

TABLE OF CONTENTS

	Personnel	vi
	Publications and Reports	x
	Introduction	xiii
I.	Physical Electronics	1
	Physical Electronics in the Solid State	1
	Conduction in Zinc Sulphide Single Crystals	1
	Surface States on Semiconductors	2
	Characteristics of Semiconductor Junctions	3
	Electron Emission	4
	The Thermionic Diode as a Heat-to-Electric-Power Transducer	4
	Experimental Techniques	5
	Transistor-Regulated Power Supply	5
II.	Microwave Gaseous Discharges	8
	Microwave Noise Radiation from Plasmas	8
	Electromagnetic Containment of Charged Particles	10
	The Interaction of a Plasma Beam with a Magnetic Field	12
	Effect of Ions on RF Conductivity of a Magnetized Plasma	17
	Microwave Properties of Warm, Anisotropic Plasmas	21
III.	Plasma Dynamics	23
	Hydromagnetic Waveguide	23
	Hydromagnetic Instabilities	26
	Studies of Magnetohydrodynamic Shocks	27
	Construction and Instrumentation of a T Tube for Magnetically Driven Shocks	28
IV.	Solid State Physics	31
	Elastic Constants of Sodium Iodide	31
	Recombination of Electrons with Donors	32
	An Application of Cyclotron Resonance to the Study of Collision Times and Densities of Carriers at Low Temperatures in Germanium	38
V.	Thermoelectric Processes and Materials	40
	Research Objectives	40

CONTENTS

VI.	Microwave Spectroscopy	42
	Interaction of Paramagnetic Spins with Lattice Phonons	42
	Phonon-Spin Absorption Coefficients in Paramagnetic Crystals	43
	A Tunable Ruby Maser with Large Bandwidth	44
	Ammonia Maser	47
	Antiferromagnetic Resonance	47
	Paramagnetic Resonance	48
	Nuclear Relaxation	48
VII.	Nuclear Magnetic Resonance and Hyperfine Structure	51
	Hyperfine Structure of Radio-Thallium	51
	The Relation between the g-Factors and the Lifetimes of Excited States of Two-Electron Atoms	53
	A High-Resolution Dispersion and Intensity Spectrograph	54
	Hall Effect in the Plasma of a Lamp Containing Mercury Vapor in Argon	58
VIII.	Microwave Electronics	59
	Perturbation Formula for Ferrite-Filled Cavity	59
	Small-Signal Energy Theorem for Beams with Zero Curl of Generalized Momentum	61
	Klystron Gap Theory	64
IX.	Atomic Beams	69
	Measurement of the Velocity of Light	69
X.	Frequency Modulation	74
	An Oscillating Limiter for the Suppression of Interference in FM Receivers	74
	Capture of the Weaker Signal	78
XI.	Statistical Communication Theory	81
	Measurement of First- and Second-Order Probability Densities	81
XII.	Stroboscopic Research	89
XIII.	Statistical Thermodynamics	92
	On the Nature of the λ -Line of Liquid Helium	92
	Distribution Functions in Statistical Thermodynamics	94

CONTENTS

XIV.	Physical Acoustics	95
	Introduction	95
	Noise Generation by Interacting Air Jets	95
	Field Measurements of Scatter Attenuation of Sound in the Atmosphere	99
	Scattering of Sound by Turbulence	101
	Experiments with Spherical Ultrasonic Sources	103
	Measurement of the Attenuation of Sound in Metal Rods	105
	Audibility of Airborne Ultrasound	106
	Effect of a Plane on the Power Output of a Monopole	107
	The Acoustic Impedance of a Flexible, Porous Material	110
XV.	Speech Communication	112
	Terminal Analog Speech Synthesizer	112
XVI.	Communications Biophysics	115
	Electrophysiological "State Functions" and the Handling of Sensory Information	115
	"Steady-State" Auditory Nerve Responses to Bursts of Noise at Different Repetition Rates	116
XVII.	Network Synthesis	119
	Exact Solution of the Approximation Problem for Equiripple RC Filters	119
	Synthesis of a Constant Reactive Transfer Function	119
XVIII.	Circuit Theory	121
	Sensory Aids Program: Reading Machines	121