

OPTI 600E: Diffractive Optical Elements – Fabrication and Testing

Effective Fall Semester 2016

Course Description:

This course is a hands-on fabrication and testing course in which students will learn characteristics of fabricating and testing different types of computer-generated diffractive optical elements (DOEs). Elements include binary amplitude, binary phase and gray-scale phase structures. Gratings, diffractive Fresnel lenses (DFLs) and computer-generated holograms (CGHs) will be fabricated. The primary fabrication tool will be the College of Optical Sciences Maskless Lithography Tool (MLT) and Holoeye LCOS spatial light modulators. Design techniques using Zemax ray-tracing software and an open-source Matlab program called OptiScan learned in OPTI600D will be used. On-campus students will work in pairs with a third off-campus team member, if available.

This 2016 Fall Semester class is a bit of an experiment for participating distance students. As mentioned above, each distance student will work with a pair of on-campus students. During the semester, the distance student will participate in viewing the recitation sections, reading and understanding background material and writing portions of the lab report. The division of labor is TBD for the lab report, but it is likely that the distance student will write a significant portion of the background material and help with data analysis and conclusions. Each team will co-write the required four lab reports, as explained below. At the end of the semester, the on-campus students will also develop and execute their independent projects and write the corresponding reports. Distance students are required to be on campus for one week, as described below, to complete one of the 12 listed labs and their independent lab. They can choose any of the 12 labs, whether or not their team reported on it during the semester, or not. Grades for distance students are calculated differently than for on-campus students, as shown below.

Disclaimer for Distance Students: Travel to campus will be required at the end of the semester during week 15 or 16 or between December 12th – 16th. Please coordinate travel plans with the instructor and the TA so that labs can be prepared. Travel costs will be the responsibility of the student.

Pre-requisites:

OPTI 505R and/or previous OPTI 600D Diffractive Optical Elements – Theory and Design class, access to a computer with Matlab

Number of Units/ component:

1 Unit – Limited to 16 on-campus students and 1 distance student per 2 on campus students.

Locations and Times:

Location: Lab 753. Times TBA – Semester-length lab class. Each session should last about 3 hours, but extra time could be arranged at the end of the semester for the Independent Project Lab and for distance student end of semester labs.

Instructor Information:

Prof. Tom D. Milster
Office 729, Optical Sciences
520-621-8280
milster@optics.arizona.edu
Office hours: MWF 1-2pm.

Expected Learning Outcomes:

- Practical understanding of technology used to fabricate DOEs.
- Practical understanding of technology used to test DOEs.
- Experience fabricating and testing various types of DOEs.
- Experience designing and implementing diffractive structures on an LCOS spatial light modulator.

Required Texts:

Course notes will be available on D2L and the MLT website. Please download the lab handout from D2L several days before your lab session, study the background material, and preform any preliminary calculations. The instructor will answer questions during office hours and at other times by appointment. There will be a lab recitation on Friday at 10 AM in room 305 each week to discuss the upcoming lab. This recitation will be videotaped for distance students.

Number of Exams and Papers:

For on-campus students, course grade is determined from 4 Short Lab Team Reports and one Independent Project Lab Report. For the first 4 team reports, students will choose 4 out of 12 lab topics examined during the regular lab sessions 1-12. The final two weeks of the semester will be used for the Independent Project Lab, where students will work on a project of their choice from the topics presented in the course.

For distance students, course grade is determined from 4 Short Lab Team Reports, one additional lab report, and one Independent Project Lab Report. For the first 4 team reports, students will choose 4 out of 12 lab topics examined during the regular lab sessions 1-12. During the on-campus week, the distance student will complete one of the 12 listed labs and one Independent Project Lab.

Course Policies:

Grading Policy (on-campus)

Short Lab Team Reports	80% (20% Each)
Independent Project Lab Report	20%
Total	100%

Grading Policy (distance)

Short Lab Team Reports	60% (15% Each)
Addition lab report (1 of 12)	20%
Independent Project Lab Report	20%
Total	100%

The grade will be determined according to the cumulative percentage earned such that 85-100% = A, 70-84% = B, 60-69% = C, 50-59% = D, below 50% = E.

Rubric for grading short lab reports: (on-campus/distance)

(4/4)pts – Detailed design description

(4/3)pts – Description of fabrication process (Note, if fabrication processes are similar to previously submitted reports, you can reference those reports to save space.)

(4/2)pts – Explanation of testing procedures (Note, if testing procedures are similar to previously submitted reports, you can reference those reports to save space.)

(4/2)pts – Presentation of testing data

(4/4)pts – Comparisons of test results to theoretical predications and explanations of discrepancies.

NOTE: Labs are done in lab groups of 2-3 students, preferably with 2 on campus students and 1 distance student. Distance students will be expected to assist their group with design, data analysis and report writing. Distance students will complete 1 lab and work on their final project during their designated visiting time. Reports are submitted on D2L. Length is 5 pages maximum. Follow the format of a journal manuscript with single-spaced lines and a single column. Be sure to put the lab number and group member names in the file name. Only one copy of the report needs to be submitted. Choose one member of your group to submit the reports. The Independent Project Lab Report follows the same format as the Short Lab Reports.

- The first two Short Lab Reports are due by 5pm on **October 17**.
- The second two Short Lab Reports are due by 5pm on **November 24**.
- The Independent Project Lab Report is due by 5pm on **December 7**.

PRELIMINARY SCHEDULE

Week 1: 22 August
No Labs.

Week 2: 29 August
Lab 1: Grating Fabrication and Testing I – Binary amplitude

Week 3: 5 September
Lab 2: Grating Fabrication and Testing II – Binary phase

Week 4: 12 September
Lab 3: Grating Fabrication and Testing III - Gray-scale phase

Week 5: 19 September
Lab 4: Grating Fabrication and Testing IV – LCOS SLM

Week 6: 26 September
Lab 5: FZP Fabrication and Testing I – Binary amplitude

Week 7: 3 October
Lab 6: FZP Fabrication and Testing II – Binary phase

Week 8: 10 October
Lab 7: FZP Fabrication and Testing III - Gray-scale phase

Week 9: 17 October
Lab 8: FZP Fabrication and Testing IV – LCOS SLM

Week 10: 24 October
Lab 9: Other Diffractive Optical Elements

Week 11: 31 November
Lab 10: CGH Fabrication and Testing I – Binary phase

Week 12: 7 November
Lab 11: CGH Fabrication and Testing II – Gray-scale phase

Week 13: 14 November
Lab 12: CGH Fabrication and Testing III – LCOS SLM

Week 14: 21 November
Independent Project Lab

Week 15: 28 November
Independent Project Lab

Week 16: 5 December
Independent Project Lab (through 12/9)

Academic Integrity (<http://web.arizona.edu/~studpubs/policies/cacaint.htm>)

According to the Arizona Code of Academic Integrity, “Integrity is expected of every student in all academic work. The guiding principle of academic integrity is that a student’s submitted work must be the student’s own.” Unless otherwise noted by the instructor, work for all assignments in this course must be conducted independently by each student. Co-authored work of any kind is unacceptable. Misappropriation of exams before or after they are given will be considered academics misconduct.

Misconduct of any kind will be prosecuted and may result in any or all of the following:

- Reduction of grade
- Failing grade
- Referral to the Dean of Students for consideration of additional penalty, i.e. notation on a student's transcript re. academic integrity violation, etc.

Attendance Policy

It is important to attend all classes, as what is discussed in class is pertinent to adequate performance on assignments and exams. If you must be absent, it is your responsibility to obtain and review the information you missed. This is especially important in this course where a substantial amount of course material will emerge through class discussion.

"All holidays or special events observed by organized religions will be honored for those students who show affiliation with that particular religion. Absences pre-approved by the UA Dean of Students (or Dean's designee) will be honored."

Classroom Behavior

The Arizona Board of Regents' Student Code of Conduct, ABOR Policy 5-308, prohibits threats of physical harm to any member of the University community, including to one's self.

See: <http://policy.web.arizona.edu/threatening-behavior-students>.

Students with a Learning Disability

If a student is registered with the Disability Resource Center, he/she must submit appropriate documentation to the instructor if he/she is requesting reasonable accommodations. (<http://drc.arizona.edu/instructor/syllabus-statement.shtml>).

The information contained in this syllabus, other than the grade and absence policies, may be subject to change with reasonable advance notice, as deemed appropriate by the instructor.