

Contents

Preface

vii

- 1. Introduction to Biochemistry of Eukaryotic Cells, Anabolic and Catabolic Reactions** 1
 - Introduction 1
 - Eukaryotic cell 2
 - Basic levels of body organization 5
 - Cellular injury and death 5
 - Metabolic reactions 6
 - Homeostasis 6
 - Multiple choice questions 8
- 2. Enzymes** 9
 - Introduction 9
 - Coenzymes 11
 - Isoenzymes 11
 - Enzyme specificity 13
 - Enzyme kinetics 15
 - Enzyme inhibition 16
 - Therapeutic enzymes 19
 - Multiple choice questions 21
 - Case studies 24
- 3. Biologic Oxidation, Respiratory Chain, Lipid Peroxidation, Antioxidants** 27
 - Biological oxidation 27
 - The respiratory chain 27
 - Stages in the production of energy 28
 - The pathway of electrons (based on the chemiosmotic hypothesis) 29
 - Substances that inhibit the respiratory chain 31
 - Reactive oxygen species and superoxide ions 31
 - Lipid peroxidation 32
 - Importance of antioxidant levels in food 32
 - Multiple choice questions 33
- 4. Carbohydrates** 35
 - Introduction 35
 - Functions of Carbohydrates 35
 - Classification and properties of carbohydrates 36
 - Digestion and absorption of carbohydrates 40
 - Carbohydrate metabolism 42
 - Krebs cycle (TCA cycle or citric acid cycle) 47
 - Gluconeogenesis 54
 - Glycogenesis 56
 - Blood sugar (glucose) 59
 - Deranged glucose metabolism 63
 - Diabetes mellitus 65
 - Glucose tolerance test 66
 - Diabetic drugs and treatment 68
 - Hypoglycemia 69
 - Diagnosis of diabetes mellitus 70
 - Multiple choice questions 70
 - Case studies 74
- 5. Lipids** 78
 - Introduction 78
 - Classification and importance 78
 - Compound (conjugate) lipids 79
 - Derived lipids 80
 - Digestion and absorption of lipids 89
 - Metabolism of lipids 91
 - Cholesterol biosynthesis 98
 - Cholesterol absorption 99
 - Lipoprotein metabolism 100
 - Multiple choice questions 105
 - Case studies 110
- 6. Proteins** 113
 - Introduction 113
 - Amino acids 113
 - Structure of proteins 115
 - Important properties of proteins 121
 - Structure–function relationship of proteins 123

Mechanism of physiologic hemostasis	128		
Absorption of amino acids	132		
Amino acid metabolism	132		
Inborn errors of amino acid metabolism	140		
Proteinuria	143		
Biochemical cardiac markers	146		
Multiple choice questions	147		
Case studies	152		
7. Nonprotein Nitrogenous Molecules	155		
Introduction	155		
Nonprotein nitrogen	155		
Urea metabolism	156		
Creatine metabolism	160		
Basic components of nucleic acids	161		
Biosynthesis of purines	167		
Biosynthesis of pyrimidine	168		
Purine catabolism, uric acid metabolism	171		
Uric acid excretion	172		
Pyrimidine catabolism	174		
Multiple choice questions	174		
Case studies	175		
8. Water and Electrolyte Metabolism	178		
Introduction	178		
Electrolyte metabolism	179		
Mineral metabolism	180		
Sodium metabolism	181		
Potassium metabolism	182		
CSF electrolytes	183		
Calcium metabolism	184		
Phosphorus metabolism	188		
Iron metabolism	191		
Importance of trace elements	195		
Multiple choice questions	203		
Case studies	206		
9. Acid–Base Balance	210		
Introduction	210		
Maintenance of acid–base balance	210		
Disturbed acid–base balance	212		
Respiratory acidosis	212		
Respiratory alkalosis	213		
Metabolic acidosis	214		
Metabolic alkalosis	215		
Multiple choice questions	217		
Case studies	219		
10. General Mechanism of Action of Hormones	223		
Introduction	223		
Classification of hormones	224		
Signal transduction by hormones	225		
Multiple choice questions	229		
11. Vitamins	231		
Introduction	231		
Vitamin A	232		
The national prophylaxis programme against nutritional blindness	235		
Vitamin D	236		
Vitamin E	240		
Vitamin K	241		
Water-soluble vitamins	242		
Vitamin C	242		
B complex vitamins	245		
Thiamine	245		
Riboflavin	248		
Niacin	250		
Pantothenic acid	252		
Pyridoxin	253		
Biotin	256		
Folic acid	258		
Vitamin B ₁₂ (cobalamin)	262		
Other compounds which function like vitamins	266		
Multiple choice questions	267		
Case studies	271		
12. Xenobiotics	274		
Introduction	274		
Detoxification of xenobiotics	274		
Phases of detoxification of xenobiotics	276		
Multiple choice questions	278		
13. Hemoglobin Synthesis, Properties and Related Clinical Conditions	279		
Introduction	279		
Synthesis of hemoglobin	280		
Porphyryns and disorders of heme synthesis-porphyrias	283		
Properties and functions of hemoglobin	285		

Red cell destruction:Pathologic and physiologic	290
Iron metabolism	290
Disorders of HB structure and synthesis	291
Structural variants of hemoglobin and thalassemia syndromes	292
The hemolytic anemias	292
Laboratory diagnosis of hemolytic anemia	293
Multiple choice questions	300
Case studies	302
14. Nutrition	305
Introduction	305
Dietary components	306
Nutritional food values	308
Determination of nutritive value assessment of proteins	311
Nutritional needs in pregnancy and lactation	315
Nutritional need of a newborn	319
Malnutrition and starvation	320
Severe acute malnutrition (SAM) and moderate acute malnutrition (MAM)	322
Health risks associated with obesity	325
Obesity preventive strategies	326
Dietary plans in disease	327
Diet for patients suffering from coronary artery disease	328
Critical illness and nutritional support	329
Nutritional disorders in the elderly	330
Nutritional support for the patient in trauma	332
Multiple choice questions	333
Case studies	335
15. Molecular Biology and Pathology	337
Introduction	337
Molecular composition and structure of DNA and RNA	337
Replication, transcription and translation mechanisms	342
Transcription	344
Translation	345
Operon concept	349
Lac operon	350
Tryptophan operon	351
Mechanism of DNA repair	352
Gene mutations	353
Molecular pathology	354
Importance of molecular pathology techniques	355
Blot techniques	355
Polymerase chain reaction (PCR)	355
Gene cloning	356
Recombinant DNA technology	358
Gene therapy	359
Restriction fragment length polymorphism (RFLP)	361
Multiple choice questions	363
16. Cancer and Tumor Markers	368
Introduction	368
The carcinogens	369
Proto-oncogenes and oncogenes	369
Oncogenic viruses	370
Definition and characteristic features of cancer	372
Characteristics of growing tumor cells	375
Multi-step process of cancer	375
Cancer treatment	376
Immunotherapy	377
Tumor markers	377
Multiple choice questions	380
17. Organ Function Tests	382
Introduction	382
Renal function tests	382
Multiple choice questions	384
Case studies	384
Liver function tests	388
Bilirubin metabolism	389
Liver diseases	390
Clinical course of vital hepatitis	391
Investigations of liver functions	391
The routinely performed liver function tests (LFTs)	392

- Multiple choice questions 394
- Case studies 395
- Thyroid function tests 398
- Synthesis of thyroid hormones 398
- Thyroid diseases 399
- Multiple choice questions 403
- Case studies 403
- Thyroid national program 405
- Hormones of the adrenal cortex and their functions 406
- Pathophysiology related to the adrenal gland, Addison's disease 408
- Cushing's disease 410
- Conn's syndrome 410
- Hormones of the adrenal medulla and their functions 411
- Beta-blockers 413
- Gastric function tests 414
- Pancreatic function tests 415
- Multiple choice questions 416
- Gastroesophageal reflux disease (GERD) 417
- Laboratory tests to determine gastric functions 418
- Multiple choice questions 419
- Adynamic ileus and acute colonic pseudo-obstruction 420
- Hirschsprung disease (HSCR) 421
- 18. Immunology** 422
 - Introduction 422
 - Immunological reaction and related terms 423
 - The basic mechanisms of innate immunity 425
 - Origin of immune cells 425
 - T cells 426
 - B cells 427
 - CD4 cells 428
 - Functions of the immune system 430
 - Antibodies (immunoglobulins) 433
 - Immunoglobulin classes 435
 - The complement system 436
 - Multiple choice questions 436
 - Vaccines 439
 - Use of human cell strains in vaccine development 440
 - Epidemiology of vaccine-preventable diseases 441
 - Components of the universal immunization program and the subnational immunization program 442
 - Vaccination of children 443
 - Vaccination of adults 446
 - Immunization in special situations 448
- 19. Medical Biochemistry Laboratory Basic Requirements, Principles and Procedures** 452
 - Introduction 452
 - Safe laboratory practice 461
 - Preparation of reagents and buffers (basic requirements) 462
 - Basic steps for drawing a blood specimen 464
 - How to perform a biochemistry laboratory test? 468
 - Waste management 469
 - Quality control 470
 - Reflectance photometry 472
 - Self-monitoring of blood glucose 472
 - Chromatography 473
 - Electrophoresis 474
 - Polyacrylamide gel electrophoresis (PAGE) 475
 - Ion selective electrode (ISE) analyzer use 476
 - Enzyme-linked immunosorbent assay (ELISA) 477
 - Immunoturbidimetry 479
 - Immunodiffusion 479
 - Radioassays (RIA) 479
 - Polymerase chain reaction (PCR) 481
- 20. Medical Biochemistry Practicals** 487
 - Primary standards, calibrators and QC serum 487
 - Diagnostic kits 487
 - Expt. 1: Determination of plasma glucose by glucose oxidase method.* 489
 - Expt. 2: Determination of serum (or plasma) urea nitrogen by Berthelot reaction method.* 493

- Expt. 3:* Determination of serum creatinine by alkaline picrate method. 494
- Expt. 4:* Determination of urine creatinine by alkaline picrate method. 495
- Expt. 5:* Determination of uric acid by end point reaction—enzymatic method. 497
- Expt. 6A:* Determination of serum glutamate pyruvate transaminase (SGPT) by end point reaction method. 498
- Expt. 6B:* Determination of glutamate oxaloacetate transaminase (SGOT) by end point reaction method. 498
- Expt. 7:* Determination of serum alkaline phosphatase (S. ALP) by end point reaction method. 501
- Expt. 8:* Serum total, direct and indirect bilirubin. 503
- Expt. 9:* Determination of serum total cholesterol by enzymatic method. 505
- Expt. 10:* Determination of serum triglycerides by enzymatic method. 506
- Expt. 11:* Determination of serum (or plasma) calcium by CPC method. 508
- Expt. 12:* Determination of serum inorganic phosphorus by direct UV-determination without reduction. 509
- Expt. 13:* Determination of total serum protein by Biuret method. 510
- Expt. 14:* Determination of serum albumin by BCG method. 511
- Expt. 15:* Physical examination of urine using multi-stix. 514
- Expt. 16:* Chemical examination of urine using multi-stix reagent strips. 516
- Expt. 17:* Microscopic examination of urine. 518
- Expt. 18:* Determination of serum amylase by colorimetric (amyloclastic). 520
- Expt. 19:* Determination of salivary amylase. 521
- Expt. 20:* Determination of effect of temperature on salivary amylase. 522
- Expt. 21:* Determination of effect of substrate concentration on salivary amylase. 522
- Qualitative experiments** 523
- Expt. 22:* Identification of a carbohydrate solution. 523
- Expt. 23:* Determination of urine glucose by Benedict test. 524
- Expt. 24:* Selivanoff's test (detection of lactose). 525
- Expt. 25:* Orthotoluidine test (for detection of galactose). 525
- Expt. 26:* Selivanoff's test for the detection of fructose. 526
- Expt. 27:* Observation of presence of protein in a solution. 526
- Index* 529

