

# Contents

<i>Preface</i>	<i>xi</i>
<i>Acknowledgments</i>	<i>xv</i>
<b>1. Introduction to optimization</b>	<b>1</b>
1.1 Optimal problem formulation	2
1.2 Engineering applications of optimization	5
1.3 Optimization techniques	6
Further reading	7
<b>2. Linear programming</b>	<b>9</b>
2.1 Formulation of the problem	9
2.2 Graphical method	17
2.3 General LPP	28
2.4 Simplex method	33
2.5 Artificial variable techniques	51
2.6 Duality Principle	58
2.7 Dual simplex method	65
Further reading	70
<b>3. Single-variable nonlinear optimization</b>	<b>71</b>
3.1 Classical method for single-variable optimization	72
3.2 Exhaustive search method	75
3.3 Bounding phase method	78
3.4 Interval halving method	80
3.5 Fibonacci search method	84
3.6 Golden section search method	88
3.7 Bisection method	92
3.8 Newton—Raphson method	94
3.9 Secant method	97
3.10 Successive quadratic point estimation method	98
Further reading	102
<b>4. Multivariable unconstrained nonlinear optimization</b>	<b>103</b>
4.1 Classical method for multivariable optimization	103
4.2 Unidirectional search method	107

4.3	Evolutionary search method	108
4.4	Simplex search method	112
4.5	Hooke—Jeeves pattern search method	120
4.6	Conjugate direction method	125
4.7	Steepest descent method	127
4.8	Newton's method	130
4.9	Marquardt's method	131
	Practice set	132
	Further reading	134
<b>5.</b>	<b>Multivariable constrained nonlinear optimization</b>	<b>135</b>
5.1	Classical methods for equality constrained optimization	135
5.2	Classical methods for inequality constrained optimization	143
5.3	Random search method	147
5.4	Complex method	148
5.5	Sequential linear programming	151
5.6	Zoutendijk's method of feasible directions	153
5.7	Sequential quadratic programming	155
5.8	Penalty function method	160
5.9	Interior penalty function method	162
5.10	Convex programming problem	163
5.11	Exterior penalty function method	166
	Practice set	168
	Further reading	169
<b>6.</b>	<b>Geometric programming</b>	<b>171</b>
6.1	Posynomial	172
6.2	Unconstrained geometric programming program	173
6.3	Constrained optimization	184
6.4	Geometric programming with mixed inequality constraints	188
	Practice set	188
	Further reading	189
<b>7.</b>	<b>Dynamic programming</b>	<b>191</b>
7.1	Characteristics of dynamic programming	192
7.2	Terminologies	194
7.3	Developing optimal decision policy	198
7.4	Multiplicative separable return function and single additive constraint	204
7.5	Additive separable return function and single additive constraint	207

7.6 Additively separable return function and single multiplicative constraint	209
7.7 Dynamic programming approach for solving a linear programming problem	209
7.8 Types of multilevel decision problem	211
Practice set	218
Further reading	221
<b>8. Integer programming</b>	<b>223</b>
8.1 integer linear programming	223
8.2 Integer nonlinear programming	245
Practice set	247
Further reading	252
<b>9. Multiobjective optimization</b>	<b>253</b>
9.1 Global criterion method	262
9.2 Utility function method	265
9.3 Inverted utility method	265
9.4 Bounded objective function method	266
9.5 Lexicographic model	267
9.6 Goal programming method	268
Further reading	270
<b>10. Nature-inspired optimization</b>	<b>271</b>
10.1 Genetic algorithm	271
10.2 Neural network-based optimization	280
10.3 Ant colony optimization	287
10.4 Particle swarm optimization	292
Further reading	295
<i>Index</i>	297