TABLE OF CONTENTS

Personnel v

Publications and Reports xiv

Introduction xviii

GENERAL PHYSICS

I. Microwave Spectroscopy 1
   Propagating Waves in High Dielectric Waveguide of Square Cross Section 1

II. Radio Astronomy 9
   Anomalous Oxygen Absorption Inferred from Nimbus-5 Microwave Experiment 9
   Stellar Interferometer: Digital Filters 15

III. Electrodynamics of Media 21
   Subsurface Probing and Communication with a Magnetic Dipole 21

PLASMA DYNAMICS

IV. Plasmas and Controlled Nuclear Fusion 27
   Waves and Radiation 27
   Comparison of Stark-Broadened Optical Line Shapes Caused by Holtsmark and Gaussian Microfields 27
   Pulse Evolution of Second-Order Wave-Wave Interactions 31
   Diffusion and Turbulence 38
   Some Fast Inexpensive Line Pulsers Now in Use 38
   Linear Analysis of the "One-Half Cyclotron Frequency" Instability 41
   Fusion-Related Studies 47
   Experimental Determination of the Expected Lifetime of a Theta-Pinch First Wall 47
   High-Temperature Plasma Physics 57
   Current-Driven Instabilities in a Plasma 57

V. Gaseous Electronics 65
   High-Pressure TEA CO₂ Laser 65
   Evolution of Field in Bound-Free Laser Systems 67
CONTENTS

VI. Applied Plasma Research 71
   Active Plasma Systems 71
   Use of MACSYMA in the Symbolic Derivations of Nonlinear Coupling Coefficients 71
   Third-Order Nonlinear Theory of Wave-Wave Interactions 84
   Laser-Plasma Interactions 99
   CO₂ Short-Pulse Amplification Studies 99
   Amplification of Two High-Intensity Nanosecond TEA CO₂ Laser Pulses (AHN) 109

COMMUNICATION SCIENCES AND ENGINEERING

VII. Processing and Transmission of Information 115
    An Optimum Receiver for the Binary Coherent State Quantum Channel 115

VIII. Linguistics 121
     Some Effects of Adaptation on Speech Perception 121

IX. Cognitive Information Processing 131
    Localization of Cellular Structures 131

X. Neurophysiology 141
    Autoradiographic Study of Changes in the Frog Tectum after Cutting the Optic Nerve 141
    Presence of Monoamines in the Salamander Tectum and Their Relation to the Spinal Lemniscus 147

XI. Signal Processing 155
    Simulator of Auditory Localization Cues 155

XII. Digital Signal Processing 157
    Pole-Zero Modeling Using Cepstral Prediction 157

Author Index 161

Research Support Index 162