CONTENT

		Page
	List of Contributors Preface	xvii xix
	Ticracc	AIA
Part	1 Mathematics of Cost Comparisons	
1.	Introduction	3
1.1	Status of Cost Engineering	3
1.2	Scope	4
1.3	Cost Engineering in Education	4
	NOMENCLATURE	6
2.	Equivalence and Cost Comparisons	13
	TIME VALUE OF MONEY AND EQUIVALENCE	13
2.1	Compound Interest as an Operator	13
2.2	Uniform Annual Amount, Unacost	17
2.3	Mathematics of Finance	20
2.4	COST COMPARISONS	24
2.4	Comparisons with Equal Duration	24
2.5	Comparisons with Unequal Durations – Common Denominator of Service Lives	25
2.6	Cost Comparison by Conitalized Cost	26
2.7	Cost Comparison by Capitalized Cost	27
2.8 2.9	Examples of Cost Comparisons Finding the Best Alternative	29 33
2.10	Considerations in Cost comparison	35
2.10	The Two Time Factors	36
2.11	Procedure for Cost Comparisons	37
2.12	NOMENCLATURE	38
	PROBLEMS	38
	REFERENCES	44
3.	Depreciation and Taxes : Equivalence after Taxes	46
	DEPRECIATION AND TAXES	46
3.1	Nature of Depreciation	46
3.2	Depreciation Terms	47
3.3	Straight-Line Depreciation (SL)	49
3.4	Sinking-Fund Depreciation (SF)	50
3.5	Declining –Balance Depreciation (DB)	52
3.6	Declining-Balance Depreciation Reducing to Salvage Value	52
3.7	Sum-of-the-Yeats-Digits Depreciation (SD)	53
3.8	Units-of-Production Depreciation (UP)	53
3.9	Taxes and Depreciation	53
3.10	Comparison of Methods	55
3.11	Special Considerations	55
3.12	Depletion	57
2 12	COST COMPARISON AFTER TAXES Propert Value After Toyon	60
3.13	Present Value After Taxes Procedure for Cost Comparison ofter Taxes	60
3.14	Procedure for Cost Comparison after Taxes NOMENCLATURE	64 66
	PROBLEMS	66 67
	REFERENCES	70

4. 4.1 4.2 4.3 4.4 4.5 4.6 4.7 4.8 4.9	Continuous Interest and Discounting Logic for Continuous Interest Continuous Interest as an Operator Uniform Flow Flow Changing at an Exponential Rate Flow Declining in a Straight Line to Zero Equivalent Uniform Flow Capitalized Cost Income Tax Equivalence NOMENCLATURE PROBLEMS REFERENCES	71 71 71 73 75 76 78 79 81 82 83 86 87
5.	Profitability	88
5.1	Nature of Profitability	88
5.2 5.3	Criteria for Profitability A Simple Project	88 89
5.4	Payout Time without Interest	89
5.5	Payout Time with Interest	90
5.6	Equivalent Maximum Investment Period	91
5.7	Positive Equivalent Recovery Period	92
5.8	Advantages and Disadvantages of Payout Time	92
5.9 5.10	Return on Original Investment (ROI) Return on Average Investment (RAI)	92 93
5.11	Net Present Value (NPV)	93
5.12	Discounted Cash Flow Rate of Return (DCFRR)	95
5.13		96
5.14	3	102
5.155.16		102 104
5.17	1 0	106
5.18	Classification System for Economic Appraising	108
5.19	Benefit-Cost Analysis	108
5.20	Life Cycle Cost	112
5.21	Cost per Unit or Cost Effectiveness	112
5.225.23	Sensitivity Analysis Uncertainty and Risk Analysis	113 113
5.24	Pitfalls in Profitability Analysis	114
	NOMENCLATURE	117
	PROBLEMS	117
	REFERENCES	121
6.	Inflation	123
6.1	Cost Comparisons under Inflation	123
6.2	Unaburden	123
6.3	Unaburden for Various Costs	125
6.4 6.5	Capitalized Cost Inclusion of productivity	127 127
6.6	Allowance for Inflation	129
	NOMENCLATURE	130
	PROBLEMS	130
	REFERENCES	131
Part	2 Optimization	
7.	Break-Even and Minimum-Cost Analysis	135
7.1	Break-Even Analysis	135
7.2	Economic-Production Charts	136
7.3	Economic-Production Charts above 100 percent Capacity	138
7.4	Economic-Production Chart for Dumping	139

7.5	Nonlinear Economic-Production Charts	140
7.6	One-Product Multiple-Machine Example	143
7.7	Multiple-Products One-Machine Example	145
7.8	Critique of the Use of Break-Even and Minimum-Cost Analysis	146
	NOMENCLATURE	147
	PROBLEMS	147
	REFERENCES	151
8.	Probability, Simulation, Uncertainty	152
	DISCRETE FREQUENCY DISTRIBUTIONS	152
8.1	Distribution Function	152
8.2	Properties of Discrete-Distribution Functions	154
8.3	Cumulative-Distribution Function	156
8.4	Binomial Distribution	157
8.5	Poisson Distribution	158
0.5	CONTINUOUS FREQUENCY DISTRIBUTIONS	159
8.6	Continuous Distributions	159
8.7	Cumulative-Distribution Function	160
8.8	Rectangular or Uniform Distribution	160
8.9	Exponential Distribution	162
8.10	Normal Distribution in Standard Form	163
8.11	Normal Distribution with Arbitrary Parameters	164
0.11	SIMULATION	165
8.12	Monte Carlo Method	165
0.12	UNCERTAINTY AND RISK ANALYSIS	167
8.13		167
8.14	•	167
8.15	·	172
0.13	NOMENCLATURE	174
	PROBLEMS	174
	REFERENCES	174
		1,,
9.	Productivity	178
	DISPLACEMENT	178
9.1	Displacement versus Replacement	178
9.2	One Year More of the Existent	179
9.3	More than 1 Year of the Existent	182
9.4	Uniform-Gradient Series	185
9.5	Best Policy with a Uniform-Gradient Cost	186
9.6	Delay Value of the Existent	189
9.7	A Mathematical Model for Technological Advancement	189
9.8	The MAPI Model	190
9.9	Group Displacement	191
	THE LEARNING CURVE	193
9.10	Practice Improves Performance	193
9.11	The Learning Curve and Learning-Curve Function	194
9.12	Properties of the Learning-Curve Function	196
9.13	Cumulative Values	199
9.14	The Learning Curve and Economic Evaluation	201
9.15	The Learning-Curve Function from Single-Unit Data	201
9.16	The Learning-Curve Function from Grouped Data	202
9.17	Development of Learning-Curve Tables	205
	VALUE ENGINEERING	206
9.18	General Description	206
9.19	Job Plan for Value Engineering	206
9.20	Applications	207
	PRODUCTIVITY	208
9.21	Definition	208
9.22	Other Aspects	209
9.23	Levels of Productivity – Diffusion	211

	NOMENCLATURE	212
	PROBLEMS	213
	REFERENCES	215
1.0		217
10.	Optimization	217
	ONE VARIABLE	217
10.1	Optimization : A Human Trait	217
10.2	Nature of Optimization	218
10.3	Optimization methods	219
10.4	Analytical Method for Optimization	220
10.5	Graphical Method for Optimization	221
10.6	Incremental Method for Optimization	222
10.7	A Cyclic Process	222
10.8	An Example Involving Rate of Return	227
10.9	A Two-Step Example with Recycle	229
10.10	Variocyclic Processes	231
	MULTIVARIABLE OPTIMIZATION	233
10.11	Analytical Method	233
	Graphical Method	234
	Incremental Method	235
	A Two-Variable Optimization Problem	236
	Lagrange Multipliers	237
	Sensitivity and Response Analysis	239
	Simplification of Multivariable Problems	240
	Formulating an Optimization Problem	241
10.10	NOMENCLATURE	242
	PROBLEMS	242
	REFERENCES	242
	REFERENCES	249
11	Subsets in Ontimization	250
11.	Subsets in Optimization	250
	INVENTORY PROBLEMS	250
	Introduction	250
	General Inventory Model	250
	Economic Lot Size	252
11.4	Safety Stock	253
	Finite Rate Delivery	254
11.6	Setting Up Inventory Problems	256
	PROBABILISTIC MODELS	257
11.7	Optimum Stock by Incremental Analysis	257
11.8	Optimum Inventory Based on Expectation	258
11.9	Monte Carlo Simulation in Inventory	259
	QUEUING PROBLEMS	262
11.10	Prevalence	262
11.11	Description of a Queuing System	263
11.12	Classification of Queuing Systems	263
	The Simplest Model	263
	Models Involving Probability	266
	Finite Queuing	266
	General Method with Certainty	267
	General Method with Uncertainty	268
11.17	NOMENCLATURE	270
	PROBLEMS	271
	REFERENCES	275
	KLI LIKLIVELD	213
12.	Linear, Dynamic, and Geometric Programming	276
14.	LINEAR PROGRAMMING	276
12.1		276
	Optimization of an Objective Function Development of Linear Programming Equations	
12.2	Development of Linear-Programming Equations	277
12.3	Slack Variables	278
12.4	Quality Constraints	279

12.5	Method of Solution	279
12.6	Algebraic Method	283
	Simplex Method	284
12.8	Applications	288
	DYNAMIC PROGRAMMING	288
	An Allocation Example	290
	A Transportation Example	290
12.11	Pros and Cons of Dynamic Programming	291
	GEOMETRIC PROGRAMMING	293
	The Format	293
	A Simple Application	295
12.14	Some Comments on Geometric Programming	296
	NOMENCLATURE	296
	PROBLEMS	297
	REFERENCES	301
13.	Special Mathematical Techniques	302
	UNIVARIABLE SEARCH METHODS	302
13.1	Search Techniques	302
	Uniform Search	302
	Uniform Dichotomous Search	304
	Sequential Dichotomous Search	305
	Fibonacci Search Techniques	305
13.6	Comparison of Methods	307
	MULTIVARIABLE FUNCTIONS	308
	One-at-a-Time Method	308
	Method of Steepest Ascent (or-Descent)	309
13.9	Constrained Optimization	311
12 10	SUMMATION OF SERIES	312
	Recurring Power Series Concept Term from a Concepting Function	312
	General Term from a Generating Function	313
13.12	Some Recurring Power Series NOMENCLATURE	314 315
	PROBLEMS	315
	REFERENCES	318
	3 Cost Estimation and Control	
14.	Capital Investment Cost Estimation	321
14.1	Definitions	321
14.2	Types of Estimates	322
14.3	Available information against Accuracy	326
14.4	Cost of making Estimates	326
14.5	Functions of Capital-Cost Estimates	326
	Estimating Techniques	327
14.7	Computer-Aided Estimating	333
	Cost Indexes	334
	Planning Estimates Detailed Estimates Against Preliminary Estimates	341 341
	Equipment Costs for Preliminary Estimates	341
	Equipment Costs for Freminiary Estimates Equipment Costs by Scaling	344
	Turnover Ratios	346
	Investment Costs by Scaling	347
	Power Factors Applied to Plant Costs	347
	Factor Methods of Estimating	348
	The Lang Factor Method	349
	Hand Factors	349
	Chilton Method	351
	Plant Cost by Analytical Procedure	353
	Compartmentalization Methods of Estimating	357
	The miller Method	358

14.23	Building cost	365
14.24	Pipeline costs	365
	Costs of Port Facilities	365
	Power Plant Costs	365
	International Costs	371
14.28	Staying within Limitations NOMENCLATURE	376 376
	PROBLEMS	377
	REFERENCES	378
	TELL EXELLOSES	370
15.	Operating-Cost Estimation	382
	Definitions	382
	Operating-Cost Estimation – General	383
	Raw Materials	386
	Utilities Operation Lohon	388
	Operating Labor Payroll Charges	390 392
	Maintenance	392
	Operating Supplies	393
	Laboratory and Other Service Costs	393
	Waste Disposal and Avoidance of nuisances	393
	Royalties and Rentals	394
	Contingencies	395
	Indirect Costs	395
	Distribution costs	398
	Summary of Operating Cost Estimation Shortcut Methods	399 402
13.10	QUESTIONS	403
	PROBLEMS	404
	REFERENCES	404
		40.5
16.	Cost Control CARITAL COST CONTROL	407
16.1	CAPITAL-COST CONTROL The Nature of Control	407 407
	Capital Expenditure Control	408
	Cost Control	408
	Estimating	413
	Planning and Scheduling	415
16.6	Material Control	416
	OPERATING-COST CONTROL	418
16.7	The Repetitive Nature of Operating Costs	418
	Conjunction with Cost Accounting	418
	Defining Objectives Standard Costs	421 421
	Cost reporting	421
	Corrective Action	422
	Classification of Operating-Cost Control	423
	CRITICAL-PATH METHOD (CPM)	424
16.14	Network Diagrams	424
	A Simple Network	424
	Advantages of CPM	427
16.17	Precedence Diagramming	427
	PROBLEMS DEEEDENCES	428
	REFERENCES	430
	Associated Topics	
17.		
1/.	Cost Accounting	
	BASIC CONCEPTS	435
17.1 17.2		435 435 435 436

17.3	Types of Accounting	437
	The Mechanics of Accounting	438
	Definitions and Classification of Cost	440
	Cost Accounting for Expenditure of Construction Funds	441
	Cost Accounting for manufacturing Operations	441
	Cost Centers and unit costs	442
17.9	Job-Order Costing and Process Costing	442
	OVERHEAD ALLOCATION	444
17.10	Techniques of Overhead-Cost Accounting	444
17.11	Cost Behavior against Activity Volume	446
17.12	Direct Costing and Absorption Costing	447
17.13	Standard Costs and Budgets	447
17.14	Joint Costs	448
	RELATED TOPICS	450
17.15	Inventory Valuation	450
17.16	Depreciation	450
	QUESTIONS	451
	REFERENCES	451
18.	Cost Engineering and Beyond	453
18.1	Elements of complete Cost	453
18.2	Start-Up Costs	453
18.3	Plant Location	455
18.4	Contingencies	456
18.5	Financing	457
18.6	Pricing for Profitability	458
	Levelized Cost	459
	Forecasting	461
	Cash Flow for Financing	463
	Profit	463
	Planning Against Scheduling	464
	Role of the Computer	464
	Management Organization	466
	Legal Aspects	467
	Ethics	471
18.16	Social Aspects	471
	NOMENCLATURE	472
	REFERENCES	473
APPE	ENDIXES	
1.	Discrete Compound Interest	474
2.	Continuous Compound Interest	488
3.	Probability	501
4.	Learning Curve	506
Answ	ers to Problems	510
Index		525