# Contents


Preface viii
About the Companion Website x

**Part I General principles of the nervous system 1**

**Chapter 1 Introduction to the Nervous System 3**
Cells of the Central Nervous System 5
Central Nervous System 5
Peripheral Nervous System 8
Questions to Ponder 9

**Chapter 2 Development of the Nervous System 10**
Early Development 11
Neurulation 13
Early Development of the Spinal Cord and Brain 18
Development of the Spinal Cord 20
Development of the Brain 22
Synonyms and Eponyms of the Nervous System 29
Questions to Ponder 29

**Chapter 3 Histophysiology of the Nervous System 30**
Neurons 31
Neuroglia 38
Generation and conduction of Nerve Impulses 42
Synonyms and Eponyms of Nervous System Histopathology 46
Questions to Ponder 46

**Chapter 4 Neurotransmitter substances 47**
Classification of Neurotransmitter Substances 50
Questions to Ponder 57

**Chapter 5 Spinal cord 58**
Morphology of the Spinal Cord 59
Internal Morphology of the Spinal Cord 65
Vascular Supply of the Spinal Cord 68
Synonyms and Eponyms of the Spinal Cord 72
Questions to Ponder 72

**Chapter 6 Gross Anatomy of the Brain 73**
Cerebrum 74
Diencephalon 85
Cerebellum 86
Brainstem 89
Synonyms and Eponyms of the Brain 94
Questions to Ponder 94

**Chapter 7 Brainstem 95**
Internal Organization of the Brainstem 95
Medulla 99
Pons 105
Midbrain 110
Synonyms and Eponyms of the Brainstem 119
Questions to Ponder 119

**Chapter 8 Meninges and Cerebrospinal Fluid 120**
Cranial Meninges 121
Spinal Meninges 128
Venous Sinuses of the Cranial Dura Mater 129
Cerebrospinal Fluid 133
Ventricles of the Brain 133
Synonyms and eponyms of the Nervous System 135
Questions to Ponder 135

**Chapter 9 Vascular Supply of the Central Nervous System 136**
Vascular Supply of the Spinal Cord 137
Arterial Supply of the Brain 138
Venous Drainage of the Brain 151
Synonyms and Eponyms of the Vascular Supply of the Central Nervous System 155
Questions to Ponder 155

**Chapter 10 Autonomic Nervous System 156**
Sympathetic Nervous System 159
Parasympathetic Nervous System 166
Enteric Nervous System 169
Neurotransmitters and Receptors of the Autonomic Nervous System 170
Pelvic Autonomic Functions 171
Synonyms and Eponyms of the Autonomic Nervous System 174
Questions to Ponder 174

**Chapter 11 Spinal Reflexes 175**
Components of Reflexes 175
Lower Motoneurons 176
Skeletal Muscle Innervation 177
Skeletal Muscle Receptors 177
Muscle Stretch Reflex 179
Reciprocal Inhibition 179
Autogenic Inhibition (Inverse Myotatic Reflex) 180
Flexor Reflex (Withdrawal Reflex, Nociceptive Reflex) 180

Crossed Extension Reflex 181
Maintenance of Muscle Tone via the Gamma Loop 181
Alpha-Gamma Coactivation 182
Synonyms and Eponyms of the Spinal Reflexes 184
Questions to Ponder 184

**Part II Integrative Components of the Nervous System 185**

**Chapter 12 Ascending sensory Pathways 187**
Sensory Receptors 188
Anterolateral System 197
Tactile Sensation and Proprioception 207
Sensory Pathways to the Cerebellum 212
Modulation of Nociception 224
Neuroplasticity 226
Synonyms and Eponyms of the Ascending Sensory Pathways 226
Questions to Ponder 227

**Chapter 13 Motor Cortex and Descending Motor Pathways 228**
Cortical Areas Controlling Motor Activity 229
Descending Motor Pathways 231
Synonyms and Eponyms of the Motor Cortex and Descending Motor Pathways 248
Questions to Ponder 249

**Chapter 14 Basal Nuclei 250**
Components of the Basal Nuclei 251
Nuclei Associated with the Basal Nuclei 255
Input, Intrinsic, and Output Nuclei of the Basal Nuclei 257
Connections of the Basal Nuclei 259
Circuits Connecting the Basal Nuclei, Thalamus, and Cerebral Cortex 265
Other Circuits of the Basal Nuclei 267
Neurotransmitters of the Basal Nuclei 268
"Direct" and "Indirect" Loops (Pathways) of the Basal Nuclei 270
Circuits that Modulate Activity of the Basal Nuclei 271
Synonyms and Eponyms of the Basal Nuclei 277
Questions to Ponder 278

**Chapter 15 Cerebellum 279**
Morphology of the Cerebellum 281
Cerebellar Peduncles 289
Deep Cerebellar Nuclei 291
Afferents (Input) to the Cerebellum 292
Efferents (Output) from the Cerebellum 296
Functional Organization of the Cerebellum: Intrinsic Circuitry 298
Synonyms and Eponyms of the Cerebellum 302
Questions to Ponder 302

**Chapter 16 Reticular Formation 303**
Morphology of the Reticular Formation 304
Zones of the Reticular Formation 305
Nuclei Associated with the Reticular Formation 307
Input to and Output from the Reticular Formation 307
Functions of the Reticular Formation 308
Synonyms and Eponyms of the Reticular Formation 314
Questions to Ponder 314

**Chapter 17 Cranial Nerves 315**
Olfactory Nerve (CN I) 320
Optic Nerve (CN II) 320
Oculomotor Nerve (CN III) 321
Trochlear Nerve (CN IV) 323
Trigeminal Nerve (CN V) 325
Abducent Nerve (CN VI) 332
Facial Nerve (CN VII) 336
Vestibulocochlear Nerve (CN VIII) 338
Glossopharyngeal Nerve (CN IX) 339
Vagus Nerve (CN X) 342
Spinal Accessory Nerve (CN XI) 345
Hypoglossal Nerve (CN XII) 346
Synonyms and Eponyms of the Cranial Nerves 348
Questions to Ponder 349

**Chapter 18 Visual System 350**
Eye 350
Central Visual Pathways 355
Visual Reflexes 365
Synonyms and Eponyms of the Visual System 375
Questions to Ponder 375

**Chapter 19 Auditory System 376**
Ear 376
Auditory Transmission 381
Central Auditory Pathways 383
Synonyms and eponyms of the Auditory System 391
Questions to Ponder 391

**Chapter 20 Vestibular System 392**
Vestibular Apparatus 393
Vestibular Nerve (CN VIII) 399
Central Pathways of the Vestibular System 400
Control of Ocular Movements 403
Vestibular Nystagmus 406
Caloric Nystagmus 408
Synonyms and Eponyms of the Vestibular System 409
Questions to Ponder 410

**Chapter 21 Olfactory System 411**
Olfactory Receptor Cells 412
Olfactory Transduction 412
Olfactory Nerve (CN I) 414
Central Connections of the Olfactory System 415
Synonyms and Eponyms of the Olfactory System 418
Questions to Ponder 419

**Chapter 22 Limbic System 420**
Limbic Lobe 421
Brainstem Centers Associated with Limbic System Function 432

Pathways of the Limbic System 432
Limbic Association Cortex 435
Limbic System Input to the Endocrine, Autonomic, and Somatic Motor Systems 435
Synonyms and Eponyms of the Limbic System 437
Questions to Ponder 438

**Chapter 23 Hypothalamus 439**
Borders 440
Hypothalamic Zones and Component Nuclei 441
Hypothalamic Regions (areas) and Component Nuclei 446
Connections of the Hypothalamus 448
Pathways of the Hypothalamus 449
Functions of the Hypothalamus 452
Hypothalamohypophyseal Connections 455
Synonyms and Eponyms of the Hypothalamus 462
Questions to Ponder 463

**Chapter 24 Thalamus 465**
Borders 465
Anatomy 467
Internal and External Medullary Laminae 468
Thalamic Nuclei 469
Synonyms and Eponyms of the Thalamus 477
Questions to Ponder 478

**Chapter 25 Cerebral Cortex 479**
Cells of the Cerebral Cortex 481
Types of Cortex 483
Cell layers of the Neocortex 484
Vertical Columnar Organization of the Cerebral Cortex 485
Afferents (Input) to the Cerebral Cortex 485
Efferents (Output) from the Cerebral Cortex 486
Internal Capsule and Corona Radiata 489
Lobes of the Cerebral Cortex 489
Functional Organization of the Cerebral Cortex 490
Cerebral Dominance 498
Synonyms and Eponyms of the Cerebral Cortex 504
Questions to Ponder 506

Questions to Ponder: Answers to Odd Questions 507

Index 517