384. Advanced Surface Metrology. (3) See OPTI 6384 for course description.

OPTI 8400. Industrial Internship. (1-3) See OPTI 6400 for course description.

OPTI ~~6110~~ 8610. Seminar. (1) See OPTI 6610 for course description.

OPTI 8611. Graduate Colloquium. (1) See OPTI 6611 for course description.

OPTI 8800~~691~~. Independent Study. ~~Research Seminar.~~ (1-3) See OPTI 6800~~691~~ for course description.

OPTI 8991. Dissertation Research. (1-3) Prerequisite: Admission to candidacy. Research for the dissertation. May be repeated for credit up to 45 credits. Graded on a Pass/Unsatisfactory basis. *(Fall, Spring, Summer)*

ATTACHMENT 4. CROSS-LISTING CONSULTATION

Electrical Engineering Cross-List Consultation

Hi Angela:

I was running between meetings and missed your calls. Yes, this is perfectly acceptable. We will proceed with the short form to include the cross-listing.

Best
-Asis

Asis Nasipuri, Professor and Interim Chair
Electrical and Computer Engineering
EPIC 2352 | The University of North Carolina at Charlotte
9201 University City Boulevard | Charlotte, NC 28223-0001
Phone: 704-687-8418 | Cell: 704-287-6163 | Fax: 704-687-5588 | URL: www.ece.uncc.edu/~anasipur

From: angeladavies99@gmail.com [mailto:angeladavies99@gmail.com] **On Behalf Of** Angela Davies
Sent: Monday, April 20, 2015 1:34 PM
To: Nasipuri, Asis
Cc: Clayton, Mark; Boreman, Glenn
Subject: Urgent: cross-listing short form acknowledgement request

Hi Asis,

We are now putting through a long form proposal for many changes to the OSE program.

Following the voting of the Optics Faculty, we are including a request to create a formal OPTI course to cross-list with the ECGR course we have been cross-listing with recently. The course is

ECGR 5192 Solid State Microelectronic Devices

For a cross-list, the catalog description for both the new OPTI course and the existing ECGR course need to indicate the cross list. Your department needs to put through a short form proposal to request the catalog change on your side for the ECGR course.

We have drafted the short form for you. See attached.

In order for the OSE program changes to move through, the Graduate Council would like **an email response from you indicating that you are**

i) aware of the need to change the catalog description for the above listed ECGR course and

ii) you are beginning this short-form process.

It would help if you could respond right away - we need to get your email response to the Graduate Council as soon as possible.

Thanks so much.

Angela

--
Angela D. Davies | Professor
Director, Optical Science and Engineering Graduate Program
UNC Charlotte | Department of Physics and Optical Science
235 Grigg Hall
9201 University City Blvd. | Charlotte, NC 28223-0001
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Mechanical Engineering Cross-List Consultation

i) I am aware of the need to change the catalog
ii) with this email I am asking Tony to start the short form process

Scott

Sent from my iPhone

On Apr 20, 2015, at 1:33 PM, Angela Davies <adavies@uncc.edu> wrote:

Hi Scott,

We are now putting through a long form proposal for many changes to the OSE program.

Following the voting of the Optics Faculty, we are including a request to create formal OPTI courses to cross-list with the MEGR courses we have been cross-listing with recently. The courses are

MEGR 6/8181 Engineering Metrology and
MEGR 7/8284 Advanced Surface Metrology

For a cross-list, the catalog descriptions for both the new OPTI course and the existing MEGR course need to indicate the cross list. Your department will have to put through a short form proposal to request the catalog change on your side for the MEGR courses.

We have drafted the short form for you. See attached.

In order for the OSE program changes to move through, the Graduate Council would like **an email response from you indicating that you are**

i) aware of the need to change the catalog descriptions for the above listed MEGR courses and

ii) you are beginning this short-form process.

It would help if you could respond right away - we need to get your email response to the Graduate Council as soon as possible.

Thanks so much.

Angela

--
Angela D. Davies | Professor
Director, Optical Science and Engineering Graduate Program
UNC Charlotte | Department of Physics and Optical Science
235 Grigg Hall

9201 University City Blvd. | Charlotte, NC 28223-0001

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Applied Physics Cross-List Consultation

Yes
I am aware of these changes and am fully supportive
Glenn Boreman
Chair, Phys & Opt Sci

Sent from my iPhone

On Apr 20, 2015, at 1:42 PM, "Angela Davies" <adavies@uncc.edu> wrote:

Hi Glenn,

We are now putting through a long form proposal for many changes to the OSE program.

Following the voting of the Optics Faculty, we are including a request to create formal OPTI courses to cross-list with the PHYS courses we have been cross-listing with recently. The courses are

PHYS 4/5271 Waves and Optics,
PHYS 6141 Quantum Theory I, and
PHYS 6271 Advanced Solid State Physics

For a cross-list, the catalog descriptions for both the new OPTI course and the existing PHYS course need to indicate the cross list. The Physics Department will have to put through a short form proposal to request the catalog change on the physics side for the PHYS courses.

We have drafted the short form for the Physics Department. See attached.

In order for the OSE program changes to move through, the Graduate Council would like **an email response from you indicating that you are**

i) aware of the need to change the catalog descriptions for the above listed PHYS courses and

ii) you are beginning this short-form process.

It would help if you could respond right away - we need to get your email response to the Graduate Council as soon as possible.

Thanks so much.

Angela

--
Angela D. Davies | Professor
Director, Optical Science and Engineering Graduate Program
UNC Charlotte | Department of Physics and Optical Science
235 Grigg Hall

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Nanoscale Science Cross-List Consultation

Hi Angela,
I am writing to confirm that I am aware of the change to the catalog descriptions for NANO 8101, 8102, and 8203, and I am beginning the short form process.

Please let me know if you need anything else.

Good luck with your proposal!

Best wishes.
Bernadette

Sent from my iPhone

On Apr 20, 2015, at 1:34 PM, Angela Davies <adavies@uncc.edu> wrote:

Hi Bernadette,

We are now putting through a long form proposal for many changes to the OSE program.

Following the voting of the Optics Faculty, we are including a request to create formal OPTI courses to cross-list with the NANO courses we have been cross-listing with recently. The courses are

NANO 8101 Introduction to Instrumentation and Processing at the Nanoscale, NANO 8102 Nanoscale Phenomena, and
NANO 8203 Collaborative Research Proposal

For a cross-list, the catalog descriptions for both the new OPTI course and the existing NANO course need to indicate the cross list. Your department will have to put through a short form proposal to request the catalog change on your side for the NANO courses.

We have drafted the short form for you. See attached.

In order for the OSE program changes to move through, the Graduate Council would like **an email response from you indicating that you are**

i) aware of the need to change the catalog descriptions for the above listed NANO courses and

ii) you are beginning this short-form process.

It would help if you could respond right away - we need to get your email response to the Graduate Council as soon as possible.

Thanks so much.

Angela

--
Angela D. Davies | Professor
Director, Optical Science and Engineering Graduate Program
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9201 University City Blvd. | Charlotte, NC 28223-0001
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