

Contents

<i>Preface</i>	<i>xi</i>
<i>Acknowledgements</i>	<i>xiii</i>
1. Automotive engineering development	1
<i>R.H. Barnard</i>	
1.1 Introduction	1
1.2 Innovations and inventions	1
1.3 Mass production	3
1.4 The development of the world motor industry	7
1.5 Streamlining	12
1.6 Commercial vehicles	13
1.7 Engine developments	15
1.8 Transmission system development	19
1.9 Steering	21
1.10 Suspension	21
1.11 Brakes	24
1.12 Interior refinement	25
1.13 Safety design	25
1.14 Too much innovation	26
1.15 References and further reading	26
2. Modern materials and their incorporation into vehicle design	29
<i>Rob Hutchinson</i>	
2.1 Introduction	29
2.2 Structure and manufacturing technology of automotive materials	30
2.3 Mechanical and physical properties of automotive materials	41
2.4 Materials selection for automotive components	44
2.5 Component materials case studies	47
2.6 References and further reading	55
3. The manufacturing challenge for automotive designers	57
<i>P.G. Leaney and R. Marshall</i>	
3.1 Introduction	57
3.2 Lean product development and lean production	59
3.3 Design to manufacture as a single process and IPPD	63
3.4 Manufacturing analysis, tools and methods	68
3.5 Materials processing and technology	78
3.6 Conclusions	88
3.7 Acronyms	89
3.8 References and further reading	89

4. Body design: The styling process	93
<i>Neil Birtley</i>	
4.1 Introduction	93
4.2 The studios, working environment and structure	94
4.3 Product planning	97
4.4 Brainstorming	97
4.5 The package	98
4.6 Review of competition	99
4.7 Concept sketching and package related sketching	100
4.8 Full sized tape drawing	102
4.9 Clay modelling	103
4.10 2D systems	108
4.11 3D systems	108
4.12 References and further reading	109
5. Body design: Aerodynamics	111
<i>Robert Dominy</i>	
5.1 Introduction	111
5.2 Aerodynamic forces	111
5.3 Drag	112
5.4 Drag reduction	113
5.5 Stability and cross-winds	117
5.6 Noise	119
5.7 Underhood ventilation	120
5.8 Cabin ventilation	121
5.9 Wind tunnel testing	121
5.10 Computational fluid dynamics	122
5.11 References and further reading	123
6. Chassis design and analysis	125
<i>John Robertson</i>	
6.1 Load case, introduction	125
6.2 Chassis types, introduction	136
6.3 Structural analysis by simple structural surfaces method	143
6.4 Computational methods	152
6.5 Summary	155
6.6 References and further reading	155
7. Crashworthiness and its influence on vehicle design	157
<i>Bryan Chinn</i>	
7.1 Introduction	157
7.2 Accident and injury analysis	158
7.3 Vehicle impacts: general dynamics	162

7.4	Vehicle impacts: crush characteristics	166
7.5	Structural collapse and its influence upon safety	175
7.6	References and further reading	184
8.	Noise vibration and harshness	187
	<i>Brian Hall</i>	
8.1	Introduction	187
8.2	Review of vibration fundamentals	188
8.3	Vibration control	197
8.4	Fundamentals of acoustics	214
8.5	Human response to sound	219
8.6	Sound measurement	219
8.7	Automotive noise criteria	221
8.8	Automotive noise sources and control techniques	223
8.9	General noise control principles	229
8.10	References and further reading	231
9.	Occupant accommodation: an ergonomics approach	233
	<i>J. Mark Porter and C. Samantha Porter</i>	
9.1	Introduction	233
9.2	Eight fundamental fallacies	235
9.3	Ergonomics in the automotive industry	239
9.4	Ergonomics methods and tools to promote occupant accommodation	240
9.5	Case studies	258
9.6	Further trends	269
9.7	Strategies for improving occupant accommodation and comfort	270
9.8	Future reading	271
9.9	Author details	272
9.10	References	273
10.	Suspension systems and components	277
	<i>Brian Hall</i>	
10.1	Introduction	277
10.2	The role of a vehicle suspension	277
10.3	Factors affecting design	278
10.4	Definitions and terminology	278
10.5	The mobility of suspension mechanisms	280
10.6	Suspension types	282
10.7	Kinematic analysis	288
10.8	Roll centre analysis	293
10.9	Force analysis	295
10.10	Anti-squat/anti-dive geometries	302
10.11	Lateral load transfer during cornering	306
10.12	Suspension components	309

10.13 Vehicle ride analysis	316
10.14 Controllable suspensions	326
10.15 References	329
10.16 Further reading	330
11. Control systems in automobiles	333
<i>H. Morris</i>	
11.1 Introduction	333
11.2 Automotive application of sensors	340
11.3 Engine management systems	343
11.4 Electronic transmission control	350
11.5 Integration of engine management and transmission control systems	353
11.6 Chassis control systems	354
11.7 Multiplex wiring systems	364
11.8 Vehicle safety and security systems	365
11.9 On-board navigation systems	368
12. The design of engine characteristics for vehicle use	371
<i>Brian Agnew</i>	
12.1 Introduction	371
12.2 The constant volume or Otto cycle	371
12.3 Deviations from the ideal cycles	375
12.4 The compression process	383
12.5 Progressive combustion	385
12.6 The chemistry of the combustion process	390
12.7 Expansion and exhaust	395
12.8 Recommended reading	399
13. Transmissions and driveline	403
<i>Nick Vaughan and Dave Simmer</i>	
13.1 Introduction	403
13.2 What the vehicle requires from the transmission	404
13.3 The manual gearbox	413
13.4 The automatic transmission	423
13.5 Continuously variable transmissions	437
13.6 Application issues for transmissions	448
14. Braking systems	455
<i>P.C. Brooks and D.C. Barton</i>	
14.1 Introduction	455
14.2 Legislation	460
14.3 The fundamentals of braking	462
14.4 Brake proportioning and adhesion utilization	470

14.5	Materials design	492
14.6	Advanced topics	498
14.7	References and further reading	500
15.	Failure prevention – The role of endurance and durability studies in the design and manufacture of reliable vehicles	503
	<i>F.L. Jones, R. Scott and D.E. Taylor</i>	
15.1	Introduction	503
15.2	Important aspects of failures in the real engineering world	504
15.3	Testing and failure prediction	525
15.4	Automotive technology and the importance of avoiding failures	530
15.5	Case studies – typical examples of automotive failures	535
15.6	References and further reading	546
16.	Future trends in automobile design	553
	<i>J. Happian-Smith and Eric Chowanietz</i>	
16.1	Introduction	553
16.2	Mechanical possibilities	553
16.3	Electrical and electronic possibilities	560
	<i>Index</i>	573