

# Contents

chapter 1	LINEAR SYSTEM THEORY	I
1.1	The Statistical Point of View	1
1.2	The Superposition Integral	2
1.3	Constant and Time-Varying Systems	5
1.4	Stability Conditions	8
chapter 2	STATISTICS OF RANDOM VARIABLES	11
2.1	Probability Theory	11
2.2	Discrete and Continuous Random Variables	14
2.3	Transformations of a Random Variable	19
2.4	Elements of Statistical Measure	20
2.5	Two-Dimensional Random Variables	23
chapter 3	RESPONSE TO DISTRIBUTED INPUTS	31
3.1	Constant Random Signals	31
3.2	Random Time Functions	33
3.3	Ensemble Correlation Functions	34
3.4	Time Correlation and Spectral Density	38
3.5	Noise Considerations	42
3.6	The Signal-Noise Balance	48
chapter 4	SYSTEMS ANALYSIS AND DESIGN	51
4.1	The General Approach	51
4.2	The Adjoint Method of Analysis	52
4.3	Perturbation Techniques	55
4.4	Homing Missile System Design	61

chapter 5	OPTIMUM SYSTEMS	71
5.1	Introduction	71
5.2	Error Criteria	73
5.3	Minimum Instantaneous Mean-Squared Error	73
5.4	Determination of the Optimum Impulse Response	78
5.5	The Optimum System Block Diagram	84
chapter 6	APPLICATIONS IN OPTIMAL SYNTHESIS	88
6.1	Fire Control	88
6.2	Tracking and Prediction	95
6.3	Guidance and Navigation	102
chapter 7	OPTIMIZATION WITH MULTIPLE INPUTS AND OUTPUTS	110
7.1	General Approach	110
7.2	Redundant Signal Processing	112
7.3	Selective Processing	118
7.4	Independent Processing	122
chapter 8	OPTIMIZING INPUTS FOR SPECIFIED LINEAR SYSTEMS	126
8.1	General Considerations	126
8.2	First-Order Systems with Minimum Error	128
8.3	Multi-Dimensionality and High-Order Systems	134
8.4	Statistical Considerations	141
chapter 9	MULTI-DIMENSIONAL, NONLINEAR, BOUNDARY- VALUED VARIATIONAL PROBLEMS	146
9.1	Introduction	146
9.2	Difficulties in the Classical Approach	148
9.3	Utility of the Dynamic Programming Approach	152
9.4	General Method for Numerical Solution	158
9.5	Additional Considerations	163
9.6	Stochastic Problems	168
appendix I	GENERAL STABILITY CONSIDERATIONS	171

CONTENTS	xi
appendix II MINIMUM MEAN-SQUARED ERROR FOR LINEAR SYSTEMS WITH MULTIPLE INPUTS AND OUTPUTS	175
appendix III PARAMETRIC EXPANSION FOR MINIMUM WEIGHTED SQUARED ERROR	177
appendix IV THE VARIATIONAL PROBLEM OF MAYER	180
references	185
index	189