

Contents

Preface — V

1 Introduction — 1

- 1.1 Science, technology and technoscience — 1
- 1.2 Contents and objectives of this book — 4
- 1.3 Profile, style and structure of this book — 5

2 Selected concepts of logic and philosophy — 9

- 2.1 Typology of definitions — 9
- 2.2 Elements of logic — 12
 - 2.2.1 Statements and arguments — 13
 - 2.2.2 Elementary rules of deductive inference — 14
 - 2.2.3 Advanced rules of deductive inference — 15
 - 2.2.4 Rules of inductive and abductive inference — 17
- 2.3 Definition and structure of philosophy — 18
 - 2.3.1 Definition of philosophy — 18
 - 2.3.2 Structure of philosophy — 19
- 2.4 Key concepts of epistemology — 20
 - 2.4.1 Truth — 20
 - 2.4.2 Knowledge and information — 23
 - 2.4.3 Scientific laws and theories — 25

3 Science in historical perspective — 27

- 3.1 Protoscience — 27
 - 3.1.1 Ancient Egypt and Mesopotamia — 27
 - 3.1.2 Ancient Greece — 29
 - 3.1.3 Roman empire — 31
 - 3.1.4 Arab empire — 31
 - 3.1.5 Medieval Europe — 32
- 3.2 Classical science — 32
 - 3.2.1 From Copernicus to Newton — 32
 - 3.2.2 From natural philosophy to sciences — 34
 - 3.2.3 From theory to practice — 36
 - 3.2.4 From steady growth to revolution — 38
- 3.3 Technoscience — 39

4 Philosophy of science in historical perspective — 43

- 4.1 Philosophy of protoscience — 43
- 4.2 Philosophy of classical science — 44
- 4.3 Philosophy of science in first half of twentieth century — 48

4.4	Philosophy of science in second half of twentieth century —	51
4.5	Recent trends in philosophy of science —	55
4.5.1	Neo-pragmatism —	56
4.5.2	Naturalism —	57
4.5.3	Scientific realism —	58
4.5.4	Bayesianism —	61
4.5.5	Specialisation —	63
5	Mathematical modelling —	65
5.1	Models in science —	65
5.2	General methodology of mathematical modelling —	70
5.3	Typology and examples of mathematical models —	75
5.4	Causal modelling —	79
5.5	Computational modelling —	87
5.6	Cognitive status of mathematical models —	90
5.6.1	Adequacy and accuracy of mathematical models —	90
5.6.2	Mathematical models and instrumentalism —	95
6	Measurement —	101
6.1	Basic concepts of measurement science —	101
6.2	System of quantities and measurement units —	107
6.3	Mathematical meta-model of measurement —	109
6.3.1	Development step #1 —	110
6.3.2	Development step #2 —	114
6.3.3	Development step #3 —	115
6.4	Interpretation of key concepts of measurement science in terms of mathematical modelling —	119
6.4.1	Measurand —	119
6.4.2	Calibration —	123
6.4.3	Measurement uncertainty —	124
7	Scientific explanation —	129
7.1	Scientific explanation <i>versus</i> scientific prediction —	129
7.2	Nomological explanation —	133
7.3	Causal explanation —	140
7.4	Computer-aided explanation —	148
7.5	Explanatory pluralism —	155
8	Context of discovery —	159
8.1	Discovery <i>versus</i> invention —	159
8.2	Theoretical aspects of technoscientific creativity —	161
8.3	Practical aspects of technoscientific creativity —	165

8.4	Generation of scientific hypotheses —	170
8.5	Pre-selection of scientific hypotheses —	171
9	Context of justification —	177
9.1	Preliminary considerations —	177
9.1.1	Basic concepts —	177
9.1.2	Introductory example —	179
9.2	Underdetermination and Duhem-Quine thesis —	183
9.3	Transformation of hypotheses into scientific knowledge —	185
9.3.1	Inference to best explanation —	185
9.3.2	Scientific evidence and confirmation —	188
9.3.3	Bayesian confirmation —	190
9.4	Research methods and research methodology —	194
9.4.1	Basic concepts —	194
9.4.2	Criteria of good research —	195
9.4.3	Contents of research methodology —	196
10	Uncertainty of technoscientific knowledge —	199
10.1	Preliminary considerations —	200
10.2	Critical <i>versus</i> naïve understanding of scientific method —	201
10.3	Demarcation problem —	202
10.4	Uncertainty of observation and measurement —	206
10.4.1	Basic methods for evaluation of measurement uncertainty —	208
10.4.2	Advanced methods for evaluation of measurement uncertainty —	215
10.5	Uncertainty of technoscientific reasoning —	218
10.6	Mitigation of uncertainty of technoscientific knowledge —	229
11	Basic concepts of Western ethics —	235
11.1	Objectives and motivations —	236
11.2	Elements of metaethics and general ethics —	241
11.2.1	Good, value, morality —	241
11.2.2	Ethics and metaethics —	243
11.2.3	Monistic approaches to ethics —	246
11.2.4	Moral responsibility —	249
11.3	Relation of ethics to humanities, sciences, law and religion —	253
11.3.1	Relation of ethics to other philosophical disciplines —	253
11.3.2	Relation of ethics to sciences —	255
11.3.3	Relation of ethics to law and religion —	257
12	Western ethics in historical perspective —	259
12.1	Ancient and medieval concepts of ethics —	260
12.1.1	Ancient code-based systems of ethics —	260

12.1.2	Ethical intellectualism of Socrates —	260
12.1.3	Eudaimonism of Plato —	261
12.1.4	Virtue ethics of Aristotle —	262
12.1.5	Moralism of stoics —	263
12.1.6	Christian ethics —	264
12.1.7	Ethics of natural law —	265
12.2	Modern concepts of ethics —	266
12.2.1	Ethics of human rights —	266
12.2.2	Moral sentimentalism of David Hume —	266
12.2.3	Formal ethics of Immanuel Kant —	267
12.2.4	Utilitarian ethics —	269
12.2.5	Material ethics of value —	271
12.2.6	Ethics of discourse —	272
12.2.7	Ethics of justice —	273
12.2.8	<i>Weltethos</i> or universal ethics —	274
13	System of values associated with technoscience —	277
13.1	Preliminary considerations —	277
13.2	Typology of values —	279
13.2.1	General characteristics of values —	279
13.2.2	Epistemic and utilitarian values —	281
13.2.3	Ethical and social values —	283
13.2.4	Trust in technoscience —	287
13.3	Conflicts of values —	289
14	Principles of moral decision-making —	297
14.1	Moral dilemmas —	297
14.2	Selected patterns of ethical reasoning —	303
14.2.1	General scheme of moral decision-making —	303
14.2.2	Selected tools of ethical reasoning —	307
14.3	Decision theory <i>versus</i> ethical reasoning —	309
14.4	Perverse effects of morally significant decisions —	318
15	General issues of research ethics —	321
15.1	Metaethical assumptions —	321
15.2	Typology and aetiology of research misconduct —	324
15.2.1	Typology of research misconduct —	324
15.2.2	Aetiology of research misconduct —	326
15.3	Evolution of research ethics —	330
15.4	Choice of a research problem —	331
15.5	Choice of research methodology —	336

- 15.5.1 Ethical background of research methodology — 336
- 15.5.2 Laboratory notebook — 338

16 Ethical aspects of experimentation — 341

- 16.1 Typology of experiment-related misconduct — 341
- 16.2 Experimentation involving humans and animals — 343
 - 16.2.1 Experimentation involving humans — 343
 - 16.2.2 Experimentation involving animals — 348
- 16.3 Acquisition and processing of experimental data — 350
 - 16.3.1 Fabrication, falsification and theft of data — 350
 - 16.3.2 Intentional misinterpretation of data — 353
- 16.4 Technical infrastructure of experimentation — 356
 - 16.4.1 Engineering aspects of experimentation — 356
 - 16.4.2 Safety aspects of experimentation — 358
 - 16.4.3 Ethical aspects of internet experimentation — 359

17 Ethical aspects of information processing — 361

- 17.1 Preliminary considerations — 361
- 17.2 Technoscientific discussion — 361
 - 17.2.1 Principles of rational discussion — 363
 - 17.2.2 Fallacious argumentation — 365
 - 17.2.3 Eristic or art of being right — 368
- 17.3 Publication of research results — 370
 - 17.3.1 Content and form of technoscientific publications — 370
 - 17.3.2 Authorship of technoscientific publications — 376
 - 17.3.3 Publication policy and its ethical implications — 380
- 17.4 Reviewing process — 384
 - 17.4.1 General principles — 384
 - 17.4.2 Editorial practices — 385
 - 17.4.3 Decline of scientific criticism — 388
- 17.5 Research grant applications — 390
- 17.6 Research assessment — 392
 - 17.6.1 Perverse effects of quantophrenic research assessment — 393
 - 17.6.2 Perverse effects of university rankings — 398

18 Legal protection of intellectual property — 401

- 18.1 Basic concepts related to intellectual property — 401
- 18.2 Legal protection of author's rights — 404
 - 18.2.1 Subject and owner of author's rights — 404
 - 18.2.2 Moral *versus* economic author's rights — 406
 - 18.2.3 Scope of personal permissible use — 407
 - 18.2.4 Citation rules — 408

18.3	Legal protection of inventor's rights —	412
18.3.1	Subject of inventor's rights —	413
18.3.2	Moral and economic inventor's rights —	415
18.3.3	Patenting procedure —	416
18.3.4	Limits of inventor's rights —	418
18.3.5	Justification of patent system —	420
18.4	Critical analysis of legal protection of economic author's and inventor's rights —	421
18.4.1	General philosophical argumentation —	422
18.4.2	Argumentation referring to differences between material and intellectual property —	425
18.4.3	Critical analysis of copyright —	427
18.4.4	Critical analysis of patent system —	427
18.5	Future of legal protection of intellectual property —	430
19	Ethical issues implied by information technologies —	439
19.1	Information technology in age of globalisation —	439
19.2	Overview of ethical issues related to use of information technology —	441
19.3	Information technology in research practice —	446
19.4	Netiquette or internet ethics —	450
19.4.1	Netiquette rules —	451
19.4.2	Netiquette <i>versus</i> ethics of journalism —	454
19.5	Ethical issues related to AI-assisted technologies —	457
20	Concluding remarks —	465
20.1	Evolution of research methodology and research ethics —	465
20.2	Education in research methodology and research ethics —	468
Appendix 1 Milestones in history of science — 473		
Appendix 2 Realistic instrumentalism — 493		
References — 505		
Index of names — 531		
Index of terms — 539		