Contents

Prefac Index	e of Competencies			v xiii
	Introduction to Biochemistry of Eukaryot Cells, Anabolic and Catabolic Reactions 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 Enzymes Introduction 9 Coenzymes 11 Isoenzymes 11	ic 1	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	
3.	Enzyme specificity 13 Enzyme kinetics 15 Enzyme inhibition 16 Therapeutic enzymes 19 Multiple choice questions 21 Case studies 24 Biologic Oxidation, Respiratory Chain,		Hypoglycemia 69 Diagnosis of diabetes mellitus 70 Multiple choice questions 70 Case studies 74	78
	Lipid Peroxidation, Antioxidants Biological oxidation 27 The respiratory chain 27	27 8	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	
	Importance of antioxidant levels in food 32 Multiple choice questions 33	6.	6. Proteins 113 Introduction 113 Amino acids 113	13
4.	Carbohydrates Introduction 35 Functions of Carbohydrates 35	ates 35 on 35	Structure of proteins 115 Important properties of proteins 121 Structure–function relationship of proteins 123	

Contents ix

	Mechanism of physiologic hemostasis 128			Multiple choice questions 217 Case studies 219	
	Absorption of amino acids 132 Amino acid metabolism 132		10.	General Mechanism of Action of Hormones	223
	Inborn errors of amino acid metabolism 140 Proteinuria 143 Biochemical cardiac markers 146 Multiple choice questions 147			Introduction 223 Classification of hormones 224 Signal transduction by hormones 2 Multiple choice questions 229	25
	Case studies 152		11.	Vitamins	231
7.	Nonprotein Nitrogenous Molecules Introduction 155 Nonprotein nitrogen 155 Urea metabolism 156 Creatine metabolism 160 Basic components of nucleic acids 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	155		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	
8.	Water and electrolyte metabolism	178		Folic acid 258	
	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		12.	Vitamin B ₁₂ (cobalamin) 262 Other compounds which function like vitamins 266 Multiple choice questions 267 Case studies 271 Xenobiotics	274
				Introduction 274 Detoxification of xenobiotics 274 Phases of detoxification of xenobiotics 276 Multiple choice questions 278	
9.	Acid-Base Balance	210	13.	Hemoglobin synthesis, Properties and	070
	Introduction 210 Maintenance of acid–base balance Disturbed acid–base balance 212 Respiratory acidosis 212 Respiratory alkalosis 213 Metabolic acidosis 214 Metabolic alkalosis 215	210		related Clinical Conditions Introduction 279 Synthesis of hemoglobin 280 Porphyrins and disorders of heme synthesis-porphyrias 283 Properties and functions of hemoglobin 285	279

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

337

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

15. Molecular Biology and Pathology

Case studies 335

Multiple choice questions 333

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 36
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

Contents Xi

	Multiple choice questions 394 Case studies 395		Epidemiology of vaccine-preventable diseases 441
	Thyroid function tests 398		Components of the universal
	,		immunization program and
	Synthesis of thyroid hormones 398		the subnational immunization
	Thyroid diseases 399		program 442
	Multiple choice questions 403		Vaccination of children 443
	Case studies 403		Vaccination of adults 446
	Thyroid national program 405 Hormones of the adrenal cortex and		Immunization in special situations 448
	their functions 406	10	·
	Pathophysiology related to the adrenal	17.	Medical biochemistry laboratory basic requirements, principles
	gland, Addison's disease 408		and procedures 452
	Cushing's disease 410		
	Conn's syndrome 410		Introduction 452
	Hormones of the adrenal medulla		Safe laboratory practice 461
	and their functions 411		Preparation of reagents and buffers (basic requirements) 462
	Beta-blockers 413		Basic steps for drawing a
	Gastric function tests 414		blood specimen 464
	Pancreatic function tests 415		How to perform a biochemistry
	Multiple choice questions 416		laboratory test? 468
	Gastroesophageal reflux disease		Waste management 469
	(GERD) 417		Quality control 470
	Laboratory tests to determine gastric functions 418		Reflectance photometry 472
			Self-monitoring of blood glucose 472
	Multiple choice questions 419 Adynamic ileus and acute colonic		Chromatography 473
	pseudo-obstruction 420		Electrophoresis 474
	Hirschsprung disease (HSCR) 421		Polyacrylamide gel electrophoresis
12	Immunology 422		(PAGE) 475
10.			Ion selective electrode (ISE)
	Introduction 422		analyzer use 476
	Immunological reaction and related terms 423		Enzyme-linked immunosorbent assay (ELISA) 477
	The basic mechanisms of innate		Immunoturbidimetry 479
	immunity 425		Immunodiffusion 479
	Origin of immune cells 425		Radioassays (RIA) 479
	T cells 426		Polymerase chain reaction (PCR) 481
	B cells 427	20	Medical Biochemistry Practicals 487
	CD4 cells 428	20.	
	Functions of the immune system 430		Primary standards, calibrators and QC serum 487
	Antibodies (immunoglobulins) 433		
	Immunoglobulin classes 435 The complement system 436		Diagnostic kits 487
	,		Expt. 1: Determination of plasma glucose
	Multiple choice questions 436 Vaccines 439		by glucose oxidase method. 489
	Use of human cell strains in vaccine		Expt. 2: Determination of serum (or
	development 440		plasma) urea nitrogen by Berthelot reaction method. 493
	development 110		reaction metrod. 199

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-stixs. 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

Qualitative experiments 521

Expt. 19: Identification of a carbohydrate solution. 521

Expt. 20: Determination of urine glucose by Benedict test. 522

Expt. 21: Selivanoff's test (detection of lactose). 523

Expt. 22: Orthotoluidine test (for detection of galactose). 524

Expt. 23: Selivanoff's test for the detection of fructose. 524

Expt. 24: Observation of presence of protein in a solution. 524

Index 527