CONTENTS

Prefa		9
Intro	duction	11
PAR	T I DISCRETE SYSTEMS OF THE VAN DER POL TYPE	15
1.	Methods of solution	15
1.1	Basic considerations	15
1.2	Methods of examining the equilibrium position stability and a method	
	of determining the amplitude of the single-frequency self-excited vibra-	
		16
1.3	Analogue solution of steady vibrations	24
2.	Two-mass systems	28
2.1	Survey of the systems analysed and their differential equations of motion	28
2.2	Investigation of equilibrium position stability by the method of boundary	
	values	31
2.3	Investigation of equilibrium position stability by the boundary curves	
	method	41
2.4	The dry friction effect—an approximate method of analysis	46
2.5	Determination of amplitudes	
2.6	Solutions derived by analogue computational methods	
2.7	Systems subject to disturbance pulses; stability investigation	
2.8	Spring non-linearity and its effect on the system	
2.9	Summary	
3.	Three-mass systems with a one-mass basic system	
3.1	Survey of the systems analysed and their equations of motion	
3.2	Boundary curves and optimum tuning	
3.3	The effect of the absorber tuning coefficient on the amplitude of self-excited vibration	
3.4	Solutions derived by analogue methods	
3.5	Summary of the results	
4.	Systems with a multiple-mass basic system	
4.1	Survey of the systems and their equations of motion	
4.2	Boundary curves and the optimum tuning	

6 Contents

4.3 4.4 4.5	The effect of the absorber tuning coefficient on vibration amplitude 191 Results of analogue solutions 208 Summary
PAR	T II ROTOR SYSTEMS 217
5.	Basic assumptions and methods of solution 217
5.1	Basic considerations, description of self-exciting forces 217
5.2	Methods of investigating the stability boundary and determination of
	amplitudes of self-excited vibrations 220
6.	Symmetric rotor systems; the effect of resilient damped mountings 222
6.1	Survey of the systems and their equations of motion 222
6.2	Stability boundary for Model X 227
6.3	Stability boundary for Model XI 230
7.	Asymmetric rotor systems; the effect of resilient damped mountings 245
7.1	Survey of the systems and their equations of motion 245
7.2	Systems with a rigid rotor 251
7.3	Systems with elastic rotors 282
8.	A tuned absorber in rotor systems 290
8.1	Basic considerations and survey of the systems 290
8.2	Incorrect application of a tuned absorber 295
8.3	Tuned absorbers in symmetric systems 296
8.4	Tuned absorbers in asymmetric systems 306
9.	Seals and elastic [mounting of the seal housings; their effect on the
	stability of rotor systems
9.1	Basic considerations 315
9.2	Analytic expression for seal forces 318
9.3	Analysis of a simple model 321
9.4	Elastic mounting of the seal housing 326
PAR	T III VIBRATIONS OF SYSTEMS IN STREAMING FLUID 341
10.	Basic considerations 341
10.1	A survey of the systems analysed 341
10.2	The phase difference between the body displacement and the dynamic
	force of the flow; stability considerations 342
11.	Vibration of an elastic body induced by a cross flow in a straight channel 345
11.1	Vibration model based on the assumption of delayed body deflection 345
11.2	The effect of dry friction; stability investigation and domains of attrac-
	tion 348
11.3	The effect of a tuned absorber 354
11.4	Vibration model based on the velocity equalization principle 356

Contents 7

11.5	The effect of additional dry friction 361
11.6	Stability investigation – domains of attraction 364
11.7	Comparison between the two basic models 368
12.	Elastic body in axial fluid stream; methods of modelling 369
12.1	A model comprising the channel 369
12.2	Systems with non-zero phase difference between the dynamic force and
	the body deflection 374
12.3	Analysis of Model XXV system including dry friction 375
12.4	Concluding remarks 382
13.	Model of a self-controlled system 383
13.1	Basic characteristics of the model 383
13.2	Methods of solution using an analogue computer; the effects of addi-
	tional dry friction and external excitation force 388
13.3	The effect of a tuned absorber 396
13.4	The effect of an elastic damped mounting on stability 400
13.5	Summary of the results 403
14.	Conclusions 405
14.1	Generalized results of stability investigations 405
14.2	Application of the results to real systems 406
Refer	rences 412