OPTI-502 Syllabus

Optical Design and Instrumentation I -- 3 Credit Hours (29 Lectures)


Foundations of Geometric Optics

1. Assumptions of geometrical optics; refractive index; optical path length; rays and wavefronts; Fermat’s principle; Snell's law; refraction and reflection; critical angle; sign conventions.

2. Plane mirrors; systems of plane mirrors; parity and orientation.

3. Non-dispersing prisms and prism types; plane-parallel plate; tunnel diagrams; reduced thickness.

4. Imaging with a thin lens; focal length; conjugates; magnification; imaging equations.

5. Real and virtual images; negative lenses; thin-lens afocal systems.

6. Imaging and optics; optical spaces; principal planes; paraxial refraction equation; power and focal lengths of general systems.

7. Gaussian imagery; magnification; cardinal points and planes; Newtonian and Gaussian equations; conjugate planes; afocal systems.

8. Object-image relationships and zones; longitudinal magnification; colinear transformation.

9. Transfer between surfaces; two component systems; Gaussian reduction.

10. Single reflecting surface; thick lens; thin lens; systems of two thin lenses.
11. Paraxial ray tracing; cardinal points by raytracing; back focal distance; virtual objects.

12. Stops and pupils; marginal and chief rays; field of view; Lagrange invariant.

13. Determination of pupil location by Gaussian optics and raytracing; numerical aperture; f-number.

14. Radiometric Transfer; $A\Omega$ product; camera equation.

15. Vignetting; real ray traces.

Elementary Optical Systems

16. Objectives; collimators; depth of focus and hyperfocal distance; Scheimpflug condition.

17. Zoom lenses; simple magnifier; magnifying power.

18. Keplerian telescope; eye relief; field lenses; eyepieces; Galilean telescope; mirror systems.

19. Image erection and relay systems; microscopes.

20. Telecentric systems; imaging properties of afocal systems.

21. Eye

Optical Materials and Dispersion

22. Glass properties; dispersion and Abbe number; other optical materials.

23. Dispersing prisms; minimum deviation; index measurement; prism spectrometer.

24. Thin prisms; combinations of thin prisms; achromatic prism; direct vision prism.
25. Longitudinal chromatic aberration; thin lens achromatic doublet; rainbows.

Other Optical Systems

26. The stop and its effects on image quality and system performance.

27. Illumination systems; diffuse illumination; projection condenser system; Kohler illumination; critical illumination; slide projector.

28. Light Sources; integrating sphere and bars; practical considerations; dark field and Schlieren systems; overhead projector; Fresnel lenses.

29. Photographic systems; viewfinders and focusing aids; autofocus systems; autocollimator; scanners.