

TABLE OF CONTENTS

Personnel	vi
Publications and Reports	ix
Introduction	xii
I. Physical Electronics	1
Electron Emission Problems	1
New Method for Emission Evaluation Applicable to Oxide Cathodes	1
Reflection of Slow Electrons at a Metal Surface	6
Physical Electronics in the Solid State	7
Hall Effect in Lead-Sulfide Films	7
Electric Properties of Ion-Bombarded Germanium Surfaces	8
Surface Studies on Semiconductors	9
Gaseous Discharges	9
Ion Generation, Distribution Functions, and Probe Measurements	9
Experimental Techniques	10
Null Rotating Coil Magnetometer	10
Ionization Gauge Control Circuit	11
Spectral Emissivity of the Refractory Metals	14
II. Microwave Gaseous Discharges	15
Plasma Oscillations	15
High-Density Microwave Plasma	16
Striations in a Microwave Discharge	17
Pulse Breakdown in Gases	18
Microwave Investigation of Nitrogen Afterglow	19
III. Solid State Physics	22
IV. Low Temperature Physics	23
V. Microwave Spectroscopy	24
Molecular Motion in Electrostatic Fields	25
Weak-Field Zeeman Effect in N ¹⁴ H ₃	26
A Simple Frequency Discriminator	27
Traveling-Wave Cavity	28
Paramagnetic Resonance	29
VI. Nuclear Magnetic Resonance and Hyperfine Structure	30
High-Speed Pole-Face Scanner	31
Homogeneous Fields Produced by Distributions of Poles	31
Nuclear Magnetic Resonance in Solids	32
Isotope Shift of Mercury 197-197*	33

CONTENTS

	The Hyperfine Structure of the 3P_1 State of Mercury by Double-Resonance Methods	34
	Lifetime of the 3P_1 State of Cadmium	35
	Nonradiative Transfer of Energy between Atoms in a Vapor	35
	Intensity Measurements of Resonance Radiation from Mercury Arcs	36
	Double-Resonance Calculations	40
	Coincidence Techniques	40
	Radiofrequency Method	40
	Optical Method	41
VII.	Microwave Electronics	44
	Noise Measurements	44
	Minimum Noise Figure of Traveling-Wave Amplifiers	44
	Measurement of Noise Figure	45
	Beam Noise Measurement	46
	Low-Noise Traveling-Wave Tubes at 500 Mc/sec	46
	Noise Theory	46
	Invariants of Linear Noisy Networks	46
	Shot Noise in Transistors	50
	Dense Beam Studies	51
	Klystrons	55
	Distributed Klystron Theory	55
	Distributed Klystrons	58
	Phase Bunching for a Synchrotron	58
VIII.	Atomic Beams	59
	Proposed Measurement of the Velocity of Light in Terms of Two Primary Standards, Cesium (Cs^{133}) and Mercury (Hg^{198})	59
	Measurements of Length	68
	Theory of Hyperfine Structure	70
IX.	Stroboscopic Research	75
X.	Multipath Transmission	76
XI.	Statistical Communication Theory	77
	Multiple Nonlinear Prediction	77
	An Application of Prediction Theory to Information Rates	80
	An Outline of Lebesgue Theory for Engineers	91
	Synthesis for Interference Filtering	92
	A Proof of the Nonintersecting Loop Rule for the Solution of Linear Equations by Flow Graphs	97
	Properties of Second-Order Autocorrelation Functions	102

CONTENTS

	A Compensator for the Digital Electronic Correlator	104
	A Level Selector Tube	107
XII.	Processing and Transmission of Information	108
	Time-Varying Linear Binary Circuits	109
	Design of Linear Sequence Filters for Arbitrary Impulse Response	111
	Timing Considerations in Clocked Switching Circuits	113
XIII.	Transistor Circuits	116
	Transistor Circuitry	116
XIV.	Semiconductor Noise	120
	The Effect of Low-Frequency Filtering on a Nongaussian Amplitude Probability Distribution	120
XV.	Irreversible Thermodynamics	124
	Theory of Thermal Noise	124
XVI.	Speech Analysis	127
	Acoustical Properties of Stop Sounds	127
XVII.	Mechanical Translation	131
XVIII.	Sensory Replacement	132
	Travel Aid	132
	The Vocatac	133
XIX.	Communications Biophysics	138
	Responses from the Auditory Nervous System to Bursts of Noise	138
	Correlation Studies of Electroencephalograms	141
XX.	Neurophysiology	146
	Synaptic Transmission and Primary Afferent Fibers	146
	Tremor	147
	DC Amplifier	147
	Sensory Processes	147
	Intracellular Electrode Potentials	148
	Pulse-Interval Meter	148
XXI.	Nonlinear Circuits	149
	Piecewise-Linear Transfer Function Synthesis	149
	Tuned Circuits Containing "Unsuitable" Negative Resistance	152
XXII.	Network Synthesis	158