Table of contents

Preface			••••••	10		
	n			15		
1.	Basic notions of modelling					
			l, object, phenomenon	15		
	1.2		igation of phenomena by means of models	18		
		1.2.1	Physical modelling	19		
		1.2.2	Mathematical modelling	21		
		1.2.3	Identification as a method of model formulation	22		
		1.2.4	Investigation of the mathematical model	23		
		1.2.5	Verification of solutions	23		
		1.2.6	Investigation of phenomena—summary	24		
	1.3		pirical and a causal model	25		
	1.4		fluence of purpose of modelling on the final form of the model	28		
	1.5	Discre	ete and continuous models	34		
	1.6	Stocha	astic versus deterministic models	40		
	1.7	Mode	Is related to the differential model	45		
2	The framework for modelling					
		.1 Relationships between mechanics and technology				
			Indamental notions of classical mechanics	53		
		2.2.1	The mechanical system	53		
		2.2.2	Constraints and their classification	54		
		2.2.3	Generalized coordinates	58		
		2.2.4	The number of degrees of freedom	65		
		2.2.5	Representations of the motion in space	67		
		2.2.6	Quasi-coordinates	70		
	2.3		ed notions of integrated mechanics	74		
		2.3.1	A physical system	74		
		2.3.2	Generalized constraints	74		
		2.3.3	Physical variables	75		
		2.3.4	The number of describing functions	77		
		T	the number of deberions functions	.,		

8 Table of contents

		2.3.5	Eulerian and Langrian description of the continuum motion	79			
		2.3.6	The state space	83			
3.	Mo	delling	by means of balance laws	87			
	3.1	Conse	rvation laws versus balance laws	87			
	3.2	Two in	ntroductory examples	92			
	3.3	Metho	dology of modelling by means of balance laws	95			
		3.3.1	The tetrahedron—a mnemonic aid in the modelling process	95			
		3.3.2	Basic laws of mechanics	96			
		3.3.3	Body	100			
		3.3.4	Force	106			
		3.3.5	Motion	108			
		3.3.6	Specific laws of mechanics	115			
		3.3.7	Characteristics of bodies in motion	116			
		3.3.8	Final hints	117			
	3.4		cations	118			
		3.4.1	Parachute with a payload	118			
		3.4.2	Elevator hydraulic amplifier	121			
		3.4.3	The ablation at the nose of the re-entry vehicle	128			
		2.1.5					
4.	Мо	delling	using variational principles	135			
			Newtonian to variational mechanics	135			
		4.1.1	Why variational principles?	135			
		4.1.2	Postulating or deducing the principles?	136			
		4.1.3	Verbal formulation of Hamilton's principle	140			
	42		variational principles	145			
	1.2	4.2.1	Types of principles	145			
		4.2.2	Fundamental concepts	145			
		4.2.3	Differential variational principles	161			
		4.2.4	Integral variational principles	170			
	43		ling of holonomic systems	175			
	4.5	4.3.1	Lagrange equations of the second kind	175			
		4.3.2	The Boltzmann–Hamel equations				
		4.3.3	The Lagrange–Maxwell equations	180			
		4.3.4	Case studies	180			
	11		ling of nonholonomic systems				
	4.4	4.4.1		195			
			Introductory remarks	195			
		4.4.2	Lagrange equations of the first kind with multipliers	197			
		4.4.3	Maggi equations	199			
		4.4.4	The Gibbs–Appell equations	201			
		4.4.5	Case studies	204			
-	14	1 111					
5.	Modelling by means of graphs 2						
	5.1		notions and concepts of graph theory	221			
		5.1.1	What is a graph?	221			

	5.1.2	Different kinds of graph	222
	5.1.3	Matrix representation of a directed graph	228
5.2	A brief	f history of graph theory	230
5.3		near graph modelling method	235
	5.3.1	System, components and terminals	235
	5.3.2	Terminal representation	237
	5.3.3	A system graph	242
	5.3.4	Formulating techniques	244
	5.3.5	The limits of a method	249
5.4	Model	ling of rigid-body systems	251
	5.4.1	Introductory remarks	251
	5.4.2	The key idea	258
	5.4.3	Basic notation conventions	260
	5.4.4	The mathematical description of the interconnection structure	262
	5.4.5	The kinetic energy	267
	5.4.6	The potential energy of gravity forces	272
	5.4.7	The equations of motion	274
	5.4.8	Example	278
	5.4.9	Concluding remarks	284
Poster	mint		285
Postsc	ript		205
References			288
			200
Index			200
index			490