### **Contents**

Sections are separately numbered and indicated with footers. *Italics* indicates nonpictorial pages.

The right column references other sections or video locations. Items in the right column without page numbers refer to entire sections. Video entrees show the approximate time from the beginning of the video.

#### **Preface**

#### Introduction Video 0:00 Introduction 1 Diagrammatic conventions The Overhead Projector Video 3:20 The Overhead Projector Inside an overhead projector The mirror Image orientation Handedness or parity Imaging, pp. 9,10 Illumination Radiometry, p.4 9 Illumination system typical layout 10 An illumination detail Imaging, p.10 Lamp reimaged 11 Misadjusted illumination 12 Polychromatic Rays, p.10 13 The screen Polarization, p.49 Scattering Video 10:15

## Using the Overhead Projector

- Safety for People and Apparatus
- 2 Lamp power warning
- Absorbing materials
- 4 Improving Demonstration Quality
- 6 Field limiter
- Stray light from the base
- Stray light baffle at the projection lens

Pyramidal enclosure 10 Fresnel lens artifacts Moiré 11 Nonstandard Uses of the Projector Accessing the lamp image 12 13 Light table Most perpendicular beam 14 Homemade Apparatus 15 17 Cardboards Using color filters 18 19 Apparatus support stand 20 Purchased Apparatus **Monochromatic Ray Optics** Video: 11:40 Monochromatic Ray Optics (Called Geometric Optics 2 Plane Parallel Plate in the video) Plane parallel plate 4 Axial image shift Axial image shift Lateral image shift by a tilted plate Double-thickness plate Rotating transmission scanner 9 Prism Polychromatic Ray Optics Prism monochromatic properties 10 Variation of deviation angle with orientation 11 12 Prism deviation and vertex angle 13 Prism deviation and material 14 Range of incidence angles 15 Image revolution without rotation Grating, p.7 16 Variable angle prism 17 Miscellaneous 18 Wave patterns Imaging, pp.31,44 19 Total internal reflection Fluorescence, p.3 20 TIR demonstrations

Double shadows, Video 1:13:30

21

22

Retroreflectors

Sharp shadows

### **Polychromatic Ray Optics**

- 1 Polychromatic Ray Optics
- 2 Dispersion
- 3 Prism deviation and dispersion
- 4 Prism dispersion
- 5 Dispersion and material
- 6 Dispersion with no deviation for one wavelength
- 7 Rainbow
- 8 Rainbow
- 9 Cylindrical rainbow
- 10 Fresnel lens dispersion

Video 20:05

(Called "Dispersion"

in the video)

Polarization, p.38 Overhead Projector, p.9

Imaging, p.36

### **Radiometry and Photometry**

- 1 Radiometry and photometry
- 2 Radiant energy
- 3 Power per area
- 4 Illumination uniformity at the screen
- 5 Infrared absorption
- 6 Brightness comparison
- 7 Brightness comparison

Video: 57:20

Moiré Video 30:00

- 1 Moiré
- 3 Moiré
- 4 Types of patterns
- 5 Distance measurement
- 6 Alignment and testing
- 7 Patterns with different periods
- 8 Rotation of hexagonal patterns
- 9 Moiré investigations
- 10 Shadow moiré

11 Two projectors

Monochromatic Rays, p.22

Video 1:13:40

Color moiré: video 1:15:00

**Scattering** Video: 39:20 Scattering 3 Scattering Scattering by surfaces and index difference 4 Scattering by surfaces with parallel lines Grating, pp. 7,9 Scattering by particles 7 Air molecule scattering Rayleigh scattering and polarization 8 Rayleigh scattering 9 Polarized input light 10 Polarization 11 **Apparatus** 12 Multiple Rayleigh scattering Contrast reduction by scattering 13 Imaging, p.45 **Fluorescence** Video 34:40 Fluorescence Fluorescence Fluorescence of clear plastic Monochromatic Rays, p.19 Change of wavelength 4 Light depletion 5 Different absorption wavelengths for different fluorescers 7 Absorption variation with wavelength 8 Polarization Polarization Complicated colors Interesting effects 10 Fluorescent liquid 11 **Interference Colors** Video 43:50 Interference Colors 1 3 Interference colors Variation of color with angle Complementarity of transmitted and reflected light 5 6 Polarization and color Polarization Apparatus to observe reflected interference colors

#### The Grating Video 46:40 1 Gratings 3 Transmission grating 4 Basic setup 5 Grating frame 6 Grating structure 7 Rotation about a normal to the grating Monochromatic Rays, p.15 Tilt about grating lines 9 Tilt about perpendicular to the grating lines Scattering, p.5 Polarization 10 No change 11 Different periods 12 Grating under the lens Color, p.6 13 Prism-grating comparison Polychromatic Rays, pp.3,4,5 14 Prism, grating crossed Successive gratings 15 Complementary patterns 16 17 "Special effects" 18 Decomposition The Spectroscope Video 54:40 Spectroscope 3 Absorption spectroscope 4 Grating spectroscope Grating 5 Object combinations Interference Color 6 Emission spectroscope Using the Projector, p.9 Imaging, pp. 11, 28 Color Video 1:14:45 1 Color 2 Subtractive color mixture Colored objects and colored illumination 4 Additive color mixture 5 More additive color 6 A special color addition Grating, p.12, Video 51:30

7 Colored shadows

#### **Polarization**

Video 58:30

- 1 Polarization
- 3 The polariscope
- 4 Arrangement on an overhead projector
- 5 A polariscope

Using the Projector, p.19

- 6 Some practical considerations
- 7 Some techniques
- 8 Linear Polarization and Sheet Polarizer
- 10 Two polarizers
- 11 Three polarizers
- 12 The half-shade device
- 13 Compound polarizer-analyzer combinations
- 14 Circular Polarization
- 15 Circular polarizer
- 16 Circular polarizer nonideal behavior
- 17 Circular polarization and reflected light
- 18 Making circular polarizer
- 19 Circular polariscope Polarization, p.37
- 20 Birefringence
- 22 Birefringence
- 23 Birefringent sheet
- 24 Some birefringence techniques
- 25 Observing nonplanar objects
- 26 Stress birefringence
- 27 Stretched plastic
- 28 Mapping stress lines
- 29 Double refraction and double images
- 30 Birefringence interference colors
- 31 Optical Activity
- 32 Optical activity
- 33 Optical activity
- 34 Measuring the rotation
- 35 Varying syrup distance through which light passes
- 36 Variation in rotation with wavelength
- 37 Optical activity and circular polarizers Polarization, p.14

40	I Olarization with reflection and transmission			
41	Changed polarization of transmitted light			
42	All the angles at once			
43	Brewster angle			
44	Pile of plates polarizer			
45	Miscellaneous			
46	Order of elements			
47	180-degree rotation periodicity			
48	Flipping			
49	Depolarization	Scattering		
50	Depolarization in transmission			
51	Partial polarization			
52	3D movie technique			
53	Conoscopic arrangement			
54	Wavelength analysis of polarization effects			
Im	aging	Video 24:30		
1	Imaging			
3	Diffusers for imaging	Overhead Projector, p.10		
4	Image recording			
5	Basic Image Properties			
6	Ideal imaging			
7	Transverse magnification			
8	Axial positions and magnifications			
9	Handedness	Overhead Projector, p.7		
10	Object and image rotation			
11	Imaging reversibility	Video 1:12:40		
12	Resolution			
13	Additional Optics			
14	Additional lenses			
15	Lens sharing			
16	Imaging an image (and the field lens)			
17	Defocus and Depth			
19	Defocus effects			
20	Defocus and illumination	Overhead Projector, p.10		

38 Polarization with Reflection and Transmission40 Polarization with reflection and transmission

21	Nonround apertures	
22	Some object types	
23	Complementary objects	
24	Periodic objects	
25	Thick objects	
26	Focus sensing	
27	Triangulation	
28	Aberrations	
30	Aberrations	
31	Aberration creation (with ripply glass)	Monochromatic Rays, p.18
32	Astigmatism	
33	Creating astigmatism	
34	Astigmatism by reflection	
35	Spherical aberration	
36	Lateral color	Polychromatic Rays, p.10
37	Distortion	
39	Keystone distortion	
40	Extreme distortion	
41	Anamorphic art	
42	Topography	
43	Some Types of Image Degradation	
44	Imaging through turbulent media	Monochromatic Rays, p.18
45	Imaging through scattering media	Scattering, p.13
46	Background light and contrast reduction	
47	Miscellaneous	
49	Vignetting	
50	Knife-edge test	
51	Pinhole camera	
52	Close facing projectors	
53	Objects that must be vertical	
54	Special arrangements	
55	Projector as illuminator	

# Bibliography

# Author