

Contents

Preface	v
1 Introduction	1
1.1 General properties	1
1.2 Bosons	8
1.3 Fermions	13
1.4 Perturbation theory	14
1.5 B.C.S. theory	16
1.6 Hybridization with a localized band	22
2 Flux Quantization	27
2.1 Josephson's discovery	27
2.2 Flux quantum	30
2.3 Fluxoid quantization in valence bonds.	36
2.4 Flux creep.	38
2.5 Fractional flux.	42
3 Flux Lattices	46
3.1 Ginzburg-Landau model	46
3.2 Abrikosov vortices	48
3.3 Flux-lattice melting	55
4 Magnetization	75
4.1 Magnetization of a type-II superconductor	75
4.2 Para-Meissner effect.	79
5 Microwave absorption	102
5.1 Electron spin resonance	102
5.2 E.S.R. in a superconductor.	104
5.3 Microwave absorption	107
5.4 Power absorption in one d.c. and one a.c. coil	113

5.5 Observation of Microwave Absorption	114
6 Surface resistance	134
6.1 Surface resistance	134
6.2 Penetration depth	137
6.3 Experimental results	141
6.4 Electric field effect	146
6.5 Electric fields in Ginzburg-Landau model	151
7 Mössbauer effect	156
7.1 The γ -decay schemes	156
7.2 Mössbauer effect	160
7.3 Second-order Doppler shift	166
7.4 Isomer shift	168
7.5 Recoilless fraction in a superconductor	171
7.6 Second-order Doppler shift	178
7.7 Goldanski-Karyagin effect	184
8 Levitation	190
8.1 Dipole-dipole interaction	191
8.2 Magnetic energy	193
8.3 Quantized levitation	197
8.4 Measurement of force between a magnet and a superconductor	201
9 Fractals	205
9.1 Critical exponents	205
9.2 Dimensionality of a fractal	208
9.3 Debye-Waller factor	211
9.4 Light scattering	214
9.5 Measurements of fractional dimensions	219
9.6 Fractal upper critical field	220
9.7 Fractal flux lattice melting	223
9.8 Fractal growth of magnetic field	228

10 Nuclear Magnetic Resonance	232
10.1 Nuclear magnetic resonance	232
10.2 Knight shift	234
10.3 Nuclear relaxation	235
10.4 Coherence length and susceptibility	243
10.5 Structure factors	245
10.6 Experimental relaxation rates	247
10.7 Nuclear relaxation in mixed-wave superconductors	250
10.8 Nuclear relaxation measurements	254
Appendix-A Superconducting compounds	259
Appendix-B Isotope effect	277
Appendix-C Symmetries	290
Appendix-D Pseudogap	310
Appendix-E Relativistic effects	314
Appendix-F Soft vortices	320
Appendix-G Specific heat	329
Appendix-H Quantum Hall effect	337
Author Index	353
Subject Index	360