

MASSACHUSETTS INSTITUTE of TECHNOLOGY
Department of Electrical Engineering and Computer Science

6.161 Modern Optics Laboratory - - Fall Term, 2005

Final Project Information

Issued Tues. 10/18/2005

Final Project, Important Dates:

One-page project proposal due Tues. 10/1/05

Projects begin date: Tues. 10/25/05 (in-lab)

Project presentation date (for staff preview only): Mon. 12/12/05

Project presentation Date (in Class): Tues. 12/13/05

Project writeup due date: Tues. 12/13/05 (turned in to 13-3102)

Lab cleanup day (required of **everyone**): Thurs. 12/15/05

Final Project General Information

The 6.161 final project is an opportunity for you to design, analyze and build an optical system of your choosing. This final Lab gives you an opportunity to explore in greater depth an area of interest in optics that you were not able to explore during the earlier portion of the term.

Below is a list of possible final projects. In addition, we have included a list of Professors willing to supervise work (within their own labs) that will be related to their group's research interests. During your final project, you will be provided the necessary lab equipment and all the technical help possible to ensure that your experience is both educational and rewarding. While we have listed some suggested final projects, you are still encouraged to find and develop your own project – just make sure you talk it over with the MOL staff for approval before writing up your proposal.

The final-project report will require a full write-up in journalistic style. It should be on the order of 15 to 20 pages in length (please, no longer... you should be able to condense any relevant prose into that space).

Projects may be conducted individually or in groups of two. Three-person groups are discouraged unless the project you choose warrants more than two people, and this is unlikely. You have until the date listed above to decide on final project and submit a 1-page proposal (one proposal per group). To find a final-project partner you may use the course collaboration page.

On the Project Presentation Day (in-class), each group will be required to give a 15 minute (maximum) presentation on their final project. This presentation along with a brief in-lab demonstration of your project may be videotaped for posterity. The final project presentation will occur either in the classroom or the MOL. Either bring your own computer if you want to use powerpoint slides or make sure to send a copy of your slides to **the Professor at least** one day in advance.

General Final Project Rules:

No equipment may be removed from the lab without the permission of the TA! Once removal has been approved, you must sign an equipment checkout form before removing the equipment from the lab. You are financially responsible for any equipment removed from the lab. Any keys issued to you must be returned before the last day of classes. Non-return of lab equipment or keys may result in a failing grade for the class.

You and your lab partner need to choose a final project by the Project Proposal Date. Be sure to have at least three photocopied journal articles or book chapters on the subject that you can show to the staff. You should form groups of 2 people. Write a 1-page proposal about your project, including a division of labor and a timeline (starting from the Project Begin Date). Expect to spend upwards of 40 hours in-lab on the final project, and many more hours outside of lab. You will also be required to attend a lab cleanup session after the last day of classes.

Possible Final Projects:

# of projects available	Project Description
2	<p>Lasers: Rebuild and characterize the CO₂ laser Mode-locked Nd:YAG laser repair and characterize Characterize all MOL laser diode samples</p>
2	<p>Light Modulation: Characterize a liquid crystal light modulation cell White light, laser, and imaging characteristics of a membrane-mirror light modulator Acousto-optic and electro-optic device characterization, SAW device characterization Photorefractive effects in Bi₁₂SiO₂₀ and BaTiO₃ Perform an analysis of the birefringent properties of sapphire</p>
3	<p>Fiber Optic Sensors and Systems: Enhanced temperature sensor Enhanced rotation sensor WDM communication (video and audio) Strain measurement sensor Acoustic pressure sensor Laser velocimeter Refractive index / liquid-level sensor</p>
2	<p>Interferometry: Speckle interferometry Free-space sagnac interferometer (rotation sensor) Thin-film optics (soap films, oil films, membranes) Laser microphone</p>
2	<p>Metrology (3D and 2D imaging): Structured light metrology Speckle metrology Fluid flows / thin film velocimetry</p>
3	<p>Holography: Reflection holograms Vander-Lugt experiment Holographic encryption Double-exposure holography Full-color hologram Holographic interconnects</p>
1	<p>Fourier-Optics: Develop and demonstrate novel compact CTLP filters and objects suitable for an in-class demo</p>

Outside-lab project supervisors:

Prof. Hank Smith – optical nanostructures

Prof. Vladimir Bulovic – organic LEDs

Prof. Rajeev Ram – diode lasers

Prof. Erich Ippen – femtosecond optics

Prof. Mark Schattenburg – nanostructures for space applications

Requirements for the Final Project Writeup

Various resources are available to help you in writing your final report. One that we recommend is the Mayfield Handbook of Technical & Scientific Writing. Staff will be grading your final report on: (1) its scientific merit; (2) organization and content; (3) scope of the project; (4) clear and accurate writing; and, (5) your level of understanding. The staff expects a well-thought-out, well-written, well-conceived report. The timeliness of its submission and your level of understanding on the subject of the report are extremely important. Some basic pointers on the final project:

1. Use words instead of equations whenever possible. This does not mean that you should write “take the integral of $g(x)$ times e to the minus j two pi f -sub- x times x with respect to x over the interval from negative infinity to positive infinity,” but rather, it would be more appropriate to use descriptions of well-known functions such as “take the spatial Fourier transform of $g(x)$.”
2. Diagrams and pictures should be simple and well labeled. There should be no question as to the content or meaning of a diagram or picture. Use pictures and diagrams to simplify your work, thereby enabling the reader to come to an easier understanding of the material.
3. Footnote or endnote your sources! If you don't, it's plagiarism. Many students don't adequately reference their sources. Many students think that the instructor will deduct points since there is little ‘original’ work. The MOL staff does not expect significant scientific breakthroughs from a 6.161 final project (however, we won't be disappointed if you do manage to revolutionize the field of optics). Don't worry... some advances in scientific knowledge and understanding come from rephrasing and reorganizing ideas presented by previous authors. Just make sure you use your own words, which are based on your own understanding, credited to the appropriate source.
4. You need to have a title page, an abstract, a table of contents, a list of tables, a table of figures, a bibliography, and the primary text. Pages should be numbered. Also, please use a roman typeface for the ease of the reader.

5. Keep any code or long, drawn-out derivations in an Appendix; don't bury the reader in equations or code!

Requirements for the Final Project Presentation

1. Use viewgraphs (overhead transparencies) or PowerPoint slides appropriately (5-8 should be adequate).
2. Use plenty of pictures (do not burden your audience with too much text on your slides).
3. Remember who your audience is!
4. Explain the theory behind your project, explain your experimental method, and explain any data or results you have gathered.
5. Explain any discrepancies between your data and theory.
6. No more than 15 minutes per group for the presentation. This will be *strictly* enforced. You may be under 15 minutes (encouraged).
7. You must arrange a time to practice the presentation beforehand in front of the TA. You should also practice your presentation on your own several times to make sure that you do not go over the specified time – and to ensure that you stay coherent and on-topic.
8. Presentations will be held in either the MOL or the classroom.