

Contents

CONTENTS OF VOLUME 2

10. DIELECTRICS

10.1.	Macroscopic quantities in an atomic medium	294
10.2.	Macroscopic polarization and the local field	296
10.3.	The Lorentz correction and the Clausius–Mossotti relation	298
10.4.	Static permittivity of non-polar gases	300
10.5.	Static permittivity of polar gases	302
10.6.	Dispersion in gases	305
10.7.	Static permittivity of liquids	311
10.8.	Dispersion in polar liquids	313
10.9.	Ionic solids	317
10.10.	Ionized media and plasma oscillations	325
	References	327
	Problems	327

11. FREE ELECTRONS IN METALS

11.1.	Quantum theory of free electrons in metals	330
11.2.	Extension to finite temperatures: the Fermi–Dirac distribution function	334
11.3.	Work function and contact potential	337
11.4.	The photoelectric effect and secondary emission	340
11.5.	Thermionic emission and field emission	343
11.6.	Heat capacity of the conduction electrons	348
11.7.	Electrical and thermal conductivity	351
11.8.	Thermoelectricity	354
11.9.	Electron-electron interaction	360
	References	360
	Problems	361

12. THE BAND THEORY OF METALS

12.1.	The wave equation for free electrons	362
12.2.	The energy-band approximation	364
12.3.	Electrons in a periodic potential	366
12.4.	Particle aspects	370
12.5.	Conductors and insulators on the band theory	374
12.6.	Electronic heat capacity	377
12.7.	Variation of electrical conductivity with temperature	378
12.8.	Variation of thermal conductivity with temperature	383
12.9.	Thermoelectric power	385
12.10.	The anomalous skin effect	387
12.11.	The Hall effect	388
12.12.	Conduction electrons in a strong magnetic field	390
	References	395
	Problems	395

13. SUPERCONDUCTIVITY	
13.1. Introduction	397
13.2. The Meissner effect	399
13.3. Thermodynamics of the superconducting state	402
13.4. The London equations	407
13.5. The Pippard coherence length	409
13.6. The Bardeen–Cooper–Schrieffer (BCS) theory	411
13.7. The energy gap	414
13.8. Type I and Type II superconductors	418
13.9. The Josephson effect	423
13.10. Conclusion	429
References	430
Problems	431
14. PARAMAGNETISM	
14.1. A general precession theorem	432
14.2. The vector model of the atom	434
14.3. Magnetic moments of free atoms	442
14.4. The measurement of atomic magnetic moments—the Stern–Gerlach experiment	446
14.5. Curie's law and the approach to saturation	448
14.6. Susceptibility of paramagnetic solids—the 4f group	450
14.7. Susceptibility of paramagnetic solids—the 3d group	456
14.8. Susceptibility of paramagnetic solids—strongly bonded compounds	463
14.9. Electronic paramagnetism—a summary	465
14.10. Nuclear moments and hyperfine structure	467
14.11. Magnetism of conduction electrons	470
References	474
Problems	474
15. FERROMAGNETISM	
15.1. Exchange interaction between paramagnetic ions	477
15.2. The Weiss theory of spontaneous magnetization	481
15.3. Ferromagnetic domains	485
15.4. The gyromagnetic effect	491
15.5. Thermal effects in ferromagnetism	494
15.6. Measurement of the spontaneous magnetization M_0 as a function of temperature	497
15.7. Spin waves	500
15.8. Mechanisms of exchange interaction	503
References	509
Problems	510
16. ANTIFERROMAGNETISM AND FERRIMAGNETISM	
16.1. Antiferromagnetism	511
16.2. The molecular field and two-sublattice model	512
16.3. Ferrimagnetism	519
16.4. The lanthanide ('rare-earth') metals	524
References	527
Problems	527

17. SEMICONDUCTORS	
17.1. Intrinsic and extrinsic conductivity	528
17.2. Elementary and compound semiconductors	530
17.3. Electron distribution and the Fermi level	534
17.4. Optical properties	539
17.5. Transport properties	544
17.6. Metal-semiconductor junctions	552
17.7. Theory of the p-n junction	557
References	561
Problems	562
18. SOLID-STATE DIODES	
18.1. Introduction	564
18.2. The p-n junction	565
18.3. The Zener diode	569
18.4. Rectification	571
18.5. Amplitude modulation and detection	573
18.6. Frequency changing	576
18.7. Frequency modulation	579
18.8. The point-contact diode	583
References	583
Problem	583
19. SOLID-STATE TRIODES	
19.1. The junction transistor	584
19.2. Characteristics of the junction transistor	588
19.3. Equivalent circuits for the junction transistor	592
19.4. The field-effect transistor, or FET	596
19.5. The MOS field-effect transistor, or MOSFET	602
19.6. Summary of transistor properties	605
References	605
20. AMPLIFIERS AND OSCILLATORS	
20.1. Negative feedback	606
20.2. Feedback and stabilization of a transistor amplifier	610
20.3. The small-signal low-frequency amplifier	613
20.4. Amplification at radio-frequencies	616
20.5. Power amplifiers	618
20.6. Oscillators	621
20.7. The multivibrator	624
20.8. The operational amplifier	627
References	630
21. THERMIONIC VACUUM TUBES	
21.1. The thermionic diode	631
21.2. The thermionic triode	632
21.3. Effect of transit time on input conductance	637
21.4. The klystron	639
21.5. The magnetron	645
21.6. Travelling-wave tubes	650
References	650
Problems	650

22. ALTERNATING CURRENT MEASUREMENTS	
22.1. Measurement of voltage, current, and power	652
22.2. Alternating-current bridges	658
22.3. The <i>Q</i> -meter	664
22.4. Measurements on lines	665
22.5. Measurement of frequency and wavelength	669
22.6. Measurement of electric permittivity	674
22.7. Measurement of the velocity of radio waves	676
References	678
Problems	679
23. FLUCTUATIONS AND NOISE	
23.1. Brownian motion and fluctuations	681
23.2. Fluctuations in galvanometers	683
23.3. The relation between resistance noise and thermal radiation	687
23.4. Shot noise	690
23.5. Design of receivers for optimum performance (minimum noise figure)	694
23.6. Noise in solid-state triodes	697
References	699
Problems	700
24. MAGNETIC RESONANCE	
24.1. The magnetic-resonance phenomenon	701
24.2. Molecular beams and nuclear magnetic resonance	705
24.3. Nuclear magnetic resonance in bulk material	709
24.4. Relaxation effects in nuclear magnetic resonance	712
24.5. Applications of nuclear resonance	716
24.6. Electron magnetic resonance in atomic beams	719
24.7. Electron magnetic resonance in solids	722
24.8. Cyclotron resonance with free charged particles	729
24.9. Cyclotron resonance in semiconductors	733
24.10. Azbel-Kaner resonance in metals	738
References	741
Problems	741
APPENDIX: NUMERICAL VALUES OF THE FUNDAMENTAL CONSTANTS	744
APPENDIX: SOME USEFUL UNIT CONVERSIONS	745
INDEX	747