

Opti588: Introduction to Display Science and Technology

Syllabus and Course Policies (Term: Fall 2021)

Lecture Time: Tuesday/Thursday 12:30-1:45PM Location: Rm647

Course website: <https://wp.optics.arizona.edu/opti588/> (password will be provided via email)

Instructor information

- Prof. Hong Hua, Rm 727 (west wing)
- Email: hhua@optics.arizona.edu (Preferred method of contact)
- Office hour (zoom): Tuesday 12:30-1:45PM

TA information

- Jeremy Katz, jjikatz@email.arizona.edu
- TA office hour: Thursday 2:15-3:15PM

Zoom information:

- Introduction lecture on 08/24/2021: <https://arizona.zoom.us/j/88337220479>
- Thursday discussion sessions: <https://arizona.zoom.us/j/5206268703>
- Instructor Tuesday office hours: <https://arizona.zoom.us/j/82836399868>
- TA Thursday office hours:
<https://us02web.zoom.us/j/85265146440?pwd=cFhTeEpBZjJkaStMckY2S2UzdkZSdz09>

The password for joining all the zoom meetings above: opti588

Teaching modality

- This class will be taught in a hybrid modality of flex in-person group discussion sessions and guided self-study.
- Group discussion sessions: All local students will meet between 12:30 and 1:45PM on Thursdays in Meinel Rm 647 to participate the Thursday discussion sessions, while the DL students will attend these sessions via the zoom link provided above. If a student is unable to attend a discussion session either in-person or online, he or she is required to watch the recorded discussion session which will be available through D2L after each meeting.
- Guided self-study: All students are required to watch the pre-recorded lectures posted via D2L, following the schedules attached at the end of this syllabus.
- Instructor will hold a regular office hour between 12:30 and 1:45PM on Tuesdays via the zoom link provided above. All students are encouraged to attend if you have questions about the lectures.
- TA will hold a regular office hour between 2:15 and 3:15PM on Thursdays via the zoom link provided above. All students are encouraged to attend if you have questions.

Compliance with COVID-19 mitigation guidelines

As we enter the Fall semester, your and my health and safety remain the university's highest priority. To protect the health of everyone in this class, students are required to follow the university guidelines on COVID-19 mitigation. Please visit www.covid19.arizona.edu.

- Face masks are required in the classroom during the entire duration of the meeting sessions.
- Make sure your mask covers your nose and mouth!
- If you forget your mask, please just ask and we'll aim to find one for you!
- Failure to comply will result in students being asked to leave the classroom and / or other disciplinary actions, including possibly being dropped from this class.

Course description (3 credits)

The class examines the fundamentals of 2D and 3D display technologies (e.g. human visual system, color and depth perception, color theory and metrology, and state-of-the-art display technologies), display performance evaluation and calibration, and display research frontiers. The class is suited for both graduate and undergraduate students. You are encouraged to talk to the Instructor to find out if this is the right course for you.

Prerequisite

Opti 202/502 or equivalent

Course outline

- Introduction (0.5 week)
 - How applications have been driving display developments?
 - Evolution of display technology
- Human visual system (1.5 weeks)
 - Eye anatomy and eye optics
 - Visual performance of the eye
 - Models of visual performance and photometry
- Color vision and colorimetry (3 weeks)
 - Color vision basics
 - Color matching experiments and color matching functions
 - Color systems and spaces
 - Colorimetry
- 2D display technology and operation (3 weeks)
 - Display system interfaces and performance parameters
 - CRT displays
 - Flat panel displays: AMLCD, LCOS, Plasma, OLED,
 - Projection systems
 - New display technologies: high dynamic range display, enriched color display
- Display metrology: display performance measurement and calibration (3 weeks)
 - General principles of display evaluation
 - Evaluation of 2D displays
 - Color management and calibration
- Binocular vision and 3D display technology (3 weeks)
 - Binocular vision and perception basics
 - 3D display principles and techniques
 - head-mounted displays
 - Spatially immersive displays
 - Auto-stereoscopic displays
 - Volumetric displays
 - Holographic displays
 - Human factors associated with 3D displays and 3D display evaluations

Textbook and reading

- No required textbook
- Recommended books
 - Color vision and colorimetry: theory and applications (by Daniel Malacara). Book is available via <http://ezproxy.library.arizona.edu/login?url=http://dx.doi.org/10.1117/3.881172>

- Electronic image display (by Jon C. Leachtenauer). Book is available via: <https://doi-org.ezproxy2.library.arizona.edu/10.1117/3.2265057>
- Introduction to Flat Panel Displays, 2nd Edition, By Jiun-Haw Lee, I-Chun Cheng, Hong Hua, and Shin-Tson Wu, <https://www.wiley.com/en-us/Introduction+to+Flat+Panel+Displays%2C+2nd+Edition-p-9781119282228>
- Displays: Fundamentals and Applications, by Rolf Hainich and Oliver Bimber. <http://www.amazon.com/Displays-Fundamentals-Applications-Rolf-Hainich/dp/1568814399> (The authors agreed to provide PDF copy of the book for non-commercial purposes.)
- Lecture notes will be provided.
- Supplementary readings (book chapters, articles) will be available for downloading from the course website.

Assignment and grading policy

The final grade of this course will be based on performance on (1) Written homework; (2) Exams; and (3) Final project presentation and reports. Grades in these individual items will be weighted as follows

- Written homework: 20%
- Exams
 - one term exam: 30%
 - Quizzes: 10%
- Class project (each student is required to sign up for a class project starting at the beginning of the semester. The student will perform the project through several milestones and demonstrate the completion of the project through an oral presentation and a detailed project report): 40%

The Final letter grades will not be computed "on the curve". Instead, they will be determined on a fixed scale. You are *not* competing with other students for grades; you are trying to master the course material. In principle, everyone in this class could fail, and similarly, everyone could earn an A.

Honor code

- All work in this course is to be your own, and the university honor code is in effect. Groups will collaborate on the final project, but the other three graded aspects of the course are based on individual work.
- For lecture recordings, which are used at the discretion of the instructor, students must access content in D2L only. Students may not modify content or re-use content for any purpose other than personal educational reasons. All recordings are subject to government and university regulations. Therefore, students accessing unauthorized recordings or using them in a manner inconsistent with [UArizona values](#) and educational policies ([Code of Academic Integrity](#) and the [Student Code of Conduct](#)) are also subject to civil action.

Late submission policy

No late submission is accepted for all assignments unless you receive permission from the instructor for legitimate excuses.

Attendance policy

- If you feel sick, or may have been in contact with someone who is infectious, stay home. Except for seeking medical care, avoid contact with others and do not travel.
- Notify your instructor(s) if you will be missing a course meeting or an assignment deadline.
- Non-attendance for any reason does not guarantee an automatic extension of due date or rescheduling of examinations/assessments. Please communicate and coordinate any request directly with your instructor.
- If you must miss the equivalent of more than one week of class, you should contact the Dean of Students Office DOS-deanofstudents@email.arizona.edu to share documentation about the challenges you are facing.
- Voluntary, free, and convenient [COVID-19 testing](#) is available for students on Main Campus.
- If you test positive for COVID-19 and you are participating in on-campus activities, you must report your results to Campus Health. To learn more about the process for reporting a positive test, visit the [Case Notification Protocol](#).
- COVID-19 vaccine is available for all students at [Campus Health](#).
- Visit the [UArizona COVID-19](#) page for regular updates.
- Students are responsible for completing any work that they might miss due to illness or the need to quarantine/isolate, including lecture attendance, assignments, tests and exams.
- Students who miss a lecture or a series of lectures are required to watch the recorded ZOOM lectures and provide the instructor confirmation or feedback.

Accessibility and accommodations

At the University of Arizona, we strive to make learning experiences as accessible as possible. If you anticipate or experience barriers based on disability or pregnancy, please contact the Disability Resource Center (520-621-3268, <https://drc.arizona.edu>) to establish reasonable accommodations.

Academic advising

If you have questions about your academic progress this semester, please reach out to your academic advisor (<https://advising.arizona.edu/advisors/major>). Contact the Advising Resource Center (<https://advising.arizona.edu/>) for all general advising questions and referral assistance. Call 520-626-8667 or email to advising@arizona.edu

Life challenges

If you are experiencing unexpected barriers to your success in your courses, please note the Dean of Students Office is a central support resource for all students and may be helpful. The [Dean of Students Office](#) can be reached at (520) 621-2057 or DOS-deanofstudents@email.arizona.edu.

Physical and mental-health challenges

If you are facing physical or mental health challenges this semester, please note that Campus Health provides quality medical and mental health care. For medical appointments, call (520) 621-9202. For After Hours care, call (520) 570-7898. For the Counseling & Psych Services (CAPS) 24/7 hotline, call (520) 621-3334.

OPTI588—Tentative Lecture Schedule (Fall 2021)

	Lect	Day	Lecture Plan	Topic	Assignment	Due
W1	1	Aug 24	Recitation	Introduction		
	2	Aug 26	Recorded L2	Human visual system		
W2	3	Aug 31	Recorded L3	Visual performance of the eye	HW1	
	4	Sep 2	Recorded L4	Models of visual performance		
		Sep 2	In-person (#2-4)	In-person Q&A on Lectures 2-4		
W3	5	Sep 7	Recorded L5	Photometry and color vision introduction		
	6	Sep 9	Recorded L6	Color vision basics		
		Sep 9	In-person (#5-6)	In-person Q&A on Lectures 5-6	Quiz 1 (#1-4)	
W4	7	Sep 14	Recorded L7	Color models: RGB and XYZ	HW2	HW1 due
	8	Sep 16	Recorded L8	Color models: Other color systems		
		Sep 16	In-person (#7-8)	In-person Q&A on Lectures 7-8		
W5	9	Sep 21	Recorded L 9	Color models: Color mixture		
	10	Sep 23	Recorded L10	Color system adaptation & transformations		RP1 due
		Sep 23	In-person (#9-10)	In-person Q&A on Lectures 9-10	Quiz 2 (#5-8)	
W6	11	Sep 28	Recorded L11	Display system interface and CRT displays	HW3	HW2 due
	12	Sep 30	Recorded L12	Flat panel displays: LCD		
		Sep 30	In-person (#11-12)	In-person Q&A on Lectures 11-12		
W7	13	Oct. 5	Recorded L13	Flat panel displays (plasma, DMD, OLED, etc)		
	14	Oct 7	Recorded L14	Projection display		
		Oct 7	In-person (#13-14)	In-person Q&A on Lectures 13-14	Quiz 3 (#9-12)	
W8	15	Oct 12	Recorded L15	Laser-based display		
	16	Oct 14	Recorded L16	Other displays: Color-enriched displays		
		Oct. 14	In-person (#15-16)	In-person Q&A on Lectures 15-16		
W9	17	Oct 19	Recorded L17	Other displays: HDR displays	HW4	HW3 due
	18	Oct 21	Recorded L18	Other displays: flexible displays, HUD		
		Oct 21	In-person (#17-18)	In-person Q&A on Lectures 17-18	Quiz 4 (#13-16)	RP2 due
W10	19	Oct 26	Recorded L19	Color calibration of CRT and LCD		
	20	Oct 28	Recorded L20	Physical display quality measures		
		Oct 28	In-person (#19-20)	In-person Q&A on Lectures 19-20		
W11	21	Nov 2	Recorded L21	Perceptual display quality measures	HW5	HW4 due
	22	Nov 4	Recorded L22	Display Utility assessment		
		Nov 4	In-person (#21-22)	In-person Q&A on Lectures 21-22	Quiz 5 (#17-20)	
W12	23	Nov 9	Recorded L23	Recorded mid-term review		
	25	Nov 11	Recorded L25	Binocular visual perception		RP3 due
		Nov 11	In-person (#23-25)	In-person Q&A on Lectures 23-25, Mid-term review		
W13	26	Nov 16	Recorded L26	Stereoscopic display systems		
		Nov 18		Term Exam	Exam	
W14	27	Nov 23	Recorded L27	Head-mounted displays for VR/AR		HW5 due
		Nov 25				Holiday
W15	28	Nov 30	Recorded L28	3D displays, autostereoscopic display systems, volumetric displays		
	29	Dec. 2		Final project presentations		
W16	30	Dec 7		Final project presentations		
W17		Dec 10-16		Final week (No final exam, FRP due)		FRP due

Opti588—Fall 2021 Semester Calendar

First Day of Class: August 24th, 2021, Last Day of Class: December 9th, 2021

	Mon.	Tuesday	Wed.	Thursday	Fri.	Notes
W1	08/23	Lect 1		Lect 2		Class begin
W2	08/30	Lect 3		Lect 4		
W3	Holiday	Lect 5		Lect 6		
W4	09/13	Lect 7		Lect 8		
W5	09/20	Lect 9		Lect 10		
W6	09/27	Lect 11		Lect 12		
W7	10/04	Lect 13		Lect 14		
W8	10/11	Lect 15		Lect 16		
W9	10/18	Lect 17		Lect 18		
W10	10/25	Lect 19		Lect 20		
W11	11/01	Lect 21		Lect 22		
W12	11/08	Lect 23	Holiday	Lect 25		
W13	11/15	Lect 26		Term exam		
W14	11/22	Lect 27		Holiday	Holiday	
W15	11/29	Lect 28		Lect 29 (Proj. Presentation)		
W16	12/06	Lect 30 (Proj. Presentation)	Last day	Reading day	Final begin	
W17	12/13					No Final Exam