

# Contents

Preface xi

## PART ONE: SENTENTIAL LOGIC 1

Unit 1: Introduction to logic 3

1. Why Study Logic? 4
  2. What Logic Is All About 6
  3. Induction and Deduction 7
  4. Form and Validity 9
  5. Truth and Validity 12
  6. The Nature of Symbolic Logic 13
  7. The Scope of Symbolic Logic 14
- Study Questions 16
- Exercises 16

Unit 2: The structure of sentential logic 18

1. Simple and Compound Sentences 20
  2. The Structure and Symbolism of Sentential Logic 23
- Study Questions 28
- Exercises 29

Unit 3: Computing truth values 31

- 1. Truth Tables for the Operators 32
- 2. Computing Truth Values 41
- 3. Truth-functional Operators 43
- 4. Non-truth-functional Operators 44
- Study Questions 46
- Exercises 47

Unit 4: Symbolizing English sentences 48

- 1. Simple Sentences 49
- 2. Truth-functional and Non-truth-functional Compounds 51
- 3. Symbolizing English Operators 52
- 4. Symbolizing Multiply Complex Sentences 62
- Exercises 66

Unit 5: Truth tables for testing validity 70

- 1. Form and Substitution Instance 72
- 2. Constructing Base Columns for Truth Tables 75
- 3. The Truth Table Test for Validity 79
- 4. Short-cut Validity Tests 84
- 5. Mechanical Decision Procedures 91
- Glossary 92
- Study Questions 93
- Exercises 94

Unit 6: Further applications of the truth table method 97

- 1. Tautologies, Contradictions, and Contingencies 98
- 2. Logical Implication and Logical Equivalence 101
- 3. Consistency 104
- 4. Statements and Statement Forms: Applying Truth Table Concepts 105
- 5. Four Kinds of Truth Table Problems and the Relations Between Them 106
- Glossary for Statement Forms 107
- Glossary for Statements 108
- Study Questions 108
- Exercises 108

Unit 7: The proof method: eight basic inference rules 112

- 1. The Proof Process 114
- 2. Eight Basic Inference Rules 115
- 3. Derivations and Proofs 123
- 4. Constructing Simple Proofs 126
- 5. Constructing More Complex Proofs 132
- Glossary 138
- Exercises 138

Unit 8: Replacement rules 144

- 1. The Structure of Replacement Rules 145
- 2. The Ten Replacement Rules 146
- 3. Constructing Simple Proofs with Replacement Rules 155
- 4. Strategies for More Complex Proofs 158
  - Exercises 165

Unit 9: Conditional proof and indirect proof 170

- 1. Conditional Proof 171
- 2. Indirect Proof 176
- 3. Discharging Assumptions; Restrictions on C.P. and I.P. 179
- 4. Using C.P. and I.P. 181
- 5. Proofs of Theorems 186
- 6. Theory of Proofs 189
  - Glossary 192
  - Exercises 193

PART TWO: MONADIC PREDICATE LOGIC 197

Unit 10: Singular sentences 199

- 1. Singular Sentences and Propositional Functions 201
- 2. Symbolizing Singular Sentences 205
- 3. Subjects and Predicates 208
- 4. Three Senses of "is" 210
  - Glossary 212
  - Exercises 213

Unit 11: Quantifiers 215

- 1. Simple General Sentences 216
- 2. Universal and Existential Quantifiers 218
- 3. Free and Bound Variables, and Related Concepts 220
- 4. Negated Quantifiers 222
  - Glossary 225
  - Exercises 225

Unit 12: Categorical propositions 227

- 1. The Four Categorical Propositions 228
- 2. Individuals, Sets, and Properties 231
- 3. Venn Diagrams 232
- 4. Symbolizing Categorical Propositions 235
- 5. Negated Categorical Propositions 239
- 6. Deriving C.Q.N. Rules from Q.N. Rules 241
- 7. Symbolizing English Categorical Sentences 241
  - Exercises 249

## viii Contents

Unit 13: Complex subjects and predicates	252
1. Complex Subjects and Predicates	253
2. Equivalent Symbolizations	257
Exercises	260
Unit 14: Quantifier form and truth-functional compounds of quantifier statements	263
1. Quantifier Form	264
2. Truth-functional Compounds and Quantifier Form	265
3. Symbolizing Truth-functional Compounds	267
Exercises	268
Unit 15: Proofs in predicate logic	270
1. Preliminary Statement of the Four Quantifier Rules	271
2. Instances of General Formulas	273
3. The Rules of U.I. and E.G.	274
4. The Rules of E.I. and U.G.; Flagging Restrictions	275
5. Constructing Proofs for "Pure" Quantifier Arguments	283
6. Constructing Proofs for Arguments Containing Truth-functional Compounds	290
7. Constructing Proofs of Quantifier Theorems	293
Exercises	295
Unit 16: Invalidity in quantifier logic	298
1. The Natural Interpretation Method	299
2. Truth Conditions for Quantifier Statements	303
3. The Model Universe Method	305
Study Questions	313
Exercises	313
<b>PART THREE: RELATIONAL PREDICATE LOGIC</b>	<b>315</b>
Unit 17: Singular relational statements and simple quantifier statements	317
1. Relational Predicates and Singular Sentences	319
2. Multiple Quantifiers	323
3. Quantifier Negation	330
4. Invalidity in Relational Logic	334
Exercises	336
Unit 18: "Categorical" relational statements	340
1. More Complex Subjects and Predicates	341
2. Symbolizing English Sentences	346
3. Proofs in Relational Predicate Logic	350
Exercises	358

Unit 19: Identity and definite descriptions	360
1. Identity Statements and Their Negations	361
2. Exceptives and “Only” Statements	362
3. Superlatives	365
4. Numerical Statements	366
5. Definite Descriptions	369
Exercises	371
Unit 20: Proofs involving identity	374
1. Rules for Identity	374
2. Proofs Containing Identity Statements	377
Exercises	381
PART FOUR: EXTRA CREDIT UNITS	383
Unit 21: Well-formed-formulas (Wffs) for sentential logic	385
Exercises	387
Unit 22: Polish notation for sentential logic	389
Exercises	391
Unit 23: Proof trees for sentential logic	392
Exercises	395
Unit 24: Using Venn diagrams to prove validity	397
Exercises	401
Unit 25: Symbolization trees	402
Exercises	410
Unit 26: Metatheory and philosophical implications	412
Unit 27: Fitch rules for sentential logic	418
Partial answers to exercises	423
Index	461