Exam 2 Review

Thick Lens Optics

Cardinal Points

Significance of F, F', P, P', N, N'

Equivalent Power

Fe = F1 + F2 – t'F1F2

Front Vertex & Back Vertex Power

Significance of Fv & F'v

Significance of reduced thickness (t' =t/n)

System of Lenses

For a system of lenses, image of first lens is the object of the second lens

Use Equivalent Power formula with d instead of t'

Optical Instruments

Simple Magnifier

F/4 assumes object at Primary Focal Point of lens

F/4 + 1 when object is between Primary Focal Point and Lens

Standard reference distance is 25cm (used for angular magnification)

Telescope

Keplerian vs Galilean

M = -Fe/Fo

Tube length = f'o + fe

AS, EnP = Objective Lens

FS, ExW = Eyepiece

ExP is behind eyepiece for Keplerian

ExP is between lenses for Galilean

Compound Microscope

Objective Lens & Eyepiece are both plus power

Magnification is product of LMo & AMe

M = LMo x Ame

Tube Length = distance between F'o and Fe

Lensometer

Uses Standard Lens (typically +20D) and moveable target.

Target movement changes vergence of light incident on measured lens.

Movement away from Standard lens creates convergence at measured lens.

Movement toward Standard lens creates divergence at measured lens.

$$x_s = f_s^2 F_v'$$

Control of Light in Optical Systems

Stops, Pupils, & Windows

- AS: limits light, controls brightness of image
- FS: limits FOV, controls how much image space can be seen
- EnP: image of AS from object space
- ExP: image of AS from image space
- EnW: image of FS from object space
- ExW: image of FS from image space

Field of View

- Measured from center of entrance pupil.
- FOV = angle subtended at the entrance pupil from the edge of the entrance window.

Eye as an Optical System

- Image of pupil through cornea is entrance pupil of the eye

Spectrometry

Photons

- Packet of light energy (quanta)

Energy Levels

Absorption & Emission

- Electrons prefer to be in ground state.
- Electrons can move to higher energy level by absorbing a photon.
- Spontaneous emission: electron moves back to ground state and releases photon.
- Stimulated emission: photon passes by electron in excited state.

Black Body / Gray Body Models.

- Black Body is ideal absorber.
- Black Body radiator emits all wavelengths when heated.
- Wavelength of Black Body peak intensity decreases as temperature increases.

Photometry

The measurement of Visible EM radiation (Visible Light)

Measurements & Units

- Energy
- Flux
- Intensity
- Luminance

Inverse Square Law

Cosine Law

Attenuation of Light

Transmission & Absorption

Transmittance & Absorptance

Absorbance: A = -logT

Filters: Colored and Neutral Density

- Spectral Transmission: light transmitted is color of filter, absorbed opposite end of spectrum. EX: blue filter transmits blue and absorbs red
- Neutral Density: all wavelengths absorbed equally

Transmittance is multiplicative

Absorbance is additive

Interference

Wave Nature of Light

Young's Double Slit Experiment

Constructive & Destructive Interference

Phase Shifts

Thin Films and AR Coatings

Newtons Rings

Interferometry

Laser Speckle Pattern

- Due to spots of Constructive and Destructive interference
- Myope: Against motion
- Hyperope: With motion

Diffraction

Single Slit / Central Maximum
Diffraction Grating (vs Prism)
Circular Aperture / Airy Disk
Minimum Angle of Resolution
Diffraction Limited System