

# MSE 488: Optical Materials

## COURSE INFORMATION

**Course Description:** The goals of this course are to 1) provide a working knowledge of optics and of the interaction of light with matter, 2) survey/examine the optics of materials in technologically important devices, and 3) explore current and developing topics in optical/photonic materials research.

**Instructor:** Prof. Qing Cao  
1008 MRL  
Email: qingcao2@illinois.edu  
Office hours: Friday 2-3 pm or by appointment

**TA:** Bao Lam  
Email: baohl2@illinois.edu  
Office hours: TBA

**Class Schedule:** MWF 1:00 - 1:50 pm  
305 MSEB

**Grading:** 1) Homework problem sets (20%)  
2) Midterm exam (40%)  
3) Final exam (40%)

Undergraduate (3 credits)		Graduate (4 credits)	
Homework	20%	Homework	15%
Midterm	40%	Midterm	30%
		Literature review	15%
		Presentation	10%
Final	40%	Final	30%

### For Graduate Student Seeking 4 credits:

A literature review paper is required to cover the recent progress on the development of an optical device based on novel optical materials. Provide a detailed report that fully discusses the motivation, approach, mechanism, challenges, and future opportunities.

**Due dates:** You will need to select a topic before Midterm exam. Dates for presentations during the last week of lecture will be assigned. Written reports will be due in the week before the presentation.

### Length and formatting:

Maximum of 5 pages (8.5" x 11" paper with 1 inch margins and 11 point minimum font size); Cite all references; bibliography does not count towards page limit

### Presentation:

10 minutes + 2 minutes for discussion (times may be adjusted depending on class attendance).

Topic literature review presentations will be graded on substance and clarity. The grade will be based by 50% on the evaluation from your peers and 50% by the instructor.

### **Written reports:**

The report will be graded based on presentation, neatness, correct use of symbols, quality of drawings and diagrams, and clarity of explanation (60%). Reports should be neat and organized, hand-written or typed. Tables and graphical representations of results should be generated using some software program such as Excel, TecPlot, MatLab, Origin, etc., rather than being hand-drawn. Correct discussion of the scientific problem and correct conclusions are important (40%). Point breakdown for the written report:

- 20% Comprehensive motivation for the project/article
- 20% Correct presentation of the underlying fundamental science
- 20% Presentation quality
- 20% Clarity of discussion
- 20% Use of clear figures

### **Homework Protocol**

Homework will be posted on gradescope.

#### ***For quantitative problems:***

Correct Numerical Answer 20%

Correct Reasoning 40%

Correct Units 20%

Legible Work Shown 20%

#### ***For Qualitative problems:***

Reasoning is clear and logical 40%

Factual statements are correct and based on course material 40%

Response is legible with correct spelling and grammar 10%

If requested, Figures or Diagrams are clear and well labeled (if not requested, these points go to the reasoning category) 10%

### **Exams:**

1) One page of notes is allowed in the exam.

2) Mid-term will be 1 hour and the final will be 2.5 hours.

3) Exams will be a mixture of qualitative and quantitative questions. The questions will cover a very broad range of topics covered in the lecture.

### **References:**

Optical Materials by Kelly S. Potter, Joseph H. Simmons

Optics by Hecht

Topics:

1. Linear Wave Function and Wave Equation
2. Maxwell's Equations

3. Light Propagation and Dispersion in Isotropic Dielectrics
4. Reflection & Refraction
5. Light Propagation and Birefringence in Anisotropic Dielectrics
6. Polarizer, Retarder, and Modulator
7. Liquid Crystals
8. Optical Cable and Waveguides
9. Light Interaction with Metals
10. Plasmonics
11. Light Interaction with Semiconductors
12. Optoelectronic Devices and Materials

### **Covid Safety**

Following University policy, all students are required to engage in appropriate behavior to protect the health and safety of the community. Students are also required to follow the campus COVID-19 protocols.

Students who feel ill must not come to class. In addition, students who test positive for COVID-19 or have had an exposure that requires testing and/or quarantine must not attend class. The University will provide information to the instructor, in a manner that complies with privacy laws, about students in these latter categories. These students are judged to have excused absences for the class period and should contact the instructor via email about making up the work.

Students who fail to abide by these rules will first be asked to comply; if they refuse, they will be required to leave the classroom immediately. If a student is asked to leave the classroom, the non-compliant student will be judged to have an unexcused absence and reported to the Office for Student Conflict Resolution for disciplinary action. Accumulation of non-compliance complaints against a student may result in dismissal from the University.

### **Academic Integrity**

The University of Illinois at Urbana-Champaign Student Code should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity. Read the Code at the following URL: <http://studentcode.illinois.edu/>.

Academic dishonesty will result in a sanction proportionate to the severity of the infraction, with possible sanctions described in 1-404 of the Student Code (<https://studentcode.illinois.edu/article1/part4/1-404/>). Every student is expected to review and abide by the Academic Integrity Policy as defined in the Student Code: <https://studentcode.illinois.edu/article1/part4/1-401/>. As a student it is your responsibility to refrain from infractions of academic integrity and from conduct that aids others in such infractions. A short guide to academic integrity issues may be found at <https://provost.illinois.edu/policies/policies/academic-integrity/students-quick-reference-guide->

[to-academic-integrity/](#). Ignorance of these policies is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

### **Anti-Racism and Inclusivity Statement**

The Grainger College of Engineering is committed to the creation of an anti-racist, inclusive community that welcomes diversity along a number of dimensions, including, but not limited to, race, ethnicity and national origins, gender and gender identity, sexuality, disability status, class, age, or religious beliefs. The College recognizes that we are learning together in the midst of the Black Lives Matter movement, that Black, Hispanic, and Indigenous voices and contributions have largely either been excluded from, or not recognized in, science and engineering, and that both overt racism and micro-aggressions threaten the well-being of our students and our university community.

The effectiveness of this course is dependent upon each of us to create a safe and encouraging learning environment that allows for the open exchange of ideas while also ensuring equitable opportunities and respect for all of us. Everyone is expected to help establish and maintain an environment where students, staff, and faculty can contribute without fear of personal ridicule, or intolerant or offensive language. If you witness or experience racism, discrimination, micro-aggressions, or other offensive behavior, you are encouraged to bring this to the attention of the course director if you feel comfortable. You can also report these behaviors to the Bias Assessment and Response Team (BART) (<https://bart.illinois.edu>). Based on your report, BART members will follow up and reach out to students to make sure they have the support they need to be healthy and safe. If the reported behavior also violates university policy, staff in the Office for Student Conflict Resolution may respond as well and will take appropriate action.

### **Disability-Related Accommodations**

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, you may visit 1207 S. Oak St., Champaign, call 333-4603, e-mail [disability@illinois.edu](mailto:disability@illinois.edu) or go to <https://www.disability.illinois.edu>. If you are concerned you have a disability-related condition that is impacting your academic progress, there are academic screening appointments available that can help diagnosis a previously undiagnosed disability. You may access these by visiting the DRES website and selecting “Request an Academic Screening” at the bottom of the page.

### **Family Educational Rights and Privacy Act (FERPA)**

Any student who has suppressed their directory information pursuant to Family Educational Rights and Privacy Act (FERPA) should self-identify to the instructor to ensure protection of the privacy of their attendance in this course. See <https://registrar.illinois.edu/academic-records/ferpa/> for more information on FERPA.

### **Religious Observances**

Illinois law requires the University to reasonably accommodate its students' religious beliefs,

observances, and practices in regard to admissions, class attendance, and the scheduling of examinations and work requirements. You should examine this syllabus at the beginning of the semester for potential conflicts between course deadlines and any of your religious observances. If a conflict exists, you should notify your instructor of the conflict and follow the procedure at <https://odos.illinois.edu/community-of-care/resources/students/religious-observances/> to request appropriate accommodations. This should be done in the first two weeks of classes.