

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



**CHOICE BASED CREDIT SYSTEM**

**SYLLABUS FOR**

**M. Sc. CLINICALBIOCHEMISTRY**

**2015 ONWARDS**

Course Code	Title of paper	Type	Hrs/wk L:T:P	Credits	Max. Marks		Name of the Instructor
					Ext.	Int.	
<b>Semester I</b>							
CLB15101 CR	Biomolecules –I: Biochemistry and Disorders	Core	4:0:0	4	80	20	SAG/AWB
CLB15102 CR	Biomolecules –II: Biochemistry and Disorders	Core	4:0:0	4	80	20	FR/SHM/ TAD
CLB15103 CR	Lab Course-I	Core	0:0:8	4	80	20	FR/SAG/ SHM/TAD
CLB15104 DCE	Cell Biology and Microbiology	Elective (DCE)	3:2:0	4	80	20	FR/SHM/S AG/AWB
CLB15105 DCE	Biophysical Techniques	Elective (DCE)	1:2:0	1 + 1 = 2	40	10	TAD
CLB15106 GE	Clinical Pathology	Elective (GE)	1:2:0	1 + 1 = 2	40	10	SAG/FR
CLB15107 GE	Medico- informatics	Elective (GE)	1:2:0	1 + 1 = 2	40	10	SHM/TAD
CLB15108 GE	Clinical Genetics	Elective (GE)	1:2:0	1 + 1 = 2	40	10	AWB
CLB15109 OE	Obesity, Inflammation and Nutritional diseases	Elective (OE)	1:2:0	1 + 1 = 2	40	10	FR
	<b>Total Credits: 24 (33 contact hours)</b>				<b>Total Marks: 600</b>		
<b>Semester-II</b>							
CLB15201 CR	Molecular Biology	Core	4:0:0	4	80	20	TAD/FR
CLB15202 CR	Clinical Immunology	Core	4:0:0	4	80	20	SAG/SHM
CLB15203 CR	Lab Course-II	Core	0:0:8	4	80	20	FR/SAG/ SHM/TAD
CLB15204 DCE	Techniques in Cell and Molecular Medicine	Elective (DCE)	3:2:0	4	80	20	FR/TAD
CLB15205 DCE	Cell Signalling	Elective (DCE)	1:2:0	1 + 1 = 2	40	10	SHM/SAG
CLB15206 GE	Protein Antibody Engineering	Elective (GE)	1:2:0	1 + 1 = 2	40	10	SHM
CLB15207 GE	Protein Biophysics	Elective (GE)	1:2:0	1 + 1 = 2	40	10	TAD/FR
CLB15208 GE	Inheritance Biology	Elective (GE)	2:2:0	2 + 1 = 3	60	15	AWB
CLB15209 OE	Basic concepts in Clinical Biochemistry	Elective (Open)	2:2:0	2 + 1 = 3	60	15	SAG
	<b>Total Credits: 28 (38 contact hours)</b>				<b>Total Marks:700</b>		
<b>Clinical Biochemistry</b>							

Semester-III							
CLB15301 CR	Organ System Diseases-I: Cardiovascular, Respiratory and Excretory systems	Core	4:0:0	4	80	20	SHM/SAG
CLB15302 CR	Organ System Diseases-II: Gastrointestinal, Neuromuscular and Skeletal systems	Core	4:0:0	4	80	20	TAD/FR
CLB15303 CR	Lab Course-III	Core	0:0:8	4	80	20	FR/SAG/ SHM/TAD
CLB15304 DCE	Advanced Endocrinology and Haematology	Elective (DCE)	3:2:0	4	80	20	SA/SAG/T AD
CLB15305 DCE	Neonatology & Congenital disorders	Elective (DCE)	1:2:0	1 + 1 = 2	40	10	SHM/FR
CLB15306 GE	Free Radical and oxidative stress related diseases	Elective (GE)	1:2:0	1 + 1 = 2	40	10	SAG
CLB15307 GE	Cell cycle and Cancer Biology	Elective (GE)	1:2:0	1 + 1 = 2	40	10	FR
CLB15308 EO	Bioethics in Clinical Research	Elective (OE)	1:2:0	1 + 1 = 2	40	10	TAD/FR
	<b>Total Credits: 24 (32 contact hours)</b>				<b>Total Marks: 600</b>		
Semester-IV							
CLB15401 CR	Internship Dissertation	Core	0:0:24	12	300	-	-
CLB15402 CR	Host Institute Grading	Core	0:0:6	3	75	-	-
CLB15403 CR	Internship Assessment	Core	0:6:0	3	75	-	SA/FR/SA G/SHM/ TAD
CLB15405 DCE	Advanced Clinical Biochemistry (Self-study Paper)	Elective (DCE)	0:8:0	4	100	-	
CLB15406 DCE	Research Proposal Writing	Elective (DCE)	0:4:0	2	50	-	SA/FR/SA G/SHM/ TAD
CLB15407 GE	Life style diseases and Lab. diagnosis	Elective (GE)	1:2:0	1 + 1 = 2	40	10	FR
CLB15408 GE	High risk Pregnancy	Elective (GE)	1:2:0	1 + 1 = 2	40	10	TAD/SH M
CLB15409 OE	Diagnostic Interpretations	Elective (OE)	1:2:0	1 + 1 = 2	40	10	SAG
	<b>Total Credits: 30 (57 contact hours)*</b>				<b>Total Marks: 750</b>		

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

**Instructors:**

SA: Dr. Shajrul Amin

SAG: Dr. Showkat Ahmad Ganie

FR: Dr. Fouzia Rashid

TAD: Dr. Tanveer Ali Dar

SHM: Dr. Syed Hussain Mir

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

### **CLB15101CR: Biomolecules-I: Biochemistry and Disorders**

#### **UNIT I - Basic Concepts of Biochemical Reactions**

Organic reaction mechanisms (Group-transfer reactions, oxidation and reductions, coupled reactions, Elimination, Isomerization and rearrangements), Thermodynamics of phosphate compounds (Phosphoryl-transfer reactions, High energy compounds and Biological energy transducers (ATP, NADH, NADPH, FADH, CoASH), 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. Inborn errors of carbohydrate metabolism, Galactosemia and Glycogen storage diseases.

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

Classification, structure, properties, and functions of fatty acids, triacylglycerols, phospholipids, sterols. Terpenes and prostaglandins. Lipids with specific biological functions, lipoproteins, micelle and liposome, Lipid metabolism: Biosynthesis and degradation of odd carbon and even carbon: saturated and unsaturated fatty acids. Ketone bodies: formation and utilization. Biosynthesis and degradation of cholesterol. Disorders of Lipids: Clinical features and laboratory findings in disorders of triglyceride, lipoprotein and cholesterol metabolism, lipoprotein and apolipoprotein metabolism; HDL, LDL, VLDL, apoA, apoB, apoC, apoE and their receptors. Fat absorption, transport, storage and metabolism, Investigation and principles of treatment of hyperlipidemias

#### **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 Orotic acid urea).

#### **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 5<sup>th</sup> 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. Henry. R. D: Clinical Chemistry- Principles and Techniques (Harfer and Row)

# CLB15102CR: 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 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, trypsin, chymotrypsin, choline esterase, glutamate dehydrogenase, glucose-6-phosphate dehydrogenase and ceruloplasmin.

## 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 5<sup>th</sup> 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)

## **CLB15103CR: 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

# **CLB15104DCE: 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<sup>+</sup>/K<sup>+</sup>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, 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, 5<sup>th</sup> Ed. New York Garland Publications
2. De Robertis, E.D.P., and De Robertis, E.M.F. Cell and Molecular Biology (8<sup>th</sup> 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

## **CLB15105DCE: 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, Fluorescence spectyrosopy, Circular Dichroism (CD) and Mass Spectrometry (MALDI-TOF) methods.

### **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 7<sup>th</sup> 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 MolecularBiology, David Freifelder, 2nd edition, W.H. freeman and Company.
4. PhysicalBiochemistry:PrinciplesandApplications,David Sheehan, 2<sup>nd</sup>edition,JohnWiley.
5. Principles of Physical Biochemistry, K.E. Van Holde, W.C. Jhonson and P. ShingHo, 2nd edition, Prentice Hall Inc.
6. Biophysical Chemistry, C.R. Cantor, P.R. Schimmel, W.H. Freeman &Company.



# **CLB15106GE: Clinical Pathology**

## **Unit I - General Pathology**

Cell injury and adaptations-Causes & Mechanism of cell injury, Macroscopic and microscopic features of reversible & irreversible cell injury; Acute Inflammation- Definition of acute inflammation and its causes, Vascular phenomenon of inflammation, Cellular phenomenon - chemotaxis, phagocytosis and formation of exudates, Chemical mediators of inflammation, Clinical & hematological manifestations and outcome of acute inflammation, Chronic Inflammation and granuloma- Chronic inflammation - definition, examples, morphology, cells of chronic inflammation with emphasis on epithelioid cells & giant cells.

## **UNIT II - Hemodynamic disorders, thrombosis and shock**

Hyperemia and congestion - definition and morphology Normal hemostasis - mechanism and pathways, Thrombosis - definition, pathogenesis, causes, morphology and fate, Differences between Thrombophlebitis and Phlebothrombosis, Embolism & Infarctio, Oedema - definition, types, pathogenesis with examples, Transudate and Exudate, Shock - definition, types, pathogenesis, clinical manifestations and examples, Storage disorders and Amyloidosis - Classification, of storage diseases, Familial hypercholesterolemia, Lysosomal storage disease, Glycogen storage disease - an overview, Amyloidosis - definition, classification, pathogenesis, staining, clinical manifestations.

### **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.

## **CLB15107EA: Medico-Informatics**

### **UNIT I - Introduction to Medical Network Design & Development**

Emergence of Medical Informatics as a Discipline; Library facilities & Logistics; Online Resources; Grading and Class Policies, Medical data acquisition and database systems: PC based multichannel data acquisition system; storage, analysis and retrieval techniques.

### **UNIT III - Electrophysiological Methods**

Single neuron recording, patch-clamp recording, Electrocardiogram (ECG), Brain activity recording; Electroencephalogram (EEG), Lesion and stimulation of brain, pharmacological testing. Principles, Techniques and Applications of- Positron emission tomography (PET) scan, Magnetic resonance imaging (MRI), Blood gas apparatus

#### **Books Recommended:**

1. R. D. Lele, "Computer in Medicine", Tata McGraw-Hill, New Delhi
2. Tay Vaughan, "Multimedia making it work", Tata McGraw-Hill, New Delhi
3. Harold Sackman, "Biomedical Information Technology" Academic Press, New York
4. Mary BrthFecko, "Electronics Resources: Access and Issues" Bowker and Saur, London

## **CLB15108EA: 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 (3<sup>rd</sup> Edition), John Wiley & Sons.
3. Ricki Lewis, Human Genetics-Concepts & Applications (3<sup>rd</sup> Edition), McGrawHill.
4. T. A. Brown, Genomes, John Wiley & Sons (Asia) PTE Ltd.
5. Scott Freeman & Jon C. Herron, Evolutionary Analysis (5<sup>th</sup> 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, 5<sup>th</sup> Ed, Prentice Hall Internationals
9. Daniel L. Hartl & Elizabeth W. Jones, Essential Genetics, 6<sup>th</sup> Ed., Jones & Bartlett Publishers

## **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

## SEMESTER-II

### **CLB15201CR: Molecular Biology**

#### **UNIT I - Chromosomes & Replication**

Experimental evidences & proof of DNA being the genetic material. Structures of chromatin & chromosomes, Unique & Repetitive DNA, Heterochromatin, Euchromatin, Transposons. Denaturation kinetics & T<sub>m</sub>. Extra chromosomal DNA. DNA replication, Concept of replicon, Origin of replication in prokaryotes & eukaryotes. Initiation, elongation & termination of Replication in prokaryotes & eukaryotes, Regulation of replication, Role of Ori-C & DNA methylation in regulation of replication, Fidelity of replication, DNA damage & repair

#### **UNIT II - Gene Expression & Regulation I**

Fine structure of gene in eukaryotes & prokaryotes. Operon concept (Lac & Trp Operons), Interrupted genes, gene families, gene 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 III - 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; Genetic code, Aminoacylation of tRNA, tRNA-identity, aminoacyl-tRNA synthetase, translational proof-reading, translational inhibitors. Post-translational modification of proteins, Control of gene expression at translation level: Regulation of phages, viruses, prokaryotic and eukaryotic gene expression, role of chromatin in regulating gene expression and gene silencing.

#### **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:**

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.

# **CLB15202CR: Clinical Immunology**

## **UNIT I - Introduction to Immunology**

Historical perspective, Innate and adaptive Immunity, Cells and molecules of immune system (Phagocytic cells, B & T lymphocytes, NK cells, Cytokines, etc). Primary and secondary organs of immune system. Humoral and cell mediated immune response. Primary and secondary immune modulation. Antigens, super-antigens, antigenicity and Immunogenicity. Complement System, Major Histocompatibility Complexes (MHC-I & MHC-II). Antigen processing & presentation, Activation & differentiation of B & T cells, B & T cell receptors, Toll-like receptors.

## **UNIT II -Structure, Function and molecular biology of Antibody**

Classification of immunoglobulin (IgM, IgD, IgG, IgE, IgA), isotypes, allotypes and idiotypes. Organization of antibody genes, Gene rearrangement, Expression of light and heavy chain immunoglobulin, Class switching, clonal deletion, Allelic exclusion. Generation of antibody diversity, Somatic hypermutation, Gene conversion. Antibody engineering, Monoclonal antibody fragments, Antigen-antibody interactions, Kinetics of antigen-antibody binding, affinity, avidity, high and low affinity antibodies. Detection of molecules using ELISA, RIA and immunoprecipitation reactions

## **UNIT III-Autoimmune disorders**

Hypersensitivity reactions (Gell & Coombs classification, IgE mediated [Type-I], Antibody-mediated cytotoxic [Type-II], Immune complex mediated [Type III], Delayed type hypersensitivity [DTH] i.e. Type-IV), RAST testing, Autoimmunity and its proposed induction mechanism (Organ specific autoimmune diseases, Systemic autoimmune diseases). Immune response during bacterial (TB), Parasitic (malaria), & viral (HIV) infections. Congenital & acquired immune deficiencies. Development of monoclonal antibodies (Hybridoma technique) & their use in diagnostics & therapeutics.

## **UNIT IV -Transplantation Immunology**

Transplantation immunology; Immunological basis and clinical manifestations of graft rejection, Immuno-suppression; General and specific immunosuppressant therapy. Tolerance; immune tolerance to allografts, Clinical transplantation. Complement deficiencies; Clinical manifestation of C3 deficiency. Paroxysmal nocturnal hemoglobinuria. Disorders of Immunoglobulin, Multiple myeloma, Vaccines (Traditional, Recombinant Protein & DNA vaccines).

### **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
6. Basic Immunology: The Functions of the Immune System by Abul K. Abbas and Andrew H. Lichtman. Publisher: Saunders.

## **CLB15203CR: 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
- 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

# **CLB15204DCE: Techniques in Cell & Molecular Medicine**

## **UNIT I - Molecular biology and Radio labeling methods**

Isolation and purification of RNA, DNA (genomic and plasmid) and proteins, analysis of RNA, DNA and proteins by one and two dimensional gel electrophoresis, isoelectric focusing, Properties of different types of radioisotopes normally used in biology, their detection and measurement; List of commonly used radioisotopes, safety guidelines and units of radioactivity.

## **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**

Microscopic techniques- Principles, techniques and applications of simple - compound, dark field, light phase contrast, fluorescence, scanning and transmission electron microscopy; Applications of various types of microscopy like Immunofluorescence microscopy – In situ hybridization and Flow-cytometry.

### **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.



## **CLB15205DCE: 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 Transducer, G-protein defects: inactivated (pseudo hypo-parathyroidism); activated (cholera). Disorders of Intracellular receptors: androgen receptors, estrogen and progesterone receptors, glucocorticoid receptors, aldosterone receptors, Vitamin D receptors and T3 receptors.

### **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

# **CLB15206GE: Protein and Antibody engineering**

## **Unit I: Protein and antibody engineering**

Basic principles of peptide, protein and antibody engineering, Recombinant antibody fragments and their properties: Fab, Fv, scFv, Diabody, Nanobody, Hybridomas 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, Role of display technologies in drug development.

## **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 HealthCare, Germany.

## **CLB15207GE: 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, collagen helix), tertiary structure (with examples), 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.

### **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, 1<sup>st</sup> 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 5<sup>th</sup> 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

## **CLB15209OE: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, glycosurias, GTT's, hyper & hypoglycemia, blood glucose regulation and role of hormones; diabetic coma, Lipids- lipid profile estimation, hypercholesterolemia, hyperlipoproteinemia, atherosclerosis and its risk factors. Proteins -albumin, hypoalbuminemia, hypoproteinemia, Bence Jones proteins, proteins in CSF and their estimation.

### **UNIT III – Hormones**

Definition and different classes of hormones; Thyroid hormone and their mechanism of action; Pituitary hormones and their role in biological systems; Hormone regulation, Role of insulin in modulating blood glucose level

### **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 3<sup>rd</sup> 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<sup>+</sup> and K<sup>+</sup>, 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, CO<sub>2</sub> 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<sub>2</sub>-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, 18<sup>th</sup> 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

# **CLB15302CR: 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. Laboratory indices (assessment of h-secretion, provocative tests, secretin, stimulation test). 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; Zollinger-Ellison syndrome (Intrinsic factor; Schilling test); Assessment of intestinal function; Small bowel malabsorption tests; Xylose, Lactose and other disaccharides). Electrolytes, including analysis of ileostomy fluid, Alpha-1- antitrypsin clearance, Clinical features and laboratory findings in: Malabsorption, Malabsorptionsyndromes(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 contraction, energetic of contraction. Smooth muscle; Ultra structure, contraction and its control, Physiology of the normal joint, Investigations of musculo-skeletal diseases; Serological rheumatoid factors; Examination of synovial fluid, Pathophysiology and laboratory findings of joint disorders, Osteo-arthritis 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, Osteomalacia, 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, Neurological investigations; examination of CSF; Glucose protein, Oligo clonal Banding/ albumin ratio, enzymes. Disorders of neurotransmission: cholinergic systems (Alzheimer's disease, myasthenia gravis); aminergic systems (Parkinson's disease, schizophrenia). Epilepsy, Huntington's disease, mucopolysaccharide storage diseases, Leigh's syndrome, Multiple sclerosis, Psychiatric disorders; mood disorders, depressive disorders

## **UNIT IV Mineral and Drug Metabolism**

Biochemistry,physiology, clinical significance and measurement of calcium, phosphorous and magnesium. Hormones in mineral metabolism,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, 18<sup>th</sup> 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, 5<sup>th</sup> Edition – Varley*et.al.*, CBS Publishers,
7. Biochemistry by Zubay 4<sup>th</sup> 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
11. Lippincott's illustrated reviews: Pharmacology by Richard a Harvey, Pamela C ChampeRichardFinkel, Luigi X Cubeddu ,michelle a clarke, 4th edition, 2008
12. Pharmacognosy by G.E. Trease, W.C. Evans, ELBS, 2002

### CLB15303CR: 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  $\text{Na}^+$ ,  $\text{K}^+$  and  $\text{Cl}^-$
- Estimation of  $\text{Ca}^{++}$ ,  $\text{Mg}^{++}$  and P
- Estimation of  $\text{Fe}^{+2}$ ,  $\text{Cu}^{+2}$  and  $\text{Zn}^{+2}$
- Estimation of porphyrins and hemoglobin
- Tests for gastric function, occult blood
- Tests for liver and billiary tract diseases
- Tests for renal diseases

# **CLB15304DCE: Advanced Endocrinology and Haematology**

## **UNIT I - Physiology and Disorders of Endocrine system I**

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 (ACTH, LH, GH, FSH, TSH, etc ). Use of suppression and stimulations for differential diagnosis. Clinical features, laboratory findings and pathophysiology of principle disorders of- Hypothalamus and Pituitary. Acute and chronic lesions of pituitary and hypothalamus, hypopituitarism

## **UNIT II - Physiology and Disorders of Endocrine system II**

Thyroid gland: Structure, biosynthesis (iodine metabolism), secretion, transport metabolism, and function. Hypo- & hyper-thyroidism; Thyrotoxicosis, grave's disease, Thyroid nodules and cancer of thyroid. Neonatal hypothyroidism, Thyroiditis. Tests of thyroid function; stimulation and suppression tests, thyroid scanning by radionucleotides. Parathyroid gland- Structure, biosynthesis, secretion, transport metabolism and function of the hormones. Disorders of parathyroid.

## **UNIT III- Physiology and Disorders of Endocrine system III**

Adrenal gland; Structure, biosynthesis, secretion, control mechanism, transport, metabolism, and function of the hormones secreted by adrenal medulla and adrenal cortex. Disorders of adrenal cortex; Renin / Angiotensin / aldosterone disorders, Addison's disease and Cushing's syndrome; CAH, CONNS syndrome. (Use of stimulation and suppression tests e.g. dexamethasone, water deprivation tests). Disorders of adrenal medulla: Structure, biosynthesis, secretion, transport metabolism and function of the hormones secreted by gastrointestinal system, Testis and ovary. Disorders of the gonads; Gonadal hypo and hyper function, infertility, amenorrhea, hirsutism and fetoplacental disorders.

## **UNIT IV - Physiology and Disorders of Blood**

Hematopoiesis, RBC formation and maturation, Iron metabolism (serum iron, iron binding capacity, transferrin and ferritin), Porphyrins; porphyrin and heme metabolism, regulation of heme biosynthesis, Blood disorders- Anemia and polycythemia. Blood coagulation; Platelet biochemistry ; extrinsic, intrinsic, anticoagulants for clinical use and Blood coagulation tests.

### **Books Recommended:**

1. Endocrinology- an integrated approach by Stephen Nussey and Saffron Whitehead- oxford: Bios scientific publishers.
2. Williams test book of Endocrinology by Shlomo Melmed, Kenneth S, Polonsky, Reed MD and Henry M Kronebberg-Saunders.
3. Recent advances in Hematology by Renu Saxena, H.P.Pati,, Manoranjan Mahapatra-JPB publishers.
4. Essential Hematology by Victor Hoffbrand, Paul Moss and J.E. Pettit- Wiley Blackwell publishers.

## **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, 18<sup>th</sup> 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

## **CLB15306GE: Free radical and Oxidative stress related diseases**

### **UNIT I- Free radicals in biological system**

Introduction & chemistry of reactive oxygen species (ROS), Chemistry of ROS & the cellular damage they cause, ROS damage, Lipid peroxidation- measurement and protection against lipid peroxidation, Ageing. Antioxidants, composition, structure, how and why their activities are used. Enzymatic mechanisms of protection; Catalase, Glutathione peroxidase, Glutathione reductase, Glutathione-S-transferase and superoxidedismutase (SOD).

### **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 and Amyotrophic Lateral Sclerosis. 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.

# **CLB15307GE: 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, Receptor serine/threonine kinase, other protein kinases.

## **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, oncogene and G-proteins, oncogene and cell survival. Tumor suppressor genes, functions of tumor suppressor genes products. Cancer pathways, Diagnosis, prevention and treatment of cancer.

### **Books Recommended:**

1. DeRobertis EDP and DeRobertis EMF Jr. (2004) Cell and Molecular Biology, 8<sup>th</sup> Edition, Lippincott Williams & Wilkins, Philadelphia, USA.
2. The Biology of Cancer by R. Weinberg 2<sup>nd</sup> 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, 4<sup>th</sup> Ed. Cambridge University Press

# **CLB15308OE: Bio-ethics in Clinical Research and Medical Transcription**

## **Unit I –Bioethics-I**

Introduction to bioethics, ethical issues in preclinical (animal) studies & clinical studies- Ethical principles, Institutional Review Board, Special issues in research. Ethical Guidelines-ICMR, Institutional Ethics Committees, Ethical issues based on methodology of clinical Research

## **Unit II – Bioethics-II**

Basic philosophies of animal ethics: (3 'R's), Animal Ethics Committee, executive, meetings, confidentiality and indemnity, period of approval, joint animal ethics committee, process to establish an AEC, guidelines for ethical conduct in the care and use of animals. Social responsibility for clinical researcher.

### **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 SivramiahShantharam, 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, 4<sup>th</sup> Edition, Adderson Wesley

## SEMESTER IV

### **CLB15401CR: 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.

### **CLB15402CR: 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 communication skills and other criteria related to routine lab work.

### **CLB15403CR: Internship Assessment**

This will include an openers enation, 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.



# 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 ( $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{HCO}_3^-$ , 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. 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;

## 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.

## **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,

## **CLB15407GE: High Risk pregnancy**

### **UNIT I -Assessment and Monitoring of High Risk Pregnancy**

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), Laboratory assessment of fetal lung maturity, Preeclampsia. Ectopic pregnancy; epidemiology and risk factors, clinical findings, biochemical markers and management of ectopic pregnancy), Ruptured ectopic pregnancy, Rh isoimmunization, Intrauterine growth retardation.

### **UNIT II– Malignancies**

Ovarian cancer, uterine cancer, cervical cancer, gestational trophoblastic neoplasia- different stages, causes and preventive measures. Sexually transmitted diseases- syphilis, gonorrhoea, trichomoniasis, human papilloma virus infection. Diseases during pregnancy-placental inflammations and infections

#### **Books Recommended:**

1. Guyton and Hall, A Text book of Medical Physiology, W. B. Saunders
2. Textbook of Human Physiology, SaradaSubramanyam, K. MadhavanKutty, H.D.Singh
3. Robert, K. Murray et al.: Harper's Biochemistry (28th Ed.), (Appleton and Lange Stanford).
4. Frederic Martini, Fundamentals of Anatomy and Physiology (prentice Hall, New Jersey)
5. Teitz text book of clinical biochemistry 3rd edition – Burtiset *al.*, William Heinmann medical books, Ltd.
6. Harrison's Principles of Internal Medicine, 18<sup>th</sup> 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

## **CLB15408GE: Diagnostic procedures**

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

Evaluation and clinical significance of: Blood gases, Various electrolytes ( $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{HCO}_3^-$ , 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, Thyroxin and free thyroxin, 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