OPTI 535 Syllabus

Fall Semester 2021

Course Number and Title
OPTI 535 Visual Optics

Instructor Information
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TA: TBD

Course Description
This course examines the optical properties of the human eye and applies the techniques used to assess the performance of conventional optical systems to the eye. Furthermore, the operating principals behind various ophthalmic diagnostic devices including wavefront aberrometers and corneal topographers are investigated. Surgical techniques such as LASIK and cataract surgery are explored.

Course Prerequisites or Co-requisites
Some experience with geometrical optics, interference and diffraction is useful for the class.

Course Format and Teaching Methods
Live in person (assuming no pandemic restrictions). Otherwise, asynchronous online.

Course Objectives
The objective of this course is to familiarize the student with the optical properties of the human eye and the nomenclature used to describe its limitations and capabilities. The second objective of the course is to provide an understanding of the optical systems used to measure and image various components of the eye. Another objective of the course is to illustrate surgical techniques for correcting or enhancing the performance of the eye. A final objective of this class is to introduce the student to reading and dissecting patents.

Expected Learning Outcomes
At the conclusion of this class, the student will be able to

- describe the geometrical optical properties of the eye, as well as its deficiencies such as refractive error, astigmatism and higher order aberrations.
- understand how ocular performance tests such as visual acuity and contrast sensitivity relate to optical engineering performance metrics such as resolution limit and the Modulation Transfer Function.
- provide the basic layouts for various diagnostic devices such as ocular wavefront sensors, corneal topographers, retina imaging systems and optical coherence tomographers.
- understand the mechanism of action behind surgical techniques such as LASIK and cataract surgery to correct or enhance the performance of the eye.
- review a technical patent and extract information regarding the claims and embodiments of the covered technology.

400/500 Co-convened Course Information
OPTI 535 is co-convened with an undergraduate version of the course. The undergraduates will have reduced homework assignments.

Required Texts and Materials
There are no required materials for this class, but it is strongly recommended that the student get access to J. Schwiegerling, Field Guide to Visual and Ophthalmic Optics (SPIE Press, Washington, 2004). The cost of this book is about $42.00.

Schedule of Topics and Activities
Section 1 - What is vision? Anatomy of the eye. Dissection. Average and range of sizes, shapes and indices of ocular components. Overview of optical modeling. Definition of visual acuity.

Section 3 - Spherical, Chromatic, Astigmatism (axial and oblique). Techniques for measuring aberrations. Nominal values. Derivation of these quantities from raytrace data. Retinal curvature.


Section 6 – Zernike Polynomials and wavefront representation

Section 7 - Spherical ametropia, cylindrical error, Scheiner disk, vector addition of crossed cylinders. Correction with spherio-cylindrical spectacle lenses. Correction with spherical, aspheric and toric contact lenses. prism ballast.

Section 8 – Optometers, Autorefractors: image analysis, retinoscopic scanning and Scheiner disk types. Fogging.

Section 9 - Lensmeters, Accommodation, age changes, near addition. Progressive lenses. Spherical and astigmatic considerations.


Section 11 - Other corrections: RK/AK, PRK, ALK/LASIK, orthokeratology, interscleral ring.


Section 13 - Calculation of radii of curvature, astigmatic axis and conic constant from Zernike expansion coefficients. Keratoconus detection.


Section 17 - Radiometry and Photometry. MPE.


Patent Class 1 - Elements of a patent. Patent searching

Patent Class 2 - Specific Example of an ophthalmic patent

Assessments

<table>
<thead>
<tr>
<th>Assessment Categories</th>
<th>Percentage of final grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midterm Exam (Date: TBD)</td>
<td>35%</td>
</tr>
<tr>
<td>Homework assignments</td>
<td>30%</td>
</tr>
<tr>
<td>Final Project (Last few lectures of the semester)</td>
<td>35%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
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Final Project

The final project for this class is to identify an ophthalmic patent and provide a review of the technology. The review will be in the form of a short summary (~4 pages) and an in-class oral presentation (5-10 minutes).

Grading Scale and Policies

The grading scale is curved and final grades will be dependent upon the performance all of the graduate students enrolled in the class.

Nondiscrimination and Anti-harassment Policy

The University of Arizona is committed to creating and maintaining an environment free of discrimination. In support of this commitment, the University prohibits discrimination, including harassment and retaliation, based on a protected classification, including race, color, religion, sex, national origin, age, disability, veteran status, sexual orientation, gender identity, or genetic information. For more information, including how to report a concern, please see: http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy
University Policies
All university policies related to a syllabus are available at: https://academicaffairs.arizona.edu/syllabus-policies. By placing this link in your syllabus, you no longer need to have each individual policy included in your syllabus.

Subject to Change Notice
Information contained in the course syllabus, other than the grade and absence policies, may be subject to change with reasonable advance notice, as deemed appropriate by the instructor of this course.

Graduate Student Resources
Please consider including a link to the University of Arizona’s Basic Needs Resources page: http://basicneeds.arizona.edu/index.html