



Undergraduate Handbook

Fall 2018

Introduction

This handbook provides a summary of information taken from various University of Rochester publications. Also, it includes program-specific details that are of importance to Optics students. This manual contains information regarding changes to the Optics curriculum and should be read carefully and in its entirety. Policies and procedures that apply to the entire university student body take precedence over the policies and procedures contained in this handbook.

This handbook is updated to reflect the curriculum changes that are effective as of Fall 2018. Students will follow the curriculum that was in effect at the time when the major or minor was declared.

Requirements for Admission to The Institute of Optics

Students normally apply for admission to The Institute of Optics during the second semester of their sophomore year. The entrance criteria for the B.S. Degree in Optics and the B.S. degree in Optical Engineering are the same.

To be formally admitted to the major, students will need to satisfy **ALL** of the following requirements. Students must:

1. Have an overall grade point average (GPA) of at least 2.0 (C) and not be on probation.
2. Have an average GPA of at least 2.0 (C) in PHY 121(P)/122(P)/123 *or* PHY 141/142/143 (or in comparable courses taken elsewhere). PHY 113 is an acceptable substitute for PHY121.
3. Have an average GPA of at least 2.0 (C) in MTH 161/162/164 *or* MTH 141/142/143/164 (or in comparable courses taken elsewhere).
4. Have an average GPA of at least 2.0 (C) for all sophomore-level Optics core courses (OPT 241, OPT 201, OPT 261, OPT 202, and OPT 287), with **NO** grade below a C- for any course and no more than **ONE** grade of C- in any of these five courses.
5. Have a grade of C or better in WRT 105 (Reason and Writing in The College) or an authorized equivalent.

Students who have not satisfied all of these requirements may be conditionally admitted at the Undergraduate Committee's discretion. **Students who use the S/F option for any of the above courses will need to have their grades uncovered prior to being admitted.**

Students need to declare their major at: <https://secure1.rochester.edu/registrar/applications/major-minor-declaration.php>

Requirements for Graduation

130 credit hours are required for both degrees with a cumulative GPA of 2.0 or greater in all Optics courses taken at the Institute and an overall GPA of 2.0 or greater is required.

In addition, the following requirements must be satisfied:

1. **Successful completion** of WRT 105 (Reason and Writing in The College) or an authorized equivalent.
2. **One cluster**, with a GPA of 2.0 or better, in either the humanities division or the social sciences division. *A minor in either division, in most cases, satisfies this requirement.*
3. **One course** aka "Plus One" in the division *not* chosen for the cluster. This is required even if a student declares a minor.
4. **Successful completion** of the MTH 161/162/164/165 sequence. An alternative approved sequence is MTH 171/172/173/174 (if considered eligible by the Department of Mathematics). Students may also complete a third calculus sequence: MTH 141/142/143/164/165. *Note: MTH 171/172/173/164 will also satisfy the Optics math sequence.*
5. **One semester** of introductory chemistry for science majors, including the associated lab component; this requirement is commonly satisfied with CHM 137 or CHM 131 (with permission, can also be satisfied with BIO 110 or AP credit).
6. **Successful completion** of PHY 121/122/123 or PHY 141/142. *Note: PHY 121P/122P also satisfies the PHY 121/122 requirement.*
7. **Successful completion** of the following Optics core classes:
 - OPT 201 Geometrical Optics Lab
 - OPT 202 Physical Optics Lab
 - OPT 203 Instrumentation Lab
 - OPT 204 Sources and Detectors Lab
 - OPT 211 MATLAB
 - OPT 212 MATLAB
 - OPT 223 Quantum Theory of Optics Optical
 - OPT 225 Sources and Detectors
 - OPT 241 Geometrical Optics
 - OPT 242 Aberrations and Testing
 - OPT 261 Interference & Diffraction
 - OPT 262 Electromagnetic Theory
 - OPT 287 Math Methods for Optics & Physics

- OPT 310 Senior Design I (Optical Engineering Majors Only)
- OPT 311 Senior Design II (Optical Engineering Majors Only)
- OPT 320 Senior Thesis I (Optics Majors Only)
- OPT 321 Senior Thesis II (Optics Majors Only)

8. **Demonstrated competency** in the design and implementation of simple analog and digital electronic circuits. Most students satisfy this requirement with ECE 210 (Circuits for Engineers). *Note: Completion of ECE 111 and ECE 113 may also satisfy the circuits requirement.*
9. **Three technical electives** (see Appendix 1). These are four credit courses, but two-credit courses combined MAY satisfy a technical elective requirement. *Note: See your academic adviser for more information or clarification.*
10. **Complete** OPT WRT 273 (Communicating your Professional Identity).
11. **Satisfactory/Fail option:** Courses with a grade of "S" may **not** be used in the major, minor, or cluster requirements. In other words, a student may choose to S/F any course, but after doing so that course may no longer be used toward major, minor, or cluster requirements unless that grade is uncovered.

See Appendix 2 for a full listing of the required courses along with suggested course sequencing. Both Optics and Optical Engineering majors will complete the same core courses in their first three years. During their final year, Optics majors will complete a senior thesis (OPT 320/321) while Optical Engineering majors will complete a senior design project (OPT 310/311).

Overlap Policy

For students who are seeking multiple majors, the following degree overlap policies should be kept in mind:

- A. No more than **three** courses may overlap between any two majors.
- B. No more than **two** courses may overlap between a major and a minor.

For more information regarding course overlaps, consult with your adviser.

Advising on Course Selection

Program planning begins during First-year Orientation and continues throughout a student's academic career at The University of Rochester. Each entering student is assigned an academic adviser who helps with program planning and course scheduling during the undergraduate years.

Failure of an Optics or Core Course

A student will be allowed to repeat any given Optics course **only once**. Students who are attempting to progress to the next Optics course without satisfying course pre-requisites must obtain permission from the course instructor.

In addition, following a core course failure, the failed core course cannot be transferred from another institution without the written express permission of the Undergraduate Committee Chair prior to the student taking the course. Students seeking to transfer (or substitute) an Optics degree requirement from another institution must complete a course approval form. Approved courses that are completed with a grade of C or better will transfer.

Clusters

Students must complete the foundation/distribution requirements in the humanities or social sciences by taking the appropriate divisional cluster. Students may also complete a minor or additional major in the humanities or the social sciences *in lieu of a cluster*.

In addition, one course is required from the division not chosen for the cluster. This is commonly known as the “plus one” requirement; see Undergraduate Program [Coordinator](#) for further details.

As of Fall 2016, Hajim students will be allowed to do a second (optional) cluster if they so desire. A maximum of two clusters will appear on a student’s transcript. For more information on the policy, see the Undergraduate Program Coordinator.

Definition of Senior Thesis (For BS in Optics Degree)

The senior thesis is a scholarly project that includes background analysis of a topic and an element of original research. The thesis can be Optics-specific (experimental and/or theoretical), or it may be cross-disciplinary (ex. a historical or philosophical analysis of Optics, a pedagogical activity, or an investigation that intersects with other science or engineering disciplines).

The activities may have begun prior to the senior year (as part of employment or scholarly activity in a research group), but will be significantly enriched in breadth and depth as part of the senior thesis. OPT 320 focuses on background research, formulating the question, assembling a bibliography, and establishing a research plan. OPT 321 focuses on completing the research and writing.

Because writing a thesis involves incorporating advisers' comments along the way, students should be in close contact with both their thesis adviser and their OPT 320/321 instructor during their senior year, so that they may carefully consider and integrate their suggestions. Theses will be presented in a public format prior to graduation, typically around the time of Senior Design Day.

Optics Courses and Pre-requisites

The following table includes the pre-requisites (where applicable) for all Optics courses. Before enrolling in any Optics course, students *must have successfully completed all of the designated pre-requisites*. These requirements are to ensure that students are well-prepared to succeed in *all* of their courses, as well as to stay on track with their graduation plan.

Please take note: Students who try to circumvent the pre-requisite policy independently (i.e. without their adviser's knowledge) are considered to be in violation of the honor code, and are subject to the consequences of academic dishonesty.

COURSE ID	PRE-REQUISITES
CORE COURSES	
OPT 101	None
OPT 211	None
OPT 212	OPT 211
OPT 241	MTH 161, MTH 162, PHY 121 (or MTH 141/142/143 and PHY 113)
OPT 201	None
OPT 287	MTH 164 (can be taken concurrently w/ instructor permission)
OPT 261	MTH 164 (can be taken concurrently w/ instructor permission), PHY 122/142
OPT 202	OPT 201 (or instructor permission)
OPT 262	MTH 164, MTH 165 (can be taken concurrently w/ instructor permission), PHY 122/142
OPT 242	OPT 241, OPT 261
OPT 203	OPT 202 (or instructor permission)
OPT 225	PHY 123, OPT 241, OPT 261
OPT 204	OPT 203 (or instructor permission)
OPT 223	PHY 123/143
OPT 310/320	Optics senior standing
OPT 311/321	Optics senior standing

NON-CORE COURSES W/ PRE-REQS	
OPT 243	Optics sophomore standing
OPT 244	OPT 241, OPT 242
OPT 245	Senior standing
OPT 246	OPT 262
OPT 247	OPT 246 (or instructor permission)

Technical Electives [Themes]

Technical electives are directly related to goals that are discussed with the student's academic advisor. The electives are to enhance learning of the Optical field students may want to work in the future. A minimum of three technical electives are required (12 credits total). It is the student's responsibility to check semester schedules to know when or if a course will be offered and to check the course descriptions for pre-requisites. See Appendix 1 for a listing of approved technical electives and *suggested* themes. Students may also choose 200-level STEM courses not listed in Appendix 1 as technical electives. All planned electives must be pre-approved by the student's academic advisor before the student registers for the course.

Study Abroad

The Institute of Optics highly encourages its students to take advantage of the University's study abroad program. The study abroad option is available for juniors, first-semester seniors, and select sophomores. Students interested in study abroad should consult with their adviser in order to fully understand the options for, and the implications of, studying abroad. For further information, consult the Optics study abroad guide.

Information for Transfer Students

Students who transfer into the Optics major as a junior either from another major within the University of Rochester, or from another college or university sometimes find it difficult to complete the Optics degree requirements in only two additional years. **In practice, most students in this position take three years to complete the major.** The best course of action for any student depends on the details of the student's educational background and should be discussed with the Undergraduate Program Coordinator and/or the student's academic adviser.

The Optics Minor

Students interested in completing a minor in Optics should meet with a faculty member of the Institute to plan a focused program of study. Optical sciences and technologies have great importance in a range of fields and applications, and a strong grasp of the field is a desirable option, particularly for majors in other science and engineering disciplines.

The requirements for a minor in Optics are satisfied by earning grades of C or better in five Optics courses, *one of which must be laboratory-based*. Two courses are required: OPT 241 and OPT 261. The lab component may be satisfied by OPT 201, 202, 203, or 204, or by independent research for credit. The remaining two courses can be chosen any four-credit courses offered by the Institute at the 200-level or above (with the exception of OPT 287). **Note:** Paid internships do not qualify as independent research.

Students interested in the Optics minor should note that most 200-level Optics classes have *pre-requisites in math and/or physics that must also be satisfied*, unless permission of the instructor is obtained.

Add/Drop

Important note: *Lattimore staff will not process Drop/Add forms that are not signed by an adviser and stamped by the Undergraduate Program Coordinator, Wilmot 106.*

Changes can be made online in the student's program beginning shortly after registration and through the **second** week of the semester. Beginning with the third week of the semester, Drop/Add forms, available at the Academic Services Counter (Lattimore 312), must be used. For students in the Hajim School of Engineering and Applied Sciences, courses may be dropped through the fourth week of classes by notifying the instructor (although the instructor's permission is not required) and obtaining the academic adviser's signature, the Undergraduate Program Manager's stamp, and the Associate Dean's (or a surrogate's) signature. Courses dropped before the end of the fourth week of the semester *will be deleted from the transcript and the advising record.*

From the fifth through the eleventh week of classes, Hajim School students may withdraw from a course by using a paper Drop/Add form and following the above procedure. *Course withdrawals will appear on the advising record with a grade of "W."*

Students wishing to carry fewer than fourteen credits (underload) must meet with an adviser in the Dean's Office (Lattimore 301). Full-time students who drop below twelve credits will be sent a warning letter at the end of the semester. **International students who wish to drop below twelve credits are not permitted to do so due to visa implications.**

Students wishing to carry more than nineteen credits (overload) must have earned at least a 3.0 in the previous semester. For a credit load of twenty-four credits and over, a previous semester GPA of at least 3.4 is required. All requests to carry twenty-four credits or higher must be approved by the College Administrative Committee.

Repeating Courses

Students will not be permitted to repeat a course unless the grade earned was below a C.

Departmental Awards

To be considered eligible for departmental awards, **students must complete the academic honesty record waiver form found in Appendix 5** and return it to Dustin Newman in Wilmot 106.

Academic Honesty

Optics students are to be held accountable to the same academic honesty policies and procedures that are applicable University-wide. **The enforcement of the honor code is very strict, and students found to be in violation WILL face penalties. It is the responsibility of every student to thoroughly read, understand, and to adhere to the academic honesty**

policies of the University. Please see the Undergraduate Program Coordinator for any clarification or questions.

The full policy, as of Fall 2015, can be accessed here:
<https://www.rochester.edu/college/honesty/undergraduates.html>

Exceptional Circumstances

Occasionally, scheduling conflicts or program changes prohibit a student from completing an intended cluster, or a student is unable to complete the requirements for the degree as laid out in the University Bulletin. Extenuating circumstances may merit waiving certain requirements or reviewing alternatives that will enable the student to obtain a degree.

If such circumstances are presented via petition, they will be considered on a case-by-case basis. The Undergraduate Committee of the Institute of Optics reviews petitions pertaining to the major and departmental requirements. The Administrative Committee of the College reviews petitions relating to College requirements. Petition forms are available from the Undergraduate Program Coordinator or on page twelve of this handbook.

Undergraduate Committee

The Undergraduate Committee is responsible for Optics curriculum content and the policies and procedures found in this handbook. The Undergraduate Committee meets approximately once per month during the academic year and is made up of the professors listed below:

Prof. Andrew Berger	Goergen 405, 3-4724	andrew.berger@rochester.edu
Prof. Julie Bentley	Goergen 507, 3-1687	bentley@optics.rochester.edu
Prof. Tom Brown	Goergen 517, 5-7816	brown@optics.rochester.edu
Prof. Wayne Knox	Goergen 507, 3-5520	wknox@optics.rochester.edu
Per Adamson	Wilmot 533, 5-7762	adamson@optics.rochester.edu

The primary administrative point of contact for committee matters (e.g. petitions) is the Undergraduate Program Coordinator:

Dustin Newman	Wilmot 106, 5-7764	dustin.newman@rochester.edu
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Appendix 1: Optics Technical Electives

Three technical electives are required. *Suggested* technical elective themes are listed in blue in the first row of the table below. **The combinations listed below are not a mandatory sequence of technical electives; they serve as a starting point for students considering technical elective combinations.** Classes in **green** are Optics core courses that pair up nicely with suggested electives. Choose classes in the vertical column below the technical elective theme you wish to explore or consult your adviser for additional class themes and/or combinations.

Biomedical Optics	Optics + Math	Lens Design	Photonic Materials/ Devices	Optics & Physics	Lab Special	Lasers and Photonics	Optomechanics
OPT 241	OPT 287	OPT 241	OPT 225	OPT 223	OPT 204	OPT 225	OPT 242
OPT 248	MTH 2XX	OPT 243	ME 280	PHY 235	OPT 253	ECE 235	ME 226
OPT 276	MTH 2XX	OPT 244	OPT 421*	PHY 227	OPT 257	OPT 465*	OPT 232
PHY 253	MTH 2XX	OPT 246	ECE 235	PHY 246	PHY 243W	OPT 468*	OPT 432*
BME 270		OPT 247	OPT 468*				
		OPT 444*					

Any four credit 200-level STEM course may be counted as a technical elective with faculty adviser approval. This approval must be documented via email or on the semester course planning form.

*For students pursuing graduate studies at The Institute, these courses cannot count for both the Bachelor's and Master's degrees in Optics

<u>Class</u>	<u>Title</u>
OPT 232	Opto-Mechanics
OPT 243	Optical Fabrication and Testing
OPT 244	Lens Design
OPT 246	Thin Film Coatings
OPT 247	Advanced Optical Coatings
OPT 248	Vision and the Eye
OPT 253	Quantum Optics Lab
OPT 257	Advanced Senior Laboratory
OPT 276	Biomedical Optics
OPT 421	Optical Properties of Materials
OPT 432	Intro to Optomechanics
OPT 444	Lens Design
OPT 465	Laser Systems
OPT 468	Waveguide Optoelectronic Devices
BME 270	Biomedical Microscopy
ECE 235	Intro to Optoelectronics
ME 226	Intro to Solid Mechanics
ME 280	Intro to Material Science
MTH 2XX	Any upper division math course
PHY 227	Thermo and Stat Mechanics
PHY 235	Advanced Classical Mechanics
PHY 243W	Advanced Lab Topics
PHY 246	Quantum Theory
PHY 253	Biological Physics

Optics Foundation (required for major) Courses at a Glance
Class of 2019 and beyond

CHM 131/137*	Chemistry for Engineers
OPT 211	MATLAB for Optics Majors I (2 cr.)
OPT 211	MATLAB for Optics Majors II (2 cr.)
ECE 210**	Circuits for Scientists and Engineers
MTH 161	Calculus IA
MTH 162	Calculus IIA
MTH 164	Multidimensional Calculus
MTH 165	Linear Algebra with Differential Equations
OPT 201	Geometrical Optics Laboratory (2 cr.)
OPT 202	Physical Optics Laboratory (2 cr.)
OPT 203	Instrumentation & Testing Laboratory (2 cr.)
OPT 204	Sources and Detectors Lab (2 cr.)
OPT 223	Quantum Theory of Optics
OPT 225	Optical Sources and Detectors
OPT 241	Geometrical Optics
OPT 242	Aberrations, Interferometers, and Testing
OPT 261	Interference and Diffraction
OPT 262	Electromagnetic Theory
OPT 287	Mathematical Methods for Optics and Physics
OPT 310/311	Senior Design I/II (Optical Engineering majors only)
OPT 320/321	Senior Thesis I/II (Optics majors only)
PHY 121/121P	Mechanics
PHY 122/122P	Electricity and Magnetism
PHY 123	Modern Physics
WRT 105	Reason & Writing in the College
WRT 273	Communicating your Professional Identity (2 cr.)

* *BIO 110 may be taken in lieu of CHM 131/137, by petition.*

** *ECE 111 and ECE 113 are a suitable substitute for ECE 210. Please see your academic adviser for more details.*

Appendix 3: Undergraduate Committee Petition Form

UNIVERSITY OF ROCHESTER
SCHOOL OF ENGINEERING AND APPLIED SCIENCES
THE INSTITUTE OF OPTICS
PETITION FOR OPTICS UNDERGRADUATE COMMITTEE

DATE: _____

NAME: _____ ID: _____

CLASS: _____ EMAIL: _____

ADVISER: _____

I ask that the Optics Undergraduate Curriculum Committee approve the following petition for the reason(s) noted below:

Applicant Signature

Faculty Advisor Signature

Date

APPROVED **DENIED** **NEED MORE INFORMATION**

Comments on reverse side if needed →

Appendix 4: Academic Honesty Release Form

I hereby waive my rights of confidentiality in my Board on Academic Honesty records and authorize the Board to report to the person or persons named below any record of violations of the College Academic Honesty Policy for which I have been found responsible.

Completion of this form is voluntary and I understand that this waiver may be revoked at any time by informing the Undergraduate Program Coordinator, Dustin Newman (Wilmot 106) that I wish to withdraw it.

*****Only students with a signed academic honesty release form on file in Wilmot 106 will be eligible for consideration for departmental awards, prizes, and other related honors.**

Print name of student: _____

Signature of student: _____

Date: _____

Board on Academic Honesty Report to be released to:

Name: Dustin R. Newman

Title: Undergraduate Program Coordinator

Department: Institute of Optics

Email: dustin.newman@rochester.edu

Phone: x5-7764

The person or persons to whom this record has been released shall maintain the confidentiality of the information consistent with applicable laws and University policies.

B.S. in OPTICAL ENGINEERING (Math 14X Track)
Sample Schedule

First-Year (~30 Credits)

<u>Fall</u>	<u>Credits</u>	<u>Spring</u>	<u>Credits</u>
MTH 141 (Calculus I)	4	MTH 142 (Calculus II)	4
CHM 137 (Chemistry for Engineers)	4	PHY 113 (Mechanics)	4
WRT 105* or Cluster Course #1	4	WRT 105* or Cluster Course #1	4
OPT 101 (Recommended)	4	OPT 211 (MATLAB for Optics Majors I)	2
Total Credits	16	Total Credits**	14

*Students not enrolled in WRT 105 in the fall should take cluster course #1. Students enrolled in WRT 105 in fall should take cluster course #1 in the spring.

**Note: Student may elect to take 16 credits during freshman spring semester (16 credit minimum is required to be eligible for Dean's List)

Summer Between First and Second Year (4 Credits)

<u>Summer</u>	<u>Credits</u>
MTH 143 (Calculus III)	4
Total Credits	4

Sophomore Year (~36 Credits)

<u>Fall</u>	<u>Credits</u>	<u>Spring</u>	<u>Credits</u>
OPT 241 (Geometrical Optics)	4	OPT 261 (Interference and Diffraction)	4
OPT 201 (Geometrical Optics Lab)	2	OPT 202 (Physical Optics Lab)	2
MTH 164 (Multidimensional Calculus)	4	OPT 287 (Math Methods for Optics and Physics)	4
PHY 122/122P (Electricity and Magnetism)	4	PHY 123 (Waves and Modern Physics)	4
Choose from: Cluster/Tech/Free/Plus One	4	Choose from: Cluster/Tech/Free/Plus One	4
Total Credits	18	Total Credits	18

Junior Year (~32 Credits)

<u>Fall</u>	<u>Credits</u>	<u>Spring</u>	<u>Credits</u>
OPT 242 (Aberrations and Testing)	4	OPT 225 (Sources/Detectors)	4
OPT 203 (Aberrations and Testing Lab)	2	OPT 204 (Sources/Detectors Lab)	2
OPT 262 (Electromagnetic Theory)	4	ECE 210** (Circuits for Engineers)	4
MTH 165 (Linear Algebra w/ Diff. Equations)	4	WRT 273 (Communicating your Prof. Identity)	2
OPT 212 (MATLAB for Optics Majors II)	2	OPT 223 (Quantum Theory)	4
Total Credits	16	Total Credits	16

Senior Year (~28 Credits)

<u>Fall</u>	<u>Credits</u>	<u>Spring</u>	<u>Credits</u>
OPT 310 (Senior Design I)	4	OPT 311 (Senior Design II)	4
Choose from: Cluster/Tech/Free/Plus One	4	Choose from: Cluster/Tech/Free/Plus One	4
Choose from: Cluster/Tech/Free/Plus One	4	Choose from: Cluster/Tech/Free/Plus One	4
Choose from: Cluster/Tech/Free/Plus One	4	Choose from: Cluster/Tech/Free/Plus One	4
Total Credits	16	Total Credits	16

Optics and Optical Engineering Degrees consist of a minimum of **130** Total Credits Distributed as Follows:

Five Math Courses	20	Nine Optics Core Classes	36
Three Physics Courses	12	Four Optics Labs	8
One Chemistry Course	4	Three Technical Electives	12
Two Writing Courses	6	Three Cluster Courses (Choose a cluster from humanities or social sciences)	12
**One Circuits Course (ECE 210 preferred, ECE 111 <u>and</u> ECE 113 suitable substitutes)	4	A single course either humanities or social science depending on cluster	4
Two MATLAB Courses	4	Two Free Electives (can be either technical or non-technical courses)	8

Note: Students who take OPT 101 only need to take ONE free elective

For Additional Information Contact:
Dustin Newman, Optics Undergrad Program Mgr
dustin.newman@rochester.edu

B.S. in OPTICAL ENGINEERING (Math 16X Track)
Sample Schedule

First-Year (~30 Credits)

<u>Fall</u>	<u>Credits</u>	<u>Spring</u>	<u>Credits</u>
MTH 161 (Calculus I)	4	MTH 162 (Calculus II)	4
CHM 137 (Chemistry for Engineers)	4	PHY 121 (Mechanics)	4
WRT 105* or Cluster Course #1	4	WRT 105* or Cluster Course #1	4
OPT 101 (Recommended)	4	OPT 211 (MATLAB for Optics Majors I)	2
Total Credits	16	Total Credits**	14

*Students not enrolled in WRT 105 in the fall should take cluster course #1. Students enrolled in WRT 105 in fall should take cluster course #1 in the spring.

**Note: Student may elect to take 16 credits during freshman spring semester (16 credit minimum is required to be eligible for Dean's List)

Sophomore Year (~36 Credits)

<u>Fall</u>	<u>Credits</u>	<u>Spring</u>	<u>Credits</u>
OPT 241 (Geometrical Optics)	4	OPT 261 (Interference and Diffraction)	4
OPT 201 (Geometrical Optics Lab)	2	OPT 202 (Physical Optics Lab)	2
MTH 164 (Multidimensional Calculus)	4	OPT 287 (Math Methods for Optics and Physics)	4
PHY 122/122P (Electricity and Magnetism)	4	PHY 123 (Waves and Modern Physics)	4
Choose from: Cluster/Tech/Free/Plus One	4	Choose from: Cluster/Tech/Free/Plus One	4
Total Credits	18	Total Credits	18

Junior Year (~32 Credits)

<u>Fall</u>	<u>Credits</u>	<u>Spring</u>	<u>Credits</u>
OPT 242 (Aberrations and Testing)	4	OPT 225 (Sources/Detectors)	4
OPT 203 (Aberrations and Testing Lab)	2	OPT 204 (Sources/Detectors Lab)	2
OPT 262 (Electromagnetic Theory)	4	ECE 210** (Circuits for Engineers)	4
MTH 165 (Linear Algebra w/ Diff. Equations)	4	WRT 273 (Communicating your Prof. Identity)	2
OPT 212 (MATLAB for Optics Majors II)	2	OPT 223 (Quantum Theory)	4
Total Credits	16	Total Credits	16

Senior Year (~32 Credits)

<u>Fall</u>	<u>Credits</u>	<u>Spring</u>	<u>Credits</u>
OPT 310 (Senior Design I)	4	OPT 311 (Senior Design II)	4
Choose from: Cluster/Tech/Free/Plus One	4	OPT 223 (Quantum Theory)	4
Choose from: Cluster/Tech/Free/Plus One	4	Choose from: Cluster/Tech/Free/Plus One	4
Choose from: Cluster/Tech/Free/Plus One	4	Choose from: Cluster/Tech/Free/Plus One	4
Total Credits	16	Total Credits	16

Optics and Optical Engineering Degrees Consist of a minimum of **130** Total Credits Distributed as Follows:

Four Math Courses	16	Nine Optics Core Classes	36
Three Physics Courses	12	Four Optics Labs	8
One Chemistry Course	4	Three Technical Electives	12
Two Writing Courses	6	Three Cluster Courses (Choose a cluster from humanities or social sciences)	12
**One Circuits Course (ECE 210 preferred, ECE 111 <u>and</u> ECE 113 suitable substitutes)	4	A single course either humanities or social science depending on cluster	4
Two MATLAB Courses	4	Three Free Electives (can be either technical or non-technical courses)	12

Note: Students who take OPT 101 only need to take TWO free electives