

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

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