

**CLINICAL BIOCHEMISTRY
UNIVERSITY OF KASHMIR
SRINAGAR-190006**



CHOICE BASED CREDIT SYSTEM

SYLLABUS FOR

M. Sc. CLINICALBIOCHEMISTRY

2017 ONWARDS

Course Code	Title of Paper	Type	Hrs/WK L:T:P	Credits	Max. Marks		Name of Instructor
					Ext.	Int.	
Semester I							
CLB17101 CR	Biomolecules –I: Biochemistry and Disorders	Core	4:0:0	4	80	20	SAG/TAD/ AWB
CLB17102 CR	Biomolecules –II: Biochemistry and Disorders	Core	4:0:0	4	80	20	FR/SHM/ AWB
CLB17103 CR	Lab Course-I	Core	0:0:8	4	80	20	FR/SAG/ SHM/TAD
CLB17104 DCE	Cell Biology and Microbiology	Elective (DCE)	3:2:0	4	80	20	FR/SHM/ SAG/AWB
CLB17105 DCE	Biophysical Techniques	Elective (DCE)	1:2:0	1 + 1 = 2	40	10	TAD
CLB17106 DEC	Molecular Biology - I	Elective (DCE)	1:2:0	1 + 1 = 2	40	10	SHM/AWB
CLB17107 GE	Clinical Pathology	Elective (GE)	1:2:0	1 + 1 = 2	40	10	SAG/FR
CLB17108 GE	Clinical Genetics	Elective (GE)	1:2:0	1 + 1 = 2	40	10	AWB
CLB17109 OE	Biochemistry for non- Biologists	Elective (OE)	1:2:0	1 + 1 = 2	40	10	SHM
	Total Credits: 26 (36 contact hours)				Total Marks: 650		
Semester-II							
CLB17201 CR	Molecular Biology - II	Core	4:0:0	4	80	20	SHM/FR
CLB17202 CR	Clinical Immunology	Core	4:0:0	4	80	20	SAG/TAD
CLB17203 CR	Lab Course-II	Core	0:0:8	4	80	20	FR/SAG/ SHM/TAD
CLB17204 DCE	Techniques in Cell and Molecular Medicine	Elective (DCE)	3:2:0	4	80	20	AWB/TAD
CLB17205 DCE	Cell Signalling & Disorders	Elective (DCE)	1:2:0	1 + 1 = 2	40	10	SHM/TAD
CLB17206 DCE	Applied Immunology	Elective (DCE)	1:2:0	1 + 1 = 2	40	10	SHM
CLB17207 GE	Protein Antibody Engineering	Elective (GE)	1:2:0	1 + 1 = 2	40	10	SHM/AWB
CLB15208 GE	Protein Biophysics	Elective (GE)	1:2:0	1 + 1 = 2	40	10	TAD/FR
CLB17209 OE	Basic concepts in Clinical Biochemistry	Elective (Open)	1:2:0	1 + 1 = 2	40	10	SAG
	Total Credits: 26(36 contact hours)				Total Marks:650		

Semester-III							
CLB17301 CR	Organ System Diseases-I: Cardiovascular, Respiratory and Excretory systems	Core	4:0:0	4	80	20	FR/AWB/ SAG
CLB17302 CR	Organ System Diseases-II: Gastrointestinal, Neuromuscular and Skeletal systems	Core	4:0:0	4	80	20	TAD/SHM/ FR
CLB17303 CR	Lab Course-III	Core	0:0:8	4	80	20	FR/SAG/ AWB/TAD
CLB17304 DCE	Advanced Endocrinology	Elective (DCE)	3:2:0	4	80	20	SAG/AWB
CLB17305 DCE	Haematology & Cardiovascular System	Elective (DCE)	1:2:0	1 + 1 = 2	40	10	TAD
CLB17306 DCE	High Risk Pregnancy & Neonatology	Elective (DCE)	1:2:0	1 + 1 = 2	40	10	SHM
CLB17307 GE	Free Radical and oxidative stress related diseases	Elective (GE)	1:2:0	1 + 1 = 2	40	10	SAG
CLB17308 GE	Cell cycle and Cancer Biology	Elective (GE)	1:2:0	1 + 1 = 2	40	10	FR/AWB
CLB17309 OE	Bioethics in Clinical Research	Elective (OE)	1:2:0	1 + 1 = 2	40	10	TAD
Total Credits: 26 (36 contact hours)					Total Marks: 650		
Semester-IV							
CLB17401 CR	Internship Dissertation	Core	0:0:24	12	300	-	-
CLB17402 CR	Host Institute Grading	Core	0:0:6	3	75	-	-
CLB17403 CR	Internship Assessment	Core	0:6:0	3	75	-	SA/FR/SAG/ SHM/ TAD
CLB17404 DCE	Research Proposal Writing	Elective (DCE)	0:4:0	2	50	-	SA/FR/SAG/ SHM/ TAD/AWB
CLB17405 DCE	Automation, Diagnostic Procedures, Interpretations & Clinical Co-relations (Self Study Paper)	Elective (DCE)	4:0:0	4	100	-	-
CLB17406 GE	Epigenetics & Gene Expression	Elective (GE)	1:2:0	1 + 1 = 2	40	10	AWB
CLB17407 GE	Basics in Cellular Signalling	Elective (GE)	1:2:0	1 + 1 = 2	40	10	SHM
CLB17408 OE	Obesity, Inflammation and Nutritional diseases	Elective (OE)	1:2:0	1 + 1 = 2	40	10	FR
Total Credits: 30 (57 contact hours)*					Total Marks: 750		

CR-Core; DCE-Discipline Centric Elective; GE- General Elective; OE- Open Elective

Instructors:

SA: Dr.Shajrulamin
FR: Dr.Fouzia Rashid
SHM: Dr. Syed Hussain Mir
SAG: Dr.Showkat Ahmad Ganaie
TAD: Dr. Tanveer Ali Dar
AWB: Dr. Abdul Wajid Bhat

***Department is offering more core credits than recommended as the fourth semester is having internship dissertation in the course which is to be necessarily carried outside the department.**

Total credits for M.Sc. Clinical Biochemistry: 96
Total Marks for M.Sc. Clinical Biochemistry: 2400

SEMESTER I

CLB17101CR: Biomolecules-I: Biochemistry and Disorders

UNIT I - Basic Concepts of Cell Bioenergetics

First and second law of thermodynamic, concept of free energy, standard free energy change of a chemical reaction, Thermodynamics of high-energy phosphate compounds - ATP and other high energy phosphate compounds. ATP cycle, structural basis of free energy change during hydrolysis of ATP, Nernst equation and Redox-potentials.

UNIT II – Carbohydrates: Composition, structure, metabolism and disorders

Carbohydrate structure, classification, properties, chemical reactions, Isomerism and functions. Carbohydrate Metabolism- basic concepts, Glycolysis, Krebs cycle, Pentose phosphate pathway, Gluconeogenesis, Glycogenesis, Glycogenolysis, Regulation of carbohydrate metabolism.

UNIT III – Lipids: Composition, structure, metabolism and disorders

Classification, structure, properties and functions of fatty acids, triacylglycerols, and phospholipids. Saturated and unsaturated fatty acids. Lipid metabolism: Biosynthesis and degradation of odd and even chain carbon fatty acids. Ketone bodies: formation and utilization. Biosynthesis and degradation of cholesterol. Lipoproteins and apolipoproteins. Disorders of lipids

UNIT IV - Nucleic Acids: Composition, structure, metabolism & disorders

Structure, properties of purines and pyrimidine bases, nucleoside and nucleotides. Conformation of Nucleic acids (A, B, Z-DNA, tRNA, micro-RNA), Stability of Nucleic acid structure. Nucleic Acid metabolism: Biosynthesis and degradation of purines and pyrimidines, regulation of purines and pyrimidines biosynthesis. Biosynthesis of ribonucleotides and deoxyribonucleotides. Uric acid overproduction and underexcretion; pathology and differential diagnosis of gout, treatment of gout, Enzyme disorders of purine metabolism (Lesh-Nyhan syndrome and Oroticacidurea).

Books Recommended:

1. Lehninger Principles of Biochemistry 4th Ed by David L. Nelson and Michael M. Cox, WH Freeman and Company.
2. Principles of Biochemistry by Geoffrey Zubay. Publisher: McGraw Hill College. Biochemistry By Lubert Stryer. WH Freeman and Co.
3. Biochemistry: The Molecular Basis of Life by Trudy McKee and James R McKee. Publisher: McGraw-Hill Higher education.
4. Biochemistry and Molecular biology by William H. Elliott and Daphne C. Elliott. Oxford University Press.
5. Fundamentals of Biochemistry: Life at the Molecular Level 5th Ed. By Donald Voet, Judith G. Voet and Charlotte W. Pratt. Publisher: Wiley.
6. Devlin: Textbook of Biochemistry (with clinical correlation) (John Wiley and Sons Publishers).
7. Cantrow and Trumper: Clinical Biochemistry.
8. Henry. R. D: Clinical Chemistry- Principles and Techniques (Harfer and Row)

CLB17102CR: Biomolecules-II: Biochemistry & Disorders

UNIT I - Proteins Composition, structure and metabolism

Amino acids: Structure, classification, properties and functions, peptides and polypeptides. Proteins: properties, primary, secondary, tertiary and quaternary structure, protein folding, Protein stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction), Reverse turns and Ramachandran plot. Domains and motifs, Amino acid metabolism: Biosynthesis and degradation of important amino acids and their regulation; Transamination and oxidative deamination, urea cycle

UNIT II- Protein disorders

Clinical features and laboratory findings in disorders of the plasma proteins, acute phase proteins, serum proteins and albumin, serum and urine protein electrophoresis, hypo and hyper-albuminemia; hypo- and hyperglobulinemias, Alpha-1-antitrypsin deficiency, Homozygotes vs. heterozygotes e.g. phenylketonuria, tyrosinemia, cystic fibrosis and sweat tests, amino-acidurias, organic acidurias. Protein folding disorders (Alzheimers, prions and amyloid)

UNIT III-Enzymes

Classification and nomenclature, prosthetic groups, cofactors, Mechanism of enzyme action and properties of enzymes as catalysts. Enzyme kinetics (equilibrium and steady state theory, rate equation and determination of K_m and V_{max}), specific activity, turn over number and catalytic center activity, Enzyme regulation: Principles of catalysis, mechanism of enzyme catalysis, Factors affecting rate of enzyme catalyzed reactions: pH, temperature, etc. Enzyme inhibition: reversible and irreversible inhibition, Allosteric enzymes: Model of allostery, types and kinetics; Isoenzymes and isozymes.

Unit IV - Principles of Diagnostic Enzymology

Factors affecting enzyme levels in blood. Principle, assay, and clinical significance of transaminases, creatine kinase, lactate dehydrogenase, phosphatases, isocitrate dehydrogenase, amylase, lipase, choline esterase, glutamate dehydrogenase, glucose-6-phosphate dehydrogenase.

Books Recommended:

1. Principles of Biochemistry By Geoffrey Zubay. Publisher: McGraw Hill College. Biochemistry By Lubert Stryer. WH Freeman and Co.
2. Fundamentals of Biochemistry: Life at the Molecular Level 5th Ed. By Donald Voet, Judith G. Voet and Charlotte W. Pratt. Publisher: Wiley.
3. Fundamentals of Enzymology: Cell and Molecular Biology of Catalytic Proteins By Nicholas C. Price and Lewis Stevens. Oxford University Press.
4. Fundamentals of Enzymology: Cell and Molecular Biology of Catalytic Proteins by Nicholas C. Price and Lewis Stevens. Oxford University Press.
5. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry By Trevor Palmer.
6. Enzyme Kinetics and Mechanisms (Hardcover) By Kenneth B. Taylor. Kluwer Academic Publishers.
7. Devlin: Textbook of Biochemistry (with clinical correlation) (John Wiley and Sons Publishers).
8. Cantrow and Trumper: Clinical Biochemistry.
9. Henry. R. D: Clinical Chemistry- Principles and Techniques (Harfer and Row)

CLB17103CR: Lab course-I

- Biochemical calculations
- Concept of pH and buffers
- Qualitative analysis of carbohydrates
- Qualitative analysis of amino acids
- Qualitative analysis of lipids
- TLC and paper chromatography amino acids and sugars
- Quantitative Estimation of proteins using Lowry's/ Biuret method
- Quantitative Estimation of glucose by Nelson Somogy's method
- Quantitative Estimation of cholesterol by Zlatki's Method
- Titrimetric estimation of ascorbic acid
- Sterilization techniques
- Preparation of culture media, pure culture techniques
- Study of bacterial growth by turbidimetry/ spectrophotometry and serial dilution methods
- Extraction and Assay of Enzymes

CLB17104DCE: Cell Biology and Microbiology

UNIT I - Cell and Cell Organelle-I

Structure of model membrane and biogenesis, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes. Model membranes and liposomes. Glycoconjugates and proteins in membrane systems, Transport across membranes; Ion transport, Na⁺/K⁺ATPases, etc. Concept of compartmentalization in mitochondria and endoplasmic reticulum, Transport of proteins into endoplasmic reticulum and vesicular transport

UNIT II -Cell and Cell Organelle-II

Structure and Functions of-Cell wall, Nucleus, Nucleolus, Golgi bodies - Post- translational modification of proteins, lysosomes, peroxisomes, plastids, vacuoles, chloroplast. Structure & function of cytoskeleton (Microfilaments, Microtubules and Intermediate filaments). General principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.

Unit III - Introduction to Microbiology

Introduction to microbial systems, importance of microbiology in human health and environment, Microbial growth, growth curve, measurement and factors affecting the microbial growth. Classification of microorganisms- criteria for classification Normal human microflora, Virulence and pathogenesis. Toxin: Types and their mode of action. Pure culture techniques. Microbial fermentation: Antibiotics, organic acids and vitamins. Microbes in decomposition and recycling process.

Unit IV - Basic medical Microbiology

Infectious diseases- overview, Medically important microbes, Microbial diseases - sources, route of transmission. Pathogenesis - adhesion, invasion, host cell damage, release of pathogens. Microbial virulence and virulence factors - Signs and symptoms of microbial diseases. Treatment, prevention and control of microbial infections. Microbes as pathological agents in man - Staphylococcal, Salmonellosis, Shigellosis and Clostridial food poisoning and poliomyelitis.

Books Recommended:

1. Albert B. Bray D and Lewis J Molecular biology of the cells, 5th Ed. New York Garland Publications
2. De Robertis, E.D.P., and De Robertis, E.M.F. Cell and Molecular Biology (8th Ed), W. B. Saunders College, Philadelphia
3. Microbiology: An Introduction, Eighth Edition By Gerard J. Tortora, Berdell R. Funke, Christine L. Case. Pearson Education.
4. Microbiology: Concepts and Applications by MJ Pelczar, ECS Chan and NR Krieg, McGraw-Hill.
5. General Microbiology by Stainier, Deudroff and Adelberg

CLB17105DCE: Biophysical Techniques

UNIT I – Spectroscopy Techniques

Basic principles and nature of electromagnetic radiation, Interaction of light with matter, Absorption and emission of radiation; Basic principle, instrumentation and applications of UV/Visible and Fluorescence spectroscopy; Circular Dichroism (CD) and Mass Spectrometry (MALDI-TOF) method – Principle, working and applications.

UNIT II - Chromatography and Centrifugation Techniques

Basic principle of chromatography; Separation techniques for proteins: Ion exchange chromatography, dialysis, molecular sieving, affinity chromatography. Basic principle and applications of HPLC; Centrifugation: Basic Principle, Techniques- Preparative, analytical and ultracentrifuges, sedimentation coefficient and factors affecting sedimentation coefficient

Books Recommended:

1. Keith Wilson and John Walker, Principles and Techniques of Biochemistry and Molecular biology 7th Ed. Cambridge University Press
2. Modern Experimental Biochemistry. Rodney F Boyer. Nenjamin/ Cummings publishing company Inc. Redwoodcity, California.
3. Physical Biochemistry: Applications to Biochemistry and Molecular Biology, David Freifelder, 2nd edition, W.H. Freeman and Company.
4. Physical Biochemistry: Principles and Applications, David Sheehan, 2nd edition, John Wiley.
5. Principles of Physical Biochemistry, K.E. Van Holde, W.C. Johnson and P. Shing Ho, 2nd edition, Prentice Hall Inc.
6. Biophysical Chemistry, C.R. Cantor, P.R. Schimmel, W.H. Freeman & Company.

CLB17106DCE: Introductory Molecular Biology

UNIT I- DNA: the Genetic Material

History of DNA; Experimental evidences & proof of DNA being the genetic material. Contributions and Experimental evidences provided by Structures of chromatin & chromosomes, Unique & Repetitive DNA, Heterochromatin, Euchromatin, Transposones. Denaturation kinetics & T_m . Extra chromosomal DNA. Plasmid DNA in prokaryotes. Mitochondrial DNA. Human genome features.

UNIT II- Propagation of genetic material.

DNA replication, Concept of replicon, Overview of bacterial DNA replication. Origin of replication in prokaryotes. Initiation, elongation & termination of Replication in prokaryotes, Regulation of replication, Role of Ori-C & DNA methylation in regulation of replication, Overview of eukaryotic DNA replication; Origin of replication in eukaryotes. Initiation, elongation & termination of Replication in eukaryotes, Regulation of replication, Fidelity of replication, DNA damage & repair

Books Recommended:

1. Molecular Cell Biology by H. Lodish, A. Berk, SL Zipursky, P. Matsudaira, D. Baltimore, and James Darnell.
2. Essential Cell Biology by B. Alberts, D. Bray, K. Hopkin and A. Johnson
3. Molecular Biology of the Cell by B. Alberts, A. Johnson, J. Lewis and M. Raff
4. Cell and Molecular Biology: Concepts and experiments by Gerald Karp
5. Molecular Biology of the Gene by JD Watson et al.
6. Molecular Biology of the Cell by John Wilson, Tim Hunt
7. Genes IX by Benjamin Lewin
8. Gerald Karp, Cell and Molecular Biology – Concepts and Experiments (John Willy and Sons Inc.)
9. Harvey Lodish et al. : Molecular Cell Biology - 7th ed. W.H.Freeman and Co., New York.

CLB17107GE: Clinical Pathology

Unit I - General Pathology

Cell injury, mechanism of cell injury. Reversible & irreversible cell injury. Inflammation: definition and various types of inflammation. Chemical mediators of inflammation, vasoactive factors and phagocytosis. Granuloma formation. Role of neutrophils in inflammation.

UNIT II - Hemodynamic disorders, thrombosis and shock

Hyperemia and congestion - definition and morphology, Thrombosis - definition, pathogenesis, causes, morphology and fate, Differences between Thrombophlebitis and Phlebothrombosis, Embolism & Infarction, Oedema - definition, types, pathogenesis with examples, Transudate and Exudate, Shock - definition, types, pathogenesis, clinical manifestations and examples.

Books Recommended:

1. Essentials of clinical pathology by Shirish M. Kawthalkar-JPB.
2. Clinical pathology, Haematology and blood banking by Maheshwari- Jay Kay.
3. Clinical pathology by James Carton and Richard Daly- OUP Oxford.

CLB17108GE: Clinical Genetics

UNIT I-Introduction to Genetics

Basic Mechanisms of inheritance and genetics in biology, Concept of gene: Allele, Mendelian laws, Concept of Linkage and crossing over, Multiple alleles, Pleiotropy, Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, Pedigree analysis of Autosomal inheritance-dominant, recessive

UNIT II - Genetics in Medical Practice

Genetic Principles and their application in medical practice; Case studies(Interacting with patients, learning family history and drawing pedigree chart); Syndromes and disorders: definition and their genetic basis - Cystic fibrosis and Tay Sach's Syndrome; Phenylketonuria and Galactosemia; Ethical issues with clinical genetics

Books Recommended:

1. Genetics: Analysis of Genes and Genomes by Hartl, Jones
2. Tom Strachan & Andrew P. Read Human Molecular Genetics (3rd Edition), John Wiley & Sons.
3. Ricki Lewis, Human Genetics-Concepts & Applications (3rd Edition), McGrawHill.
4. T. A. Brown, Genomes, John Wiley & Sons (Asia) PTE Ltd.
5. Scott Freeman & Jon C. Herron, Evolutionary Analysis (5th Edition), Prentice Hall
6. Garner E.J, Simmons, M.J. & Snustad, D.P. Principles of Genetics, John Wiley & Sons Inc, N.Y
7. Watson, J.D., Hopkins, N. H., Roberts, J. W. Steitz & Weiner, A. M., Molecular Biology of the Genes, The Benjamin/Cummings Publishing Company Inc., Tokyo.
8. William S. Klug & Michael R. Cummings Essentials of Genetics, 5th Ed, Prentice Hall Internationals
9. Daniel L. Hartl & Elizabeth W. Jones, Essential Genetics, 6th Ed., Jones & Bartlett Publishers

CLB17109OE: Biochemistry for non-biologists

UNIT I- Life: molecular organization & genomics

Molecules of life: Carbohydrates, Lipids, Proteins and Nucleic acids (basic composition, structural and functional features). From molecules to cell - Prokaryotic cell organization. Higher organization in Eukaryotic cells. Nucleic acids are the genetic material. Gene concept. What is a Gene? Know your genes. What are genes doing? Genes control your health, behavior and Looks. Mutations cause disease.

UNIT II - Life: molecular organization & immune system

Carbohydrates are primary source of energy in our body. They are also important antigens. Blood group antigens (ABO & Rh factor). Know your Blood groups. Blood group types and their inheritance. Proteins are important enzymes and building blocks. Proteins as antibodies are the policemen of our body. Immune system, basis of vaccination, antibodies attack only foreign.

Books recommended:

1. Lehninger Principles of Biochemistry 4th Ed by David L. Nelson and Michael M. Cox, WH Freeman and Company.
2. Principles of Biochemistry by Geoffrey Zubay. Publisher: McGraw Hill College. Biochemistry By Lubert Stryer. WH Freeman and Co.
3. Biochemistry: The Molecular Basis of Life by Trudy McKee and James R McKee. Publisher: McGraw-Hill Higher education.
4. Biochemistry and Molecular biology by William H. Elliott and Daphne C. Elliott. Oxford University Press.
5. Fundamentals of Biochemistry: Life at the Molecular Level 5th Ed. By Donald Voet, Judith G. Voet and Charlotte W. Pratt. Publisher: Wiley.
6. Devlin: Textbook of Biochemistry (with clinical correlation) (John Wiley and Sons Publishers).
7. Cantrow and Trumper: Clinical Biochemistry.
8. Henry. R. D: Clinical Chemistry- Principles and Techniques (Harfer and Row)

SEMESTER-II

CLB17201CR: Molecular Biology

UNIT I- Gene structure & organization

Gene: unit of hereditary. One gene one enzyme hypothesis. Genes code for proteins: historical perspective. Codon concept. Experimental approaches for deciphering of codons. Exceptions in universal nature of codons. Fine structure of gene in prokaryotes. Gene families. Operon concept, Structure and organization of polycistronic gene. Functioning & regulation of (Lac & Trp Operons). Fine structure of gene in eukaryotes. Interrupted genes, Exons and Introns. Viral (HIV) and Phage (M13) genome organization, Overlapping genes.

UNIT II - Gene Expression & Regulation I

Transcription, Transcription factors & machinery, Formation of initiation complex in eukaryotes & prokaryotes, Transcription activators & repressors, RNA polymerases in eukaryotes & prokaryotes. Termination of transcription in eukaryotes viz prokaryotes. RNA processing, editing, capping, splicing & polyadenylation. Structure & function of different types of RNA.

UNIT II - Gene Expression & Regulation II

Protein synthesis and processing: Ribosome, formation of initiation complex in prokaryotes viz eukaryotes, initiation factors and their regulation, elongation and elongation factors in prokaryotes viz eukaryotes, termination; Aminoacylation of tRNA, tRNA-identity, aminoacyl-tRNA synthetase, translational proof-reading, translational inhibitors, Control of gene expression at translation level: Regulation of prokaryotic and eukaryotic gene expression.

UNIT IV - Molecular Diagnostics

Role of molecular diagnostics in present diagnostic era, Benefits of molecular diagnostics over serological diagnostic tests, Ethical issues related to molecular diagnostics, Basic techniques used in molecular diagnostics, Molecular diagnostics of HIV, Tuberculosis, cholera and pathogenic *E. Coli*

Books Recommended:

10. Molecular Cell Biology by H. Lodish, A. Berk, SL Zipursky, P. Matsudaira, D. Baltimore, and James Darnell.
11. Essential Cell Biology by B. Alberts, D. Bray, K. Hopkin and A. Johnson
12. Molecular Biology of the Cell by B. Alberts, A. Johnson, J. Lewis and M. Raff
13. Cell and Molecular Biology: Concepts and experiments by Gerald Karp
14. Molecular Biology of the Gene by JD Watson et al.
15. Molecular Biology of the Cell by John Wilson, Tim Hunt
16. Genes IX by Benjamin Lewin
17. Gerald Karp, Cell and Molecular Biology – Concepts and Experiments (John Willy and Sons Inc.)
18. Harvey Lodish et al. : Molecular Cell Biology - 7th ed. W.H. Freeman and Co., New York.

CLB17202CR: Clinical Immunology

UNIT I - Introduction to Immunology

Historical perspective, Innate and adaptive Immunity, Cells of immune system (Phagocytic cells, B & T lymphocytes, NK cells and dendritic cells). Humoral and cell mediated immune response. Antigenicity and Immunogenicity. Complement System, Major Histocompatibility Complexes. Antigen processing & presentation, Activation & differentiation of B & T cells.

UNIT II –Immunoglobulin: Structure and Function

Basic structure of immunoglobulins, sequencing studies of immunoglobulins (role of multiple myeloma), structural and functional properties of immunoglobulin classis (IgM, IgD, IgG, IgE, IgA), Antigen-antibody binding, antigenic determinants (isotypic, allotypic and idiotypic determinants). Class switching, clonal deletion, Allelic exclusion, Generation of antibody diversity, gene arrangement and expression of antibody gene.

UNIT III-Autoimmune disorders

Autoimmunity: Definition and its proposed induction mechanism (Organ specific autoimmune diseases, Systemic autoimmune diseases). Treatments for autoimmune diseases. Hypersensitivity reactions, various types of hypersensitivity reactions. Immune response during bacterial (TB), Parasitic (malaria), & viral (HIV) infections.

UNIT IV -Transplantation Immunology

Basis of graft rejection (Autograft, isograft and xenograft), specificity and memory of rejection response, role of cell mediated response, transplantation antigens, mechanisms involved in graft rejection, clinical manifestation of graft rejection (hyperacute and chronic rejection), immunosuppressant therapies (General and specific). Clinical transplantation (Bone marrow transplant, organ transplant and xenotransplant).

Books Recommended:

1. Fundamental Immunology by William E. Paul. Publisher: Lippincott Williams and Wilkins.
2. Immunology: International Edition by Janis Kuby, Thomas J. Kindt, Barbara A. Osborne and Richard A. Goldsby. WH Freeman and Co. Ltd.
3. Immunology by Richard A. Goldsby, Thomas J. Kindt, Barbara A. Osborne and Janis Kuby. WH Freeman and Co. Ltd.
4. Immunology by Ivan M. Roitt, Jonathan Brostoff and David Male. Publisher: Mosby.
5. Introduction to Medical Immunology by Gabriel Virella, Marcel Dekker Inc Basic Immunology: The Functions of the Immune System by Abul K. Abbas and Andrew H. Lichtman. Publisher: Saunders

CLB17203CR: Lab Course-II

- Isolation of bacterial genomic DNA
- Isolation of Plasmid DNA
- Preparation of genomic DNA from Plant tissue by CTAB method
- Isolation of DNA from blood samples by Phenol-Chloroform method
- Qualitative and quantitative determination of DNA and RNA
- Absorption spectra of Nucleic Acids and Determination of melting temperature of calf thymus DNA.
- Denaturation of DNA and UV absorption studies.
- Agarose gel electrophoresis
- Polyacrylamide gel electrophoresis (PAGE) and SDS- PAGE
- Amplification of DNA segment by PCR

CLB17204 DCE: Techniques in Cell & Molecular Medicine

UNIT I - Molecular biology and Radiolabeling methods

Principles and methods of purification of DNA from bacteria (genomic and plasmid), plants and animals; Analysis of DNA and proteins by one and two dimensional gel electrophoresis and Isoelectric focusing Radioisotope Techniques – Radioactivity decay constant, half life of an radioisotope, Detection and measurement of radioactivity; Units of radioactivity, Applications of isotopes used in biological studies

UNIT II-Recombinant DNA methods

Molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems; expression of recombinant proteins using bacterial, animal and plant vectors; isolation of specific nucleic acid sequences; generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC vectors; in vitro mutagenesis and deletion techniques, gene knock out and gene knock down in bacterial and eukaryotic organisms.

UNIT III - Applied Molecular biology methods

Protein sequencing methods, detection of post-translation modification of proteins; DNA sequencing methods, strategies for genome sequencing; methods for analysis of gene expression at RNA and protein level, large scale expression analysis, such as Dot-blotting and micro array based techniques. RFLP, RFLP in DNA fingerprinting. PCR and types (Reverse transcriptase RT-PCR, Real time/quantitative PCR, inverse PCR, nested PCR, multiplex PCR, anchored PCR and asymmetric PCR), RAPD and AFLP techniques. Blotting techniques (Southern blotting, northern-blotting and western-blotting).

UNIT IV -Microscopic Techniques

Optical microscopy – Principles and techniques of photomicroscopy, application and limitations, Individual components of a microscope; Electron Microscopy - Principle of electron microscopes, preparation of samples, Scanning and Transmission electron microscopy; Flow-cytometry – principle and applications

Books Recommended:

1. Watson, J.D., Hopkins, N. H., Roberts, J. W. Steitz& Weiner, A. M., Molecular Biology of the Genes, The Benjamin/Cummings Publishing Company Inc., Tokyo.
2. Daniel L. Hartl& Elizabeth W. Jones, Essential Genetics, 2nd Ed., Jones & Bartlett Publishers
3. T. A. Brown, Genomes, John Wiley & Sons (Asia) PTE Ltd.
4. Genetics: Analysis of Genes and Genomes by Hartl, Jones
5. Molecular Biology of the gene by Watson, Roberts, Staitz and Weiner
6. Molecular biology by Robert Weiver
7. Molecular Biotechnology by Bernard R. Glick and Jack J Pasternak
8. Old R.W. and Primrose, S.B.: Principles of Gene Manipulations, Blackwell Scientific Publication, London.
9. Primrose, S.B.: Animal Biotechnology Blackwell Scientific Publication, London.
10. Watson, J.D. et al.: Cell and Molecular Biology, John Wiley.
11. Freifelder, D.: Molecular Biology, Jones and Bartlett, USA.

CLB17205DCE: Cell Signaling and disorders

UNIT I- Signal transduction

Fundamentals of signal transduction. Signal transduction through cell-surface receptors (GPCR signaling pathway, IP3 pathway, Receptor Tyrosine Kinase pathway, Non receptor TK pathway, Receptor Ser/Thr kinase pathway). Signal transduction through intracellular receptors. Signal transduction pathways that control gene expression. JAK-STAT and MAPK pathway. Hormone response elements, CRE and CREB. Secondary messengers (cAMP, cGMP, NO, Ca, IP3, DAG). Structural and functional properties of steroid receptors.

UNIT II- Disorders of Signal transduction

Disorders of cell surface receptors; Insulin receptor, Growth factor receptors, LDL-receptors, dopamine receptors. Antibodies to receptors: Ab to insulin receptor, TSH receptor, acetylcholine receptor, G-protein defects: inactivated (pseudo hypo-parathyroidism); activated (cholera). Disorders of Intracellular receptors: androgen receptors, estrogen and progesterone receptors, cancer causing mutations in signalling molecules.

Books Recommended:

1. Biochemistry of signal transduction and regulation by Gerhard Krauss
2. Signal transduction: principles, pathways and process by Lewis C. Cantley, Tony Hunter, Richard Server and Jeremy Thorner-Cold spring Harbor Laboratory press.
3. Signal transduction and human diseases by Toren Finkel, J. Silvio Gutkind- Wiley-Liss

CLB17206DCE: Applied Immunology

Unit I: Monoclonal antibodies

Production of monoclonal antibodies by hybridoma techniques and recombinant DNA techniques, applications of monoclonal antibodies, recombinant antibodies, monoclonal antibody fragments (Fab, scFv, diabody, nanobody and antibody conjugate), chimeric and humanized antibodies as drug candidates, FDA approved antibodies for cancer targeting.

Unit II: Immunological techniques

Strength of antigen-antibody interactions, precipitation reactions, radial and double immuno diffusion methods, immunoelectrophoresis, agglutination reactions (Hemagglutination, bacterial agglutination and passive agglutination), ELISA and its types, radioimmunoassay and Immunofluorescence.

Books Recommended:

1. Fundamental Immunology by William E. Paul. Publisher: Lippincott Williams and Wilkins.
2. Immunology: International Edition by Janis Kuby, Thomas J. Kindt, Barbara A. Osborne and Richard A. Goldsby. WH Freeman and Co. Ltd.
3. Immunology by Richard A. Goldsby, Thomas J. Kindt, Barbara A. Osborne and Janis Kuby. WH Freeman and Co. Ltd.
4. Immunology by Ivan M. Roitt, Jonathan Brostoff and David Male. Publisher: Mosby.
5. Introduction to Medical Immunology by Gabriel Virella, Marcel Dekker Inc Basic Immunology: The Functions of the Immune System by Abul K. Abbas and Andrew H. Lichtman. Publisher: Saunders

CLB17207GE: Protein Antibody engineering

Unit I: Protein and antibody engineering

Structural & Functional features of Antibodies. Recombinant antibody fragments and their properties: Fab, Fv, scFv, Diabody, Nanobody, Basic principles of peptide, protein and antibody engineering. Hybridoma and Display technologies for monoclonal antibody development, Basic principles and scope of display technologies. Linkage of phenotype and genotype, Advantages and applications of display technologies and protein engineering,

Unit II: Applications of recombinant antibodies

Monoclonal viz. Recombinant antibodies in drug development, Scope and problems of antibody based drugs, Generation of chimeric and humanized monoclonal antibodies for clinical applications, Recombinant antibodies in current medical use: Application of monoclonal antibody based drugs in treatment of cancers and other diseases.

Books Recommended:

1. Immunology by Richard A. Goldsby, Thomas J. Kindt, Barbara A. Osborne and Janis Kuby. WH Freeman and Co. Ltd.
2. Basic Immunology: The Functions of the Immune System by Abul K. Abbas and Andrew H. Lichtman. Publisher: Saunders.
3. Antibody Engineering: by R. Kontermann & S. Dubel. Springer-Verlag, Berlin.
4. Phage Display: A laboratory manual. CF. Barbas, DR. Burton, JK. Scot & GJ. Silverman. Cold Spring Harbor Laboratory press, New York.
5. Antibody Engineering: Methods and Protocols. Methods in Molecular Biology (Volume-248), Humana Press.
6. Antibody-Drug Conjugates: Methods in Molecular Biology (Volume-1045, 2013), Humana Press.
7. Antibody Drug Discovery. Molecular Medicine and Medicinal Chemistry (Volume-4) edited by. CR. Wood, Bayer Health Care, Germany.

CLB17208GE: Protein Biophysics

Unit I: Peptide Conformation

Definition of peptide, peptide unit, peptide group, bond length, cis and trans conformation, Ramachandran Plot, primary, secondary (alpha helix, beta sheet, beta turn), tertiary structure (Forces involved), Motifs, super secondary structures, Domain and Quaternary structures (Example - Hemoglobin).

Unit II: Protein Folding, Misfolding and Aggregation

Protein folding: Introduction, Protein folding dilemma, Levinthals Paradox, Models- Nucleation condensation, framework and Hydrophobic collapse Model; Folding funnel hypothesis & free energy landscape; Introduction to protein misfolding, Amyloid fibrils- introduction and mechanism- nucleation condensation, Factors affecting aggregation. Prions.

Books Recommended:

1. Introduction to Protein Structure (2nd edition) by Carl Branden and John Tooze; Garland Science ISBN-13: 978-0815323051
2. Protein Folding (1st edition) by Thomas E. Creighton; W. H. Freeman ISBN-13: 978-0716770275
3. How Protein Work by M. Williamson, 1st Ed. 2011, Garland Sciences
4. Principles of Biochemistry by Geoffrey Zubay. Publisher: McGraw Hill College. Biochemistry by Lubert Stryer. WH Freeman and Co.
5. Fundamentals of Biochemistry: Life at the Molecular Level 5th Ed. By Donald Voet, Judith G. Voet and Charlotte W. Pratt. Publisher: Wiley.

CLB17209OE: Basic Concepts in Clinical Biochemistry

UNIT I-Introduction to Clinical Biochemistry

Definition and scope of clinical biochemistry in diagnosis, collection and preservation of biological fluids (blood, urine & CSF), normal values of important constituents of blood, CSF and urine. Requirements of setting up of clinical laboratory, collection preparation, preservation, and handling of clinical samples, quality control, Safety measures in clinical laboratory.

UNIT II-Clinical Importance of Biomolecules

Carbohydrates- Estimation of glucose, glycosuria, hyper & hypoglycemia, blood glucose regulation and role of hormones; diabetic coma, Lipids- lipid profile estimation, hypercholesterolemia, atherosclerosis and its risk factors.

Books Recommended:

1. Clinical biochemistry, metabolic and clinical aspects by William J. Marshall, Stephan K
2. Elsevier science health.
3. Fundamentals of Clinical Biochemistry by Teiz, W.B-Saunders Company.
4. Clinical Biochemistry: An illustrated color text 3rd Ed. by Allan Gaw, Micheal Murphy, Robert Cowan, Denis O Reilly, Micheal Stewart and James Shepherd. Churchill Livingtons.

SEMESTER-III

CLB17301CR: Organ System Diseases-I: Respiratory, Cardiovascular and Excretory systems

UNIT I –Acid base balance -I

Regulation of water and electrolyte balance; Role of Na⁺ and K⁺, Role of kidneys and hormones. Clinical features and laboratory findings in- dehydration, overhydration, Hyper-natremia, hypo-natremia; (SIADH), hypo-kalemia, hyper-kalemia. Acid-Base balance; regulation by kidney and hormones. Acid-base disorders.

UNIT II–Acid base balance -I

Physiology of respiratory system, Diffusion of gases through respiratory membrane; Role of transferrin, oxygen, CO, CO₂ in respiration. Investigation of respiratory diseases; Chronic respiratory failure, Clinical features and laboratory findings in COPD, Cystic fibrosis, asthma and pneumonia

UNIT III- Kidney Physiology and Disorders

Brief anatomy of Nephron, Urine formation; Glomerular filtration, Tubular reabsorption, Tests of kidney function and their Clinical co-relations: tests of glomerular functions, measurement of GFR, Clearance tests (creatinine and inulin clearance), Plasma creatinine, urea, β₂-microglobulin. Tubular functions tests. Normal urine composition, urinalysis; microscopic analysis, Clinical features and laboratory findings in- Glomerulonephritis; acute glomerulonephritis, progressive glomerulonephritis, nephritic syndrome. Nephrotic syndrome, acute renal failure/chronic renal failure, renal calculi.

UNIT IV- Physiology & Disorders of Hepatobiliary System

Liver structure and function: brief anatomy; functions of liver (bile acid formation and metabolism). Biochemical indices in hepatobiliary disorders; bilirubin Bile acids, serum enzymes (ALP, AST, GGT, LDH) Serum proteins (immunoglobulins, prothrombin) Serum lipids (lipoprotein X, role of LCAT). Liver function tests (cholangiography). Diseases of hepatobiliary system; Clinical features laboratory findings in- intrahepatic cholestasis, extrahepatic cholestasis, acute liver diseases; viral hepatitis (hepatitis A,B,C,D and E), Toxic hepatitis (hepatotoxic drugs), chronic liver diseases; liver cirrhosis.

Books Recommended:

1. Clinical Biochemistry: Metabolic And Clinical Aspects by William J. Marshall, Stephan K. Bangert, Elizabeth S.M.; Elsevier Science Health Science
2. Fundamentals of Clinical chemistry – Teitz, W.B.Saunders company,
3. Practical Clinical Biochemistry, volume I and II, 5th edition – Varley *et al.*, CBS Publishers,.
4. Biochemistry by Zubay 4th Edition (WMC Brown Publishers)
5. Physiological basis of Medicine (Best & Taylor)
6. Teitz text book of clinical biochemistry 3rd edition – Burtis *et al.*, William Heinman medical books, Ltd.
7. Clinical biochemistry – Metabolic and clinical aspects, Pearson Professional Ltd
8. Gerald Karp, Cell and molecular Biology. (John Welly and Sons)
9. Frederic Martini, Fundamentals of Anatomy and Physiology (prentice Hall, New Jersey)
10. Harrison's Principles of Internal Medicine, 18th Edition (Harrison's Principles of Internal medicine) by Dan L. Longo, Anthony S. Fauci, Dennis L. Kasper, Stephen L. Hauser, J. Larry Jameson and Joseph Loscalzo, McGrawHill publishers

CLB17302CR: Organ System Diseases-II: Gastrointestinal, Neuromuscular and Skeletal Systems

UNIT I- Physiology and Disorders of Gastrointestinal System

Mechanism of gastric secretion-HCl production, Gastrointestinal hormones Clinical features and laboratory findings in diseases of the stomach: peptic ulcer, neoplastic disease.

Physiology of the pancreatic function, Assessment of pancreatic function. Pancreatic enzymes; Secretin and CCK-PZ tests. Clinical features and laboratory findings in diseases of the pancreas; Acute and chronic pancreatitis; Assessment of intestinal function; Small bowel malabsorption tests; Xylose, Lactose and other disaccharides). Clinical features and laboratory findings in: Malabsorption, Malabsorption syndromes(A); gluten intolerance, inflammatory bowel disease, Crohns disease

UNIT II -Physiology and Disorders of Musculo-Skeletal system

Physiology of muscle, Skeletal muscle - Ultrastructure, Molecular mechanism of its contraction;. Smooth muscle - Ultra structure, contraction and its control; Joints- Physiology, Types of Joints – fibrous, cartilage and synovial; Synovial fluid and its properties; Pathophysiology and laboratory findings of joint disorders -Osteoarthritis and Rheumatoid Arthritis; Bone metabolism- Biochemical markers of bone turnover. Significance of urinary cyclic AMP, Clinical features and laboratory findings in the disorders like Tetany, Osteoporosis, Rickets and Paget's disease

UNIT III- Physiology and disorders of Nervous System

Nerve impulse transmission: Structure of neuron, mechanism of nerve impulse conduction along axon, Action Potential; Threshold action potential. Neurotransmitters; Excitatory and Inhibitory neurotransmitters, Pre-synaptic and post-synaptic events of neuromuscular junctions, Structure of nervous system; CNS, peripheral nervous system. Disorders of neurotransmission: cholinergic systems (Alzheimer's disease, myasthenia gravis); aminergic systems (Parkinson's disease,). Epilepsy, Huntington's disease, Multiple sclerosis, Psychiatric disorders; mood disorders, depressive disorders.

UNIT IV Mineral and Drug Metabolism

Biochemistry, physiology, clinical significance of measurement of calcium, phosphorous and magnesium. Integrated control of mineral metabolism. Approaches to pharmacological testing, Use of gastrointestinal tract for drug absorption, T half-life, Drug metabolism, excretion; Pharmacokinetics, pharmacodynamics and pharmacogenetics, Drug metabolism in elderly; Clinical applications of pharmacogenetic testing, Defining pharmacogenetic targets, Examples of clinically relevant pharmacogenetic targets (Thiopurine S-Methyltransferase, Cytochrome P450 2D6, N-Acetyltransferases; NAT1 & NAT2).

Books Recommended:

1. Harrison's Principles of Internal Medicine, 18th Edition (Harrison's Principles of Internal medicine) by Dan L. Longo, Anthony S. Fauci, Dennis L. Kasper, Stephen L. Hauser, J. Larry Jameson and Joseph Loscalzo, McGrawHill publishers
2. Gerald Karp, Cell and molecular Biology. (John Wiley and Sons)
3. Frederic Martini, Fundamentals of Anatomy and Physiology (prentice Hall, New Jersey)
4. Clinical Biochemistry: Metabolic And Clinical Aspects by William J. Marshall, Stephan K. Bangert, Elizabeth S.M.; Elsevier Science Health Science
5. Fundamentals of clinical chemistry – Teitz, W.B. Saunders company
6. Practical clinical biochemistry, volume I and II, 5th Edition – Varley *et al.*, CBS Publishers,
7. Biochemistry by Zubay 4th Edition (WMC Brown Publishers)
8. Physiological basis of Medicine (Best & Taylor)
9. Teitz text book of clinical biochemistry 3rd edition – Burtis *et al.*, William Heinmann medical books, Ltd.
10. Clinical biochemistry – Metabolic and clinical aspects, Pearson Professional Ltd

CLB17303CR: Lab Course-III

- Estimation of serum albumin and determination of albumin/globulin ratio.
- Estimation of serum triglycerides, total cholesterol, HDL cholesterol, LDL cholesterol.
- Estimation of serum bilirubin
- Estimation of serum acid phosphate, alkaline phosphate, ALT and AST and their clinical use
- Estimation of serum urea and creatinine
- Urine analysis – Routine and microscopic examination
- Sub Cellular fractionation and marker enzymes activity
- Estimation of serum of normal and sickle hemoglobin
- Estimation of T3, T4, and TSH by ELISA/RIA
- Estimation of antinuclear antibodies and C reactive protein
- Separation of mononuclear cells by Ficoll-Hypaque.
- TLC/ DLC
- Estimation of non-protein nitrogen, urea, urate, creatine and creatinine.
- Tests for urinary proteins
- Tests for lipids and lipoproteins
- Estimation of cholesterol
- Estimation of Na⁺, K⁺ and Cl⁻
- Estimation of Ca⁺⁺, Mg⁺⁺ and P
- Estimation of Fe⁺², Cu⁺² and Zn⁺²
- Demonstration of PCR - RFLP, RT-PCR/ Q-PCR Techniques
- Tests for liver and billiary tract diseases
- Tests for renal diseases

CLB17304DCE: Advanced Endocrinology

UNIT I - Physiology and Disorders of Pituitary Gland

General characters and classification of hormones; Hypothalamus & pituitary gland; Structure, biosynthesis, secretion, transport metabolism, and function of the hormones secreted by pituitary gland, (control mechanism of hypothalamus and pituitary), Hypo and hyper secretion of hormones secreted by pituitary.

UNIT II - Physiology and Disorders of Thyroid Gland

Thyroid gland: Structure, biosynthesis, secretion, transport metabolism, and function. Hypo-& hyperthyroidism. Proteolysis of thyroglobulin and secretion of thyroxine and triiodothyronine, storage and transport of iodine. Regulation of thyroid hormone synthesis antithyroid agents. Parathyroid gland: Structure, biosynthesis, secretion, transport metabolism and function of the hormones. Disorders of parathyroid.

UNIT III- Physiology and Disorders of Pancreatic Hormones

Pancreatic hormones: structure and biosynthesis of pancreatic hormones, organization of islet cells, synthesis, destruction and mechanism of action of insulin, effect of insulin on carbohydrate and lipid metabolism, Insulin signaling system, insulin deficiency, glucagon chemistry, metabolic effects of glucagon and somatostatin.

UNIT III- Physiology and Disorders of Adrenal Gland

Adrenal gland hormones: Adrenal medulla- Epinephrine and nor-epinephrine, their biosynthesis, metabolism of Epinephrine and nor-epinephrine, biological actions of Epinephrine and nor-epinephrine and their regulation. Adrenal cortex- synthesis of adrenal cortical steroids, biological actions and transport of cortical steroids. Mechanism of action of adrenal steroid hormones.

Books Recommended:

1. Harrison's Principles of Internal Medicine, 18th Edition (Harrison's Principles of Internal medicine) by Dan L. Longo, Anthony S. Fauci, Dennis L. Kasper, Stephen L. Hauser, J. Larry Jameson and Joseph Loscalzo, McGrawHills publishers
2. Gerald Karp, Cell and molecular Biology. (John Welly and Sons)
3. Frederic Martini, Fundamentals of Anatomy and Physiology (prentice Hall, New Jersey)
4. Clinical Biochemistry: Metabolic And Clinical Aspects by William J. Marshall, Stephan K. Bangert, Elizabeth S.M.; Elsevier Science Health Science
5. Fundamentals of clinical chemistry – Teitz, W.B.Saunders company
6. Practical clinical biochemistry, volume I and II, 5th Edition – Varley *et al.*, CBS Publishers,
7. Biochemistry by Zubay 4th Edition (WMC Brown Publishers)
8. Physiological basis of Medicine (Best & Taylor)
9. Teitz text book of clinical biochemistry 3rd edition – Burtiset *al.*, William Heinmann medical books, Ltd.
10. Clinical biochemistry – Metabolic and clinical aspects, Pearson Professional Ltd

CLB17305DCE: Hematology and Cardiovascular System

UNIT I- Physiology and Disorders of Blood

Principles of Hematopoiesis, RBC formation and maturation and its regulation, Iron metabolism (Role of transferrin and ferritin), porphyrin and heme metabolism, Blood disorders- Anemia and polycythemia. Hemostasis – Principle, Types of mechanism –Vascular spasm, platelet plug formation and Coagulation - Intrinsic and extrinsic pathway; Anticoagulants for clinical use

UNIT II- Physiology and Disorders of Cardio-vascular system

Anatomy and physiology of heart, cardiac cycle (cardiac output, venous return and their regulation) Examination of cardiovascular system; Blood pressure, ECG, Clinical features and role of the laboratory in; Myocardial Infarction, (serum enzymes, troponin, myoglobin and other markers, monitoring treatment with drugs); Heart failure (congestive heart failure), Atherosclerosis (lipids, lipoproteins and apoproteins in assessing risk, LCAT), Shock and Hypertension.

Books Recommended:

1. Harrison's Principles of Internal Medicine, 18th Edition (Harrison's Principles of Internal medicine) by Dan L. Longo, Anthony S. Fauci, Dennis L. Kasper, Stephen L. Hauser, J. Larry Jameson and Joseph Loscalzo, McGrawHills publishers
2. Gerald Karp, Cell and molecular Biology. (John Welly and Sons)
3. Frederic Martini, Fundamentals of Anatomy and Physiology (prentice Hall, New Jersey)
4. Clinical Biochemistry: Metabolic And Clinical Aspects by William J. Marshall, Stephan K. Bangert, Elizabeth S.M.; Elsevier Science Health Science
5. Fundamentals of clinical chemistry – Teitz, W.B.Saunders company
6. Practical clinical biochemistry, volume I and II, 5th Edition – Varley *et al.*, CBS Publishers,
7. Biochemistry by Zubay 4th Edition (WMC Brown Publishers)
8. Physiological basis of Medicine (Best & Taylor)
9. Teitz text book of clinical biochemistry 3rd edition – Burtiset *et al.*, William Heinmann medical books, Ltd.
10. Clinical biochemistry – Metabolic and clinical aspects, Pearson Professional Ltd
11. Lippincott's illustrated reviews: Pharmacology by Richard a Harvey, Pamela C Champe Richard Finkel, Luigi X Cubeddu, michelle a clarke, 4th edition, 2008
12. Pharmacognosy by G.E. Trease, W.C. Evans, ELBS, 2002

CLB17306DCE: High Risk pregnancy & Neonatology

UNIT I - Assessment and Monitoring of High Risk Pregnancy

Perinatal care. Total Maternal serum screen; first trimester screen; Down's syndrome screen, Second & Third trimester screen, [alpha-fetoprotein, hCG, unconjugated estriol), Quadriple screen, Amniotic fluid and fetal blood examination (acetylcholinesterase and other tests on amniotic fluid), Amniocentesis, Percutaneous Umbilical Cord Blood Sampling (PUBS), chorionic villus sampling (CVS), Laboratory assessment of fetal lung maturity. Ectopic pregnancy; , biochemical markers and management.

UNIT II - Neonatology & Congenital disorders

Respiratory distress syndrome, Common transient phenomena. Neonatal Infections. Neural tube defects; Spina bifida, Anencephaly, Encephaloceles (Origin and management). Neonatal anemia. Rh isoimmunization. Down syndrome. Cystic Fibrosis. Vaccination in Newborn babies, WHO recommended immunization schedule. BCG, DPT, OPV & Multivalent vaccine combinations.

Books Recommended:

1. Harrison's Principles of Internal Medicine, 18th Edition (Harrison's Principles of Internal medicine) by Dan L. Longo, Anthony S. Fauci, Dennis L. Kasper , Stephen L. Hauser, J. Larry Jameson and Joseph Loscalzo, McGrawhills publishers.
2. GHAI Essential Pediatrics, 8th Edition by Paul VK & Bagga A (CBS Publishers).
3. Frederic Martini, Fundamentals of Anatomy and Physiology (prentice Hall, New Jersey)
4. Teitz text book of clinical biochemistry 3rd edition – Burtiset *al.*, William Heinmann medical books, Ltd.
5. Guyton and Hall, A Text book of Medical Physiology, W. B. Saunders
6. Clinical Biochemistry: Metabolic And Clinical Aspects by William J. Marshall, Stephan K. Bangert, Elizabeth S.M.; Elsevier Science Health Science
7. Fundamentals of clinical chemistry – Teitz, W.B. Saunders company.

CLB17307GE: Free radical and Oxidative stress related diseases

UNIT I- Free radicals in biological system

Introduction & chemistry of reactive oxygen species (ROS), cellular damage caused by ROS. Lipid peroxidation and DNA damage and their measurement. Free radicals as useful species. Antioxidants: Protection by enzymatic antioxidants and non-enzymatic antioxidants.

Unit II- Oxidative stress related diseases

Role of oxidative stress in various cancers, role of free radicals in diabetic I and diabetic II type of diseases, various inflammatory disorders associated with free radicals, oxidative stress in neurodegenerative diseases; Alzheimer's disease, Parkinson's disease, Huntington's disease. Mitochondrial free radical theory of aging.

Books Recommended:

1. Free radicals in Biology and Medicine by Barry Halliwell and John Gutteridge- Oxford University press.
2. Free radical biology in digestive disease by Naito Y, Suematsu M, Yoshikawa T- Karger medical and scientific publishers.
3. System biology of free radicals and antioxidants by Ismail Laher- Springer.

CLB17308GE: Cell cycle and cancer biology

UNIT I- Cell Cycle

Cell division and cell cycle, Mitosis and Meiosis – different stages, variations, checkpoints. Regulation of mitosis and meiosis, Maturation promoting factor, Anaphase promoting complex, inhibitors of cdk, growth factors and D cyclins.

UNIT II - Cancer Biology

Stages in cancer development, causes and properties of cancerous cells, tumour viruses, oncogenes, functions of oncogene products, Oncogene and signal transduction. Tumor suppressor genes, functions of tumour suppressor genes products. Diagnosis, prevention and treatment of cancer.

Books Recommended:

1. DeRobertis EDP and DeRobertis EMF Jr. (2004) Cell and Molecular Biology, 8th Edition, Lippincott Williams & Wilkins, Philadelphia, USA.
2. The Biology of Cancer by R. Weinberg 2nd Ed
3. Cancer Biology by R. W. Ruddon
4. The Biological Basis of Cancer by R. G. Mckinnell, R. E. Parchment, A. O. Perantoni and G. B. Pierre, 4th Ed. Cambridge University Press

CLB17309OE: Bio-ethics in Clinical Research

Unit I –Bioethics-I

Definition of bioethics and Key ethical principles, Need and Birth of modern bioethics- Nazi experimentation, Tuskegee syphilis experiments, Tuberculosis experiments, sulfanilamide experiments, freezing experiments, etc.; Bioethics and its relation with other branches; Applications of bioethics; Ethics in clinical research – Indian perspectives

Unit II – Bioethics-II

Basic philosophies of animal ethics:- 3 'R's; Animal rights Vs animal ethics; Use of animals in research – ethical issues, alternatives of animal models; Guidelines for ethical conduct in the care and use of animals; Animal Ethics Committee in India, Process to establish an Animal Ethics Committee.

Books recommended:

1. Biological Safety: Principles And Practices (Biological Safety: Principles & Practices) by Diane O. Fleming and Debra Long Hunt
2. Biosafety in the Laboratory: Prudent Practices for Handling and Disposal of Infectious Materials by National Research Council (U. S.)
3. Biotechnology, Biosafety, and Biodiversity: Scientific and Ethical Issues for Sustainable Development by Sivramiah Shantharam, Jane F. Montgomery and Satellite Symposium on Biotechnology and Biodiversity
4. The language of medicine, Fifth edition, WB Saunders Company, Devi-Ellen Chabner,BA, MAT.
5. Medical Terminology a text workbook, Alice V. Prendergast, Frances C. Fulton, 4th Edition, Adderson Wesley

SEMESTER IV

CLB17401CR: Internship Dissertation

Internship represents a cross-over point between university and career. The experience one gets during an internship will indicate how he/she should structure future studies, particularly when it comes to deciding what aspects one should focus on. Students carry their internship program outside the parent department wherein project work will be carried out, based on research and actual bench work under the guidance of their respective supervisor at the place of internship. The department facilitates the students for placement for their internship. During the program the students are in close touch with their respective teachers in the department. The students are expected to put at least six working hours daily for a maximum period of six months. At the end of the internship, the internship dissertation will be submitted in the parent department and evaluated.

CLB17402CR: Host Institute Grading

During the internship, the students will be critically evaluated by the supervisors and will be graded by them based on their attendance in the lab, daily experimental work, writing and communications skills and other criteria related to routine lab work.

CLB17403CR: Internship Assessment

This will include an open presentation, defending their dissertation work to be evaluated by an external examiner (to be nominated by Head of the Department) and all the faculty members. The presentation will be followed by the viva of the students to be carried out by the external examiner.

CLB17404DCE: Research Proposal Writing

Formulating aims and objectives for your research studies helps to shape and guide your work after you've decided on a topic. Students in consultation with the faculty will discuss various issues like how to write aim, objectives, methodology and review of literature for a research proposal. After formulating their proposal, the students shall make an open presentation in front of all the faculty members.

CLB17405 DCE: Automation, Diagnostic Procedures, Interpretation & Clinical Correlations

UNIT I- Automation in Clinical Biochemistry

Historical overview, Laboratory information systems, Types of Automation, Individual steps in the analytical processes, Reagent handling and storage, reagent delivery, Chemical reaction phase, Development of standards for laboratory automation. Other areas of automation; urine analyzers, hematology cell counters and flow-cytometers. Quality Assurance & Management: Fundamentals of total quality management, elements of quality assurance program. External quality assessment- Identifying the source of analytical errors. Fundamentals of Lab Safety. Establishment and use of reference values: Concept of reference values, Selection of reference individuals, Specimen collection, Analytical procedures and quality control. Methods for determining the reference values and presentation of an observed value in relation to reference value.

UNIT –II Routine lab analysis

Bilirubin - total, conjugated (direct). Hepatitis A, B and C serology. Calculi. Iron - serum, iron binding capacity, iron saturation, transferrin, Ferritin. Lipids: cholesterol, Triglycerides, HDL-cholesterol, LDL-cholesterol, Apolipoprotein A B and E. Lipoprotein A. Cardiac Markers; CK-2 (CKMB), troponins, myoglobin, Creatinine kinase. Prostate specific antigen (PSA); alpha-fetoprotein (AFP); chorionic gonadotropin (CG). Proteins; Serum total, albumin, Urinary microalbumin, C-reactive protein. Immunoglobulin IgE, allergen specific IgE, Hemoglobins. Antibodies: anti-ds-DNA; anti-nuclear antibodies by immunofluorescence, specific anti-nuclear antibodies (SS-A, SS-B, Sm, RNP); anti-thyroglobulin, TSH receptor antibody, Islet-cell antibodies. Urine analysis (including microscopy).

UNIT III–Electrolyte and specific enzyme analysis

Evaluation and clinical significance of: Blood gases and pH (carboxyhemoglobin, Met Hb, etc); Various electrolytes (Na^+ , K^+ , HCO_3^- , etc), Urea, Uric acid. Enzymes; Alkaline phosphatase, Alanine aminotransferase, Aspartate aminotransferase, Gamma-glutamyltransferase, Lactate dehydrogenase, Creatine kinase, Amylase, Lipase; Acetylcholinesterase, Angiotensin converting enzyme, Glucose-6-phosphate dehydrogenase, Immunoreactivetrypsinogen and chymotrypsin.

UNIT IV – HORMONE ANALYSIS

Hormone tests: Growth hormone, Follicle stimulating hormone, Luteinizing hormone, Corticotropin releasing hormone, prolactin, Thyroxin and free thyroxin, Thyrotropin, Triiodo-thyronine (Total T3) and free T3, Thyroglobulin, reverse T3, Parathyroid hormone, Calcitonin, Cortisol (plasma and urinary free), Corticotropin, Antidiuretic hormone, Aldosterone, gastrin, rennin, estradiol, testosterone (total and free), C-peptide, glucagon, hCG screen (pregnancy test) and quantitative hCG. Insulin tolerance test; growth hormone stimulation test; Adrenocorticotropin, congenital adrenal hyperplasia or hirsutism. Bolus Tests. cAMP, cGMP, prostaglandins. Strategy of cancer detection by biochemical means; cancer markers and cancer screening

Books Recommended:

1. Harrison's Principles of Internal Medicine, 18th Edition (Harrison's Principles of Internal medicine) by Dan L. Longo, Anthony S. Fauci, Dennis L. Kasper, Stephen L. Hauser, J. Larry Jameson and Joseph Loscalzo, McGrawHill publishers
2. Gerald Karp, Cell and molecular Biology. (John Wiley and Sons)
3. Frederic Martini, Fundamentals of Anatomy and Physiology (prentice Hall, New Jersey)
4. Clinical Biochemistry: Metabolic And Clinical Aspects by William J. Marshall, Stephan K. Bangert, Elizabeth S.M.; Elsevier Science Health Science
5. Fundamentals of clinical chemistry – Teitz, W.B. Saunders company
6. Practical clinical biochemistry, volume I and II, 5th Edition – Varley *et al.*, CBS Publishers,
7. Biochemistry by Zubay 4th Edition (WMC Brown Publishers)
8. Physiological basis of Medicine (Best & Taylor)
9. Teitz text book of clinical biochemistry 3rd edition – Burtis *et al.*, William Heinmann medical books, Ltd.
10. Clinical biochemistry – Metabolic and clinical aspects, Pearson Professional Ltd
11. Lippincott's illustrated reviews: Pharmacology by Richard A. Harvey, Pamela C. Champe, Richard Finkel, Luigi X. Cubeddu, Michelle A. Clarke, 4th edition, 2008
12. Pharmacognosy by G.E. Trease, W.C. Evans, ELBS, 2002

CLB17406GE: Epigenetics and Gene Expression

Unit- I Epigenetic inheritance

Introduction to epigenetics. Differences between Mendelian and epigenetic inheritance. Chromatin structure; Histones, nucleosomes and higher order chromatin structure. Epigenetic Control of Chromatin Organization; DNA methylation, histone modifications. Chromosomal Inheritance of Epigenetic States during cell cycle. Metabolic and environmental control of epigenetic states. Epigenetics and diseases: Various types of cancers, fragile X-syndrome, Prader-Wili syndrome.

Unit-II Epigenetics and gene regulation

Chromatin as a regulator of gene expression; Post-translational modifications of histones and the associated writers and readers, ATP-dependent chromatin remodeling complexes, Histone Chaperones, Histone variants and Non-coding RNAs. The epigenetic code: gene silencing gene activation and long-distance regulation. Metabolic and environmental control of epigenetic states.

Books Recommended:

1. Genetics: Analysis of Genes and Genomes by Hartl, Jones
2. Tom Strachan & Andrew P. Read Human Molecular Genetics (3rd Edition), John Wiley & Sons.
3. Ricki Lewis, Human Genetics-Concepts & Applications (3rd Edition), McGrawHill.
4. T. A. Brown, Genomes, John Wiley & Sons (Asia) PTE Ltd.
5. Scott Freeman & Jon C. Herron, Evolutionary Analysis (5th Edition), Prentice Hall
6. Garner E.J, Simmons, M.J. & Snustad, D.P. Principles of Genetics, John Wiley & Sons Inc, N.Y
7. Watson, J.D., Hopkins, N. H., Roberts, J. W. Steitz & Weiner, A. M., Molecular Biology of the Genes, The Benjamin/Cummings Publishing Company Inc., Tokyo.
8. William S. Klug & Michael R. Cummings Essentials of Genetics, 5th Ed, Prentice Hall Internationals
9. Daniel L. Hartl & Elizabeth W. Jones, Essential Genetics, 6th Ed., Jones & Bartlett Publishers

CLB17407GE: Basics in Cellular Signalling

UNIT-I Introduction to Cell Structure and Signal Transduction -Cellular signaling and transport across the membrane.Active and Passive Transport.Signaling via cell surface receptors. Types of Cell surface Receptors. G-Protein Coupled Receptor (GPCR) signaling pathways. Structural and Functional features of GPCRs, Diversity of Secondary Messenger molecules in cellular signaling.

UNIT-II Signaling through Cell surface receptors with intrinsic enzymatic activities. Receptor Tyrosine Kinase (RTK) signaling. Structural and functional features of RTKs. Non-Receptor Kinase signaling Pathway (NRTKs).JAK-STAT and MAPK signaling and its role in cancer development.Signaling through intracellular receptors.

Books Recommended:

1. Molecular Cell Biology by H. Lodish, A. Berk, SL Zipursky, P. Matsudaira, D. Baltimore, and James Darnell.
2. Biochemistry of signal transduction and regulation by Gerhard Krauss
3. Signal transduction: principles, pathways and process by Lewis C. Cantley, Tony Hunter, Richard Server and Jeremy Thorner-Cold spring HarborLaboratory press.
4. Signal transduction and human diseases by TorenFinkel, J. Silvio Gutkind- Wiley-Liss

CLB17408OE: Obesity, Inflammation and Nutritional diseases

UNIT I – Nutrition and Obesity

Concept - Composition of food - macro and micro nutrients. Nutritional requirements of infants, children
Nutritional demand in pregnancy, lactation and menopause. Obesity, Risk factors of obesity, MS- Metabolic syndrome, Diagnosis. Signs, symptoms and risk factors of metabolic syndrome, Treatment and management of metabolic syndrome.

UNIT II - Nutritional Diseases

Diseases arising due to protein - calorie malnutrition and under nutrition (Kwashiorkar and Marasmus diseases) Vitamins (fat and water soluble) and Minerals – why are they important, their deficiency supplementation. Modification of dietary pattern for patients suffering from fever (Typhoid and Malaria), Jaundice, hyper acidity (Ulcer), parenteral nutrition.

Books Recommended:

1. Martin Eastwood, Principles of Human Nutrition' Blackwell publishing, II edition
2. ChandiCharan Chatterjee, 'Human Physiology' Volume I, Medical Allied Agency, XI Edition
3. Nutritional Biochemistry by Tom Brody
4. Nutritional Biochemistry of the Vitamins by DA Bender
5. Nutrition: An integrated approach by R.L. Pike and M.L. Brown
6. Text book of Biochemistry and Human Biology by G.P. Talwar
7. DWS Wong Mechanism and theory in food chemistry
8. Text book of Human Nutrition by M.S.Banji N P. Rao & V. Reddy
9. Nutritional biochemistry and Metabolism by Linten