Index

A
anisotropic medium, 47

B
biaxial crystal, 48
birefringence, 35, 47
Brewster angle, 40
Brewster’s law, 40

circular polarization, 21
circular polarizer, 41
critical angle, 137
cutoff wavelength, 145

degree of polarization, 104
dextrorotatory medium, 71
differential group delay, 202
directional coupler, 187
coupling length, 187
supermodes, 188
dispersion coefficient, 150
dispersion compensators, 186
displacement current, 6
double refraction, 40

e
elliptical polarization, 23
eelliptical polarizer, 42
eelliptical polarizer/analyzer, 131
eellipticity angle, 28
extraordinary ray (e ray), 47
extraordinary refractive index, 49
extraordinary wave (e wave), 51, 53

F
Faraday effect, 71
Faraday isolator, 72
fiber optic current sensor, 193
fiber optic polarizers, 194
fiber optic wave plates, 191
fundamental mode, 145
Gaussian spot size, 148
modal field, 146
mode field diameter, 148

group velocity, 148

H
half-wave plate, 67
Hi-Bi fibers, 170
applications, 183
bow-tie fibers, 177
geometrical birefringence, 172
mode coupling parameter, 171
PANDA fibers, 177
side-pit fibers, 176
side-tunnel fibers, 176
stress-induced birefringence, 174
high-birefringence (Hi-Bi) fibers, 170

I
ideal circular polarizer, 130
index ellipsoid, 60
initial phase, 23

J
Jones matrices, 82
of circularly birefringent media, 93
of elliptic polarizers, 95
of elliptic retarders, 95
of HWPs, 85
of left-circular polarizers, 90
of linear polarizers, 83
of linear retarders, 85
of right-circular polarizers, 91
Jones vectors, 75
Index

Jones vectors (cont.)
  circular basis vectors, 88
  normalized form, 76
  orthogonal, 76
  with elliptical basis vectors, 94

L
  laevorotatory medium, 71
  left-circular polarization, 22
  linear polarization, 19
  linear polarizer, 82
    pass axis, 82
  linearly polarized modes, 140
  low-PMD fibers, 218

M
  Malus’ law, 41
  material dispersion coefficient, 150
  Maxwell’s equations, 3, 4, 49
  Mueller matrix, 107
    of circular polarizers, 112
    of linear polarizers, 111
    of linear retarders, 115
    of rotators, 116
  multimode fiber, 148
    intermodal dispersion, 148

N
  negative crystal, 49, 58
  Nicol prism, 66

O
  optic axis, 48
  optical activity, 71
  optical fiber, 137
    attenuation, 138
    guided modes, 141
    radiation modes, 142
    step-index, 137
  optically active substance, 70
  ordinary ray (o ray), 47
  ordinary refractive index, 49
  ordinary wave (o wave), 51, 54
  origins of birefringence, 161
    bender, 164
  core ellipticity, 161
  lateral stress, 163
  magnetic field, 165
  twist, 164

P
  phase velocity, 50
  plane polarized, 19
  plane wave, 7, 10, 50
  PMD compensator, 218
  PMD measurement
    frequency-domain technique, 213
    time-domain technique, 213
  PMD mitigation, 217
  PMD vector, 206
  Poincaré sphere, 122
  Poincaré sphere representation, 122
    of birefringent media, 125
    of polarizers, 125
    properties, 126
  polarization beamsplitter, 187, 189
  polarization controller, 192
  polarization eigenmodes, 51
  polarization ellipse, 23
  polarization mode dispersion (PMD), 169, 201
    birefringence vector, 207
    dynamical equation, 210
    first order, 218
    Jones matrix analysis, 211
    probability density function, 210
    second order, 218
  polarization-maintaining fibers, 170
  polarizers, 39
  polarizing angle, 40
  Polaroid, 39
  polished half-block, 194
    frequency domain technique, 213
  positive crystal, 49, 58
  Poynting vector, 13, 51
  principal axis system, 48
  principal dielectric permittivities, 48
  principal refractive indices, 48
  principal states of polarization, 204
<table>
<thead>
<tr>
<th>Index</th>
<th>227</th>
</tr>
</thead>
</table>

**Q**  
quarter-wave plate, 35, 67

**R**  
ray refractive index, 57  
ray surfaces, 58  
ray velocity, 56  
refractive index, 7  
retarder, 35  
right-circular polarization, 22  
Rochon prism, 67  
rotator, 94

**S**  
scalar wave equation, 140  
Sellmeier equation, 150  
single-mode fiber, 145  
  dispersion-shifted, 154  
  material dispersion, 148  
  nonzero-dispersion-shifted, 154  
  pulse dispersion, 148  
  waveguide dispersion, 152  
single-polarization single-mode (SPSM) fibers, 170  
Snell’s law, 66  
state of polarization (SOP), 19  
step-index fiber, 137–139  
  exact vector modes, 156  
  HE and EH modes, 158  
Stokes parameters, 97, 134  
Stokes vector, 100  
  determination of, 106  
  of completely polarized light, 100  
  of partially polarized light, 104  
  of unpolarized light, 104  
surface plasmons, 195

**T**  
two-mode fiber sensors, 185

**U**  
uniaxial crystal, 48

**V**  
velocity of light, 6  
Verdet constant, 71

**W**  
wave equation, 6  
wave refractive index, 51  
wave velocity, 50, 54  
waveguide parameter, 142  
Wollaston prism, 69

**Z**  
zero-dispersion wavelength, 154
Arun Kumar received his M.Sc. and Ph.D. degrees in physics from the Indian Institute of Technology Delhi (IITD), in 1972 and 1976, respectively. Since 1977, he has been on the faculty of the physics department at IITD, where he has been a professor since 1995. He has been a visiting scientist at the Technical University of Hamburg, Germany (1980–1981); the Opto-electronic Group, Strathclyde University, Glasgow, UK (1988); the National Institute of Standards and Technology, Boulder, Colorado (1993–1994); the University of Nice, France (1996); and the University of Jean Monnet, Saint Etienne, France (several times). He has authored/coauthored more than 90 research papers in international journals and has supervised/co-supervised ten Ph.D. theses in the area of fiber and integrated optics.

A perturbation method for the analysis of rectangular-core waveguides, developed by Kumar and coworkers, is now known as the “Kumar method” in the literature. Kumar is a recipient of research fellowships from the Alexander von Humboldt Foundation of Germany (1980–1981) and the Indian National Science Academy (INSA) (1990–1992). His research interests are in the fields of optical waveguides, fiber and integrated optic devices, polarization mode dispersion, and plasmonic waveguides.


Professor Ghatak is the recipient of several awards, including the 2008 SPIE Educator Award in recognition of “his unparalleled global contributions to the field of fiber optics research, and his tireless dedication to optics education worldwide and throughout the developing world, in particular” and the 2003 Optical Society of America Esther Hoffman Beller Award in recognition of “his
outstanding contributions to optical science and engineering education.” He is also a recipient of the CSIR Shanti Swarup Bhatnagar Award, the 16th Khwarizmi International Award, the International Commission for Optics Galileo Galilei Award, and the Meghnad Saha Award (instituted by The University Grants Commission) for outstanding research contributions in theoretical sciences. He received a D.Sc. (Honoris Causa) from the University of Burdwan in 2007.