

# Contents

<b>Preface</b>	<b>ix</b>
<b>About the Notations</b>	<b>xi</b>
<b>1 Introduction</b>	<b>1</b>
References . . . . .	12
<b>2 Some General Results in Stability Theory</b>	<b>15</b>
2.1 Basic Concepts . . . . .	15
2.2 Linear Systems with Constant Coefficients. Stability by the First Approximation. . . . .	17
2.3 Liapunov Functions . . . . .	23
2.4 Application of Liapunov Functions in Some Problems of Hydraulic Engineering . . . . .	35
Appendix A . . . . .	50
Appendix B . . . . .	51
Appendix C . . . . .	51
Appendix D . . . . .	52
Appendix E . . . . .	53
Appendix F . . . . .	56
Appendix G . . . . .	58
References . . . . .	59

<b>3</b>	<b>Stability Problems in Power Engineering</b>	<b>61</b>
3.1	Stability of Synchronous Generators. Mathematical Models of Synchronous Machine . . . . .	61
	Liapunov Functions Associated with Synchronous Machines	68
	Inherent Stability of Synchronous Machines . . . . .	71
	Stability of the Synchronous Machine with Prime Mover and Speed Governor . . . . .	74
	The Domain of Admissible Manoeuvres . . . . .	78
	The Reduction Principle and Global behaviour of the Synchronous Generator with Prime Mover and Speed Governor . . . . .	80
3.2	Stabilization of Class of Steam Turbines for Heat-Electricity Generation . . . . .	85
	Configurations and Mathematical Models . . . . .	86
	The Invariant Set of the Models . . . . .	87
	Steady-States . . . . .	89
	Systems in Deviations and Inherent Stability . . . . .	91
	Stabilization . . . . .	93
	Appendix 1. The Theorem of G.A. Leonov . . . . .	101
	Appendix 2. A Second Order Equation . . . . .	106
	Appendix 3. Liapunov Equations . . . . .	111
	Appendix 4. The Yakubovich – Kalman – Popov Lemma . . .	113
	Appendix 5. A Result Concerning Exponential Stability . . .	117
	References . . . . .	120
<b>4</b>	<b>Stability Problems in Chemical Engineering</b>	<b>125</b>
4.1	First Model in Chemical Kinetics . . . . .	125
4.2	Stability of Closed Chemical System Subject to Mass – Action Law . . . . .	131
	The Mathematical Model . . . . .	131
	Equilibrium Points . . . . .	138
	The Liapunov Function and its Properties . . . . .	143
	Stability Results and Qualitative Properties . . . . .	148

4.3	Processes in Plate Columns . . . . .	153
4.3.1	The Invariant Set of the Model . . . . .	160
	Steady State Solutions . . . . .	163
	Stability of Steady State . . . . .	173
	Appendix . . . . .	180
	References . . . . .	187
<b>5</b>	<b>Stability Problems in Non – Engineering Fields</b>	<b>191</b>
5.1	Stability of Competitive Equilibrium in Walrasian Economic Model . . . . .	191
	The Model . . . . .	191
	Properties of the Model . . . . .	193
	Stability . . . . .	203
5.2	Volterra Models of Interacting Species . . . . .	205
	Other Properties of Dissipative Communities . . . . .	212
	A Simple Model with Harvesting . . . . .	216
	Appendix 1. Existence of Equilibria in Walrasian Economic Model . . . . .	222
	Appendix 2 . . . . .	231
	References . . . . .	233
	Index . . . . .	235