# CONTENTS


1 INTRODUCTION ..... 1

2 BASIC BIOMECHANICAL PROPERTIES OF THE CARDIOVASCULAR SYSTEM ..... 5

2.1 Biomechanics of the human heart ..... 15

2.1.1 Mechanical processes occurring during the heart cycle ..... 18

2.1.2 The principle of heart valves opening and closing ..... 27

2.2 Conduction of impulses in the heart ..... 34

2.2.1 Cellular membrane bioelectric potentials ..... 40

2.2.2 Heart muscle cells action potential ..... 48

2.2.3 Depolarization of the SA and AV nodes cells ..... 50

2.2.4 Biomechanics of the heart muscle contractile unit (sarcomere) ..... 51

2.2.5 Electrocardiography ..... 60

2.3 Some models of the mechanical response of the left and right ventricles ..... 63

2.3.1 Ventricular compliance ..... 70

2.3.2 Left ventricular work and power ..... 71

2.3.3 Basic models for describing the mechanical response of the right ventricle ..... 76

2.3.4 The functions of the left ventricle with some diseases of the cardiovascular system ..... 76

2.4 Introduction to mathematical modelling of human cardiovascular system ..... 88

References to Chapter 2 ..... 95

3 BASIC MECHANICAL PROPERTIES OF TISSUES OF THE LOCOMOTION SYSTEM

3.1 Introduction ..... 105

3.2 Mechanical properties of tissues of the cardio-vascular system ..... 106

3.2.1 The heart ..... 109

3.2.2 Arteries ..... 112

3.2.3 Veins ..... 141

3.3 Mechanical properties of some other tissues of the human body ... 146
3.3.1 Teeth ... 146
3.3.2 The oesophagus ... 148
3.3.3 The stomach ... 149
3.3.4 The intestine ... 151
3.3.5 Nerves ... 153
3.3.6 Skin ... 155
3.3.7 Conclusions ... 157
References to Chapter 3 ... 158

**4 THE LOCOMOTIVE APPARATUS OF MAN**
4.1 Introduction ... 168
4.2 Composition of the locomotive apparatus ... 168
4.3 Elements and bonds of the locomotive apparatus ... 170
4.4 System of skeletal muscles ... 172
4.4.1 Muscle structure ... 172
4.4.2 Fundamental rheological properties of living non-active muscle ... 184
4.4.3 Muscular contraction ... 189
4.4.4 Thermomechanical aspects of muscle contraction ... 210
4.4.5 Mechanical properties of active skeletal muscle ... 224
4.4.6 Some problems of the study of the behaviour of human muscles under natural conditions ... 235
References to Chapter 4 ... 239

**5 GENESIS AND PROSPECTS OF FORENSIC BIOMECHANICS**
5.1 Introduction ... 251
5.2 What are the current forensic sciences like? ... 252
5.3 Forensic Biomechanics Genesis ... 253
5.4 Extreme dynamic loading on organism ... 264
5.5 Biomechanics of falling from a height ... 264
References to Chapter 5 ... 266

**6 FORENSIC BIOMECHANICAL APPLICATION IN CRIMINALISTICS**
6.1 Introduction ... 268

6.2 Biomechanical contens of tracks of bipedal locomotion ..... 269
6.3 Assessment of the velocity of locomotion ..... 272
Reference to Chapter 6 ..... 276

**7 BIOMECHANICS OF EXTREME DYNAMIC LOADING ON ORGANISM**
7.1 Introduction ..... 279
7.2 Balance of Mechanical Energy at External Head Impact ..... 280
7.3 Experimental Data for Different Head Injuries ..... 283
7.4 Discussion of Results and Conclusion ..... 286
References to Chapter 7 ..... 291

**8 BIOMECANICAL ASPECTS OF THE FALLS FROM HEIGHT**
8.1 Introduction ..... 292
8.2 Material and Methods ..... 292
8.3 Results and Discussion ..... 295
8.4 Horizontal Distance and Height Determination Falling Pattern ..... 297
8.4.1 Material and Methods ..... 297
8.4.2 Results and Discussion ..... 299
References to Chapter 8 ..... 307

**9 NEW DIRECTIONS OF EXPERIMENTS IN FORENSIC BIOMECHANICS** ..... 309