

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, 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

CLB15305DCE: Neonatology & Congenital disorders

UNIT I–Introduction and disorders

Perinatal care, Low birth weight, Respiratory distress, Common transient phenomena, Infections, Anemia and bleeding disorders, Understanding of perinatal medicine, Thermoregulation and its disorders; Neural tube defects; Spina bifida, Anencephaly, Encephaloceles (Origin and management), Attention deficit hyperactivity disorders , Autism, X-Linked Diseases, X-Inactivation, , Mitochondrial disorders.

UNIT II- Pediatric Clinical Biochemistry

Problems in specimen collection and capillary specimens. Special problems in pediatrics: Respiratory distress syndrome;, neonatal hyperbilirubinemia; cystic fibrosis; neuroblastoma (VMA ,HVA); gastrointestinal disease (fat absorption, disaccharide intolerance, protein-losing enteropathy, Down syndrome. Heavy metal poisoning. Neonatal health management; Vaccination in Newborn babies, Recommended immunization schedule.

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. Frederic Martini, Fundamentals of Anatomy and Physiology (prentice Hall, New Jersey)
3. Teitz text book of clinical biochemistry 3rd edition – Burtiset *al.*, William Heinmann medical books, Ltd.
4. Guyton and Hall, A Text book of Medical Physiology, W. B. Saunders
5. Clinical Biochemistry: Metabolic And Clinical Aspects by William J. Marshall, Stephan K. Bangert, Elizabeth S.M.; Elsevier Science Health Science
6. Fundamentals of clinical chemistry – Teitz, W.B.Saunders company

CLB15404DCE: Advanced Clinical Biochemistry

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 - Diagnostic Procedures, Interpretation & Clinical Correlations-I

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, Immunoreactive trypsinogen and chymotrypsin. Hormone tests: Growth hormone, Follicle stimulating hormone, Luteinizing hormone, Corticotropin releasing hormone, prolactin, Thyroxine and free thyroxine, 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;

UNIT -III Diagnostic Procedures, Interpretation & Clinical correlations –II

Bilirubin - total, conjugated (direct). Hepatitis A, B and C serology. Calculi (renal). 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. Alpha-1-antitrypsin, fibrinogen, immunoglobulin IgE, allergen specific IgE, Hemoglobins. Vitamins: Vitamins – A, vitamin B12, folate and carotenoids, Schillings test: 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. Anti-glomerular basement membrane. Urine analysis (including microscopy).

UNIT IV - Biochemical markers of oncology

Strategy of cancer detection by biochemical means; cancer markers and cancer screening. Use and limitations of tumor products and enzymes in the diagnosis and monitoring of cancer (carcinoembryonic antigen (CEA); alpha-fetoprotein (AFP); human chorionic gonadotropin (hCG); total and free prostate specific antigen (PSA); CA 19-9, CA 125, other antigens), Tumor markers: CA 125, CA 19-9, CA 15-3, 5-HIAA, PTHrP, NSE. carcinoembryonic antigen (CEA); Oncogenic enzymology: acid phosphatase (ACP); alkaline phosphatase (ALP); lactate dehydrogenase (LD); other enzymes. Hormone receptors and response to therapy, Primary neoplastic endocrinopathies; paraneoplastic syndromes; multiple endocrine adenopathy (MEA) syndromes type I and type II; syndromes due to ectopic hormone synthesis.

Books Recommended:

1. Fundamentals of Clinical Chemistry – Teitz, W.B. Saunders company
2. Practical Clinical biochemistry, volume I and II, 5th edition – Varley et.al., CBS Publishers,
3. Clinical Chemistry in diagnosis and treatment 6th edition – Mayne, ELBS Publications, 1994
4. Teitz text book of Clinical Biochemistry 3rd edition – Burtis et al., William Heinmann medical books, Ltd.
5. Clinical Biochemistry – Metabolic and clinical aspects, Pearson Professional Ltd.
6. Clinical Chemistry 5th edition – Mosby, Marshall,
7. Clinical Chemistry – principles, procedures and correlations, Bishop, Lippincott,

CLB15405DCE: 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.

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. Benjamin/ 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.

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

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.

CLB15406GE: Life style diseases and laboratory diagnosis

UNIT I: Life style diseases

Cardiovascular Diseases and their types, Risk factors associated with Cardiovascular Diseases, Pathophysiology and screening of CVD patients, Prevention and Management of CVD, Role of obesity in Cardiovascular Disease. Atherosclerosis, Diabetes and its complications, Pathological links between Diabetes and Metabolic Syndrome. Obesity and Inflammatory cascades. Treatment and prevention of Diabetes.

UNIT II: Laboratory Diagnosis

Clinical Significance and Principle of various laboratory tests -Lipid Profile (TG, Cholesterol, HDL, and LDL), Blood Glucose (Fasting, Post prandial, and GTT), Kidney Function Test (Urea, Creatinine, Uric Acid), Liver Function Test (AST, ALT). Common hormone tests and their clinical significance: Thyroid function test (TSH, T3, T4, Thyroglobulin, Autoantibodies), PTH, Calcitonin, Cortisol, Testosterone, hCG screen (pregnancy test), quantitative hCG, Insulin tolerance test. Cancer markers: Carcinoembryonic antigen (CEA), Alpha-fetoprotein (AFP), Human chorionic Gonadotropin (hCG), CA 19-9, CA 125

Books Recommended:

1. Clinical Chemistry in diagnosis and treatment 6th edition – Mayne, ELBS Publications, 1994
2. Clinical Chemistry – principles, procedures and correlations, Bishop, Lippincott,

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.

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.

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. Pierce, 4th Ed. Cambridge University Press

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 Harbor Laboratory press.
4. Signal transduction and human diseases by Toren Finkel, J. Silvio Gutkind- Wiley-Liss

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

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.

CLB15208GE: Inheritance Biology

UNIT I - Inheritance of Genetic Material

DNA as genetic material, Cell cycle, DNA replication, Mendelian Inheritance and non-Mendelian inheritance, DNA damage and repair, Mutation: Types, Source of mutations. Mutations Good and bad (disease and genetic diversity).

UNIT II- 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.

UNIT III - 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. Epigenetics and diseases: Various types of cancers, fragile X-syndrome, Prader-Wili syndrome.

Books Recommended:

1. Epigenetics, C. David Allis and Thomas Jenuwein, (2007) Cold Spring Harbor Laboratory Press, New York, USA
2. Molecular Biology of Gene, Watson et al., (5th Ed. 2004), Pearson Education, Delhi, INDIA
3. Latchman, D.S. (2005) Gene Regulation. Taylor & Francis Group, USA

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

CLB15408GE: Diagnostic procedures

UNIT I - Diagnostic Procedures, Interpretation & Clinical Correlations-I

Evaluation and clinical significance of: Blood gases, Various electrolytes (Na^+ , K^+ , HCO_3^- , etc), Urea, Uric acid. Enzymes; Alkaline phosphatase, Alanine aminotransferase, Aspartate aminotransferase, Lactate dehydrogenase, Creatine kinase, Amylase, Lipase Hormone tests: Growth hormone, Follicle stimulating hormone, Luteinizing hormone, prolactin, Thyroxine and free thyroxine, Thyrotropin, Triiodo-thyronine (Total T3) and free T3, Thyroglobulin, Parathyroid hormone, Calcitonin, Cortisol (plasma and urinary free), Corticotropin, Antidiuretic hormone, Aldosterone, estradiol, testosterone (total and free), glucagon, hCG screen (pregnancy test) and quantitative hCG. Insulin tolerance test; growth hormone stimulation test; Adrenocorticotropin, congenital adrenal hyperplasia or hirsutism.

UNIT II- Diagnostic Procedures, Interpretation & Clinical correlations –II

Bilirubin - total, conjugated (direct). Hepatitis A, B and C serology. Calculi (renal). Iron - serum, Lipids: cholesterol, Triglycerides, HDL-cholesterol, LDL-cholesterol, Cardiac Markers; CK-2 (CKMB), troponins, myoglobin, Creatinine kinase. Prostate specific antigen (PSA); alpha-fetoprotein (AFP); chorionic gonadotropin (CG). Proteins; Serum total, albumin. Urine analysis.

Books Recommended:

1. Fundamentals of Clinical Chemistry – Teitz, W.B. Saunders company
2. Practical Clinical biochemistry, volume I and II, 5th edition – Varley et.al., CBS Publishers,
3. Clinical Chemistry in diagnosis and treatment 6th edition – Mayne, ELBS Publications, 1994
4. Teitz text book of Clinical Biochemistry 3rd edition – Burtis et al., William Heinmann medical books, Ltd.
5. Clinical Biochemistry – Metabolic and clinical aspects, Pearson Professional Ltd.
6. Clinical Chemistry 5th edition – Mosby, Marshall,
7. Clinical Chemistry – principles, procedures and correlations, Bishop, Lippincott

CLB15109OE: Obesity, Inflammation and Nutritional diseases

UNIT I – Nutrition and Obesity

Concept - Composition of food - macro and micro nutrients and their functions. Nutritional requirements of infants, children & youth. Nutritional demand in pregnancy, lactation and menopause. Nutrition for old people. Obesity, Risk factors of obesity, MS- Metabolic syndrome, Diagnosis and pathogenesis of metabolic syndrome. 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) deficiency diseases - Mineral deficiency diseases - symptoms and dietary supplementation. Symptoms of diseases and 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. Chandi Charan 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

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

CLB15301CR: Organ System Diseases-I: Respiratory, Cardiovascular and Excretory systems

UNIT I -Fluid, Electrolyte and Respiratory disorders

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;- metabolic, respiratory and mixed acid-base disorders; 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, Concepts about COPD, Cystic fibrosis, asthma and pneumonia

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.

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, β 2-microglobulin. Tubular functions tests. Normal urine composition, urinalysis; microscopic analysis, urinary enzymes, urine osmolality, urine anion gap; Clinical features and laboratory findings in- Glomerulonephritis; acute glomerulonephritis, rapidly progressive glomerulonephritis; nephritic syndrome. Nephrotic syndrome, acute renal failure/acute tubular necrosis, renal tubular acidosis, chronic renal failure, renal calculi, dialysis; haemodialysis, peritoneal (CAPD) dialysis

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 (conjugated, unconjugated, urobilinogen, delta-urobilinogen); 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; cirrhosis (liver cirrhosis, primary biliary cirrhosis and idiopathic cirrhosis) Chronic active hepatitis, Alcohol and liver diseases.

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 Heinmann 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, McGrawhills publishers

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.

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/ Biurett 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

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 Wiley and Sons Inc.)
18. Harvey Lodish et al. : Molecular Cell Biology - 7th ed. W.H. Freeman and Co., New York.