Contents

Introduction 2
Technologies and the future

1 **Materials and components** 6

Metals ... 8
Ceramics ... 14
Polymers ... 18
Composite materials ... 24
Renewable resources ... 30
Wood processing ... 34
Nanomaterials ... 38
Surface and coating technologies ... 42
Intelligent materials ... 48
Testing of materials and structures ... 52
Materials simulation ... 56
Self-organisation ... 60

2 **Electronics and photonics** 64

Semiconductor technologies ... 66
Microsystems technology ... 72
Power electronics ... 78
Polymer electronics ... 84
Magneto-electronics ... 88
Optical technologies ... 92
Optics and information technology ... 98
Laser ... 104
Sensor systems ... 110
Measuring techniques ... 114

3 **Information and communication** 120

Communication networks ... 122
Internet technologies ... 128
Computer architecture ... 134
Software ... 140
Artificial intelligence ... 146
Image evaluation and interpretation ... 150

4 **Life Sciences and biotechnology** 156

Industrial biotechnology ... 158
Plant biotechnology ... 162
Stem cell technology ... 166
Gene therapy ... 170
Systems biology ... 174
Bionics ... 178

5 **Health and Nutrition** 184

Intensive care technologies ... 186
Pharmaceutical research ... 190
Implants and prostheses ... 196
Minimally invasive medicine ... 202
Nanomedicine ... 206
Medical imaging ... 210
Medical and information technology ... 216
Molecular diagnostics ... 222
Assistive technologies ... 226
Food technology ... 230

6 **Communication and knowledge** 236

Digital infotainment ... 238
Ambient intelligence ... 244
Virtual and augmented reality ... 250
Virtual worlds ... 256
Human-computer cooperation ... 262
Business communication ... 268
Electronic services ... 272
Information and knowledge management 276

7 **Mobility and transport** 282

Traffic management ... 284
Automobiles ... 288
Rail traffic ... 294
Ships ... 300
Aircraft ... 304
Space technologies ... 310

8 **Energy and Resources** 316

Oil and gas technologies 318
Mineral resource exploitation 324
Fossil energy 330
Nuclear power 334
Wind, water and geothermal energy 340
Bioenergy 346
Solar energy 352
Electricity transport 358
Energy storage 362
Fuel cells and hydrogen technology 368
Microenergy technology 374

9 **Environment and Nature** 380

Environmental monitoring 382
Environmental biotechnology 388
Water treatment 394
Waste treatment 398
Product life cycles 402
Air purification technologies 406
Agricultural engineering 410
Carbon capture and storage 416

10 **Building and living** 420

Building materials 422
Structural engineering 426
Sustainable building 432
Indoor climate 436

11 **Lifestyle and leisure** 440

Sports technologies 442
Textiles 446
Cosmetics 450
Live entertainment technologies 454
Domestic appliances 458

12 **Production and enterprises** 462

Casting and metal forming 464
Joining and production technologies 470
Process technologies 476
Digital production 482
Robotics 486
Logistics 492

13 **Security and Safety** 496

Information security 498
Weapons and military systems 504
Defence against hazardous materials 510
Forensic science 516
Access control and surveillance 522
Precautions against disasters 528
Disaster response 532
Plant safety 536

Sources of collage images 540

Subject index 541