

OPTI 435/535 Syllabus

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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 2 - Schematic eye models. Gullstrand-LeGrand and Helmholtz models. First-order properties. Locations of cardinal points. Definitions of near point, far point, myopia and hyperopia. Aspheric eye models. Stiles-Crawford, photopic response, diffraction. Location of eye axes.

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

Section 4 - Visual performance - Theoretical resolution. Vernier acuity, grating acuity, Snellen acuity. Vision charts. Specification of visual acuity. Contrast sensitivity. Fourier theory - PSF, MTF, modulation threshold. Campbell and Green experiments. Van Nes and Bouman experiments. Changes in contrast sensitivity. Square-wave response.

Section 5 - Double-pass measurement of PSF. Deconvolution. Asymmetric passes. Aberroscope. Shack-Hartmann test, Raytracing, Talbot-Moire.

Section 6 – Zernike Polynomials and wavefront representation

Section 7 - Spherical ametropia, cylindrical error, Scheiner disk, vector addition of crossed cylinders. Correction with spherocylindrical 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 10 - Intraocular lenses. Power calculations. Multifocal contact and intraocular lenses. Aphakia and pseudophakia. Defocus Transfer Function.

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

Section 12 – Pupillometry. Measurement of the anterior cornea. Placido disks, stereophotogrammetry and scanning slit devices. Height, slope and curvature representations of the cornea. Derivation of relationships. Keratometric index of refraction.

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

Section 14 – Miscellaneous Ocular Measurements. Measurement of corneal thickness - scanning slit, pachymetry. Measurement of the angle in glaucoma. Gonioscopy. Scheimpflug imaging. Phakometry, Purkinje images.

Section 15 - Visual Fields. Spatial and temporal summation. Perimetry: Tangent Screen, Goldman projection, Static and Kinetic. Scotomas

Section 16 - Measurement and imaging the retina. Direct and indirect ophthalmoscopy, fundus camera. Confocal scanning laser ophthalmoscope. Optical coherence tomography. Applications: glaucoma screening, nerve fiber layer measurement.

Section 17 - Radiometry and Photometry. MPE.

Section 18 - Color matching. Additive and subtractive color mixing. Color vision - Trichromatic vs. opponent-process theories. Spectral response of cone pigments. Color blindness.

Patent Class 1 - Elements of a patent. Patent searching

Patent Class 2 - Specific Example of an ophthalmic patent

Eye Lecture - Miscellaneous types of eyes found in nature.