

Contents

Preface	<i>page xi</i>
1 Light	1
1.1 The story	1
1.2 Models for the behavior of light	3
1.3 Measurements of light rays	9
1.4 Spectra	13
1.5 Magnitudes	22
Summary	28
Exercises	29
2 Uncertainty	32
2.1 Accuracy and precision	32
2.2 Describing populations	38
2.3 Probability distributions	43
2.4 Estimating uncertainty	48
2.5 Propagation of uncertainty	51
2.6 Additional topics	55
Summary	55
Exercises	56
3 Place, time, and motion	59
3.1 Astronomical coordinate systems	59
3.2 The third dimension	77
3.3 Time	82
3.4 Motion	87
Summary	92
Exercises	94
4 Names, catalogs, and databases	97
4.1 Star names	98
4.2 Non-stellar objects outside the Solar System	102

4.3	Objects at non-optical wavelengths	105
4.4	Atlases, finding charts, and sky surveys	105
4.5	Solar System objects	108
4.6	Websites and other computer resources	109
	Summary	110
	Exercises	111
	5 Optics for astronomy	113
5.1	Principles of geometrical optics	113
5.2	Lenses, mirrors, and simple optical configurations	124
5.3	Simple telescopes	130
5.4	Image quality: telescopic resolution	133
5.5	Aberrations	135
	Summary	146
	Exercises	147
	6 Astronomical telescopes	150
6.1	Telescope mounts and drives	150
6.2	Reflecting telescope optics	153
6.3	Telescopes in space	162
6.4	The current revolution in ground-based observing	169
6.5	Atmospheric blur	174
6.6	Adaptive optics	177
6.7	Extremely large telescopes	187
	Summary	189
	Exercises	190
	7 Matter and light	193
7.1	Isolated atoms	193
7.2	Isolated molecules	200
7.3	Solid-state crystals	202
7.4	Photoconductors	214
7.5	The MOS capacitor	216
7.6	The p–n junction	218
7.7	The vacuum photoelectric effect	222
7.8	Superconductivity	224
	Summary	228
	Exercises	229
	8 Detectors	232
8.1	Detector characterization	232
8.2	The CCD	239
8.3	CMOS arrays	256

8.4 Infrared arrays	256
8.5 Photo-emissive devices	261
8.6 Thermal detectors	265
Summary	267
Exercises	268
9 Digital images from arrays	271
9.1 Arrays	271
9.2 Digital image manipulation	276
9.3 Preprocessing array data: bias, linearity, dark, flat, and fringe	281
9.4 Combining images	293
9.5 Digital aperture photometry	304
Summary	313
Exercises	314
10 Photometry	316
10.1 Introduction: a short history	317
10.2 The photometric response function	319
10.3 The idea of a photometric system	329
10.4 Common photometric systems	330
10.5 Absorption by the atmosphere	336
10.6 Transformation to a standard system	348
10.7 Absorption outside the atmosphere	349
10.8 Wavelength changes	353
Summary	357
Exercises	358
11 Spectroscopy	362
11.1 Dispersive spectrometry	363
11.2 Dispersing optical elements	365
11.3 Spectrometers without slits	374
11.4 Basic slit and fiber spectrometers	375
11.5 Single-object spectrometer design for astronomy	379
11.6 Multiplexed spectrometers	382
11.7 Spectrometer stability and mounting	388
11.8 Data acquisition and reduction	389
11.9 Interpreting spectra	395
Summary	412
Exercises	414
Appendices	417
References	451
Index	455