

SYLLABUS for M. Sc. BIOCHEMISTRY
Choice Based Credit System (Semester Pattern)
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
Effective from 2015-2016

Scheme of teaching and examination under semester pattern Choice Based Credit System (CBCS) for M.Sc. Program in Biochemistry

M. Sc. Biochemistry Semester I												
Code	Theory / Practical	Teaching scheme (Hours / Week)				Credits	Examination Scheme					
		Th	Pract	Total	Duration in hrs.		Max. Marks		Total Marks	Minimum Passing Marks		
							External Marks	Internal Ass		Th	Pract	
Core 1	Paper 1: Protein Biochemistry	4	-	4	4	3	80	20	100	40		
Core 2	Paper 2: Advanced Enzymology	4	-	4	4	3	80	20	100	40		
Core 3	Paper 3: Biochemical Research Techniques	4	-	4	4	3	80	20	100	40		
Core 4	Paper 4: Plant Biochemistry	4	-	4	4	3	80	20	100	40		
Pract. Core 1 & 2	Practical 1: Protein Biochemistry and Enzymology	-	8	8	4	3-8*	100*	-	100		40	
Pract. Core 3 & 4	Practical 2: Biochemical Research Techniques and Plant Biochemistry	-	8	8	4	3-8*	100*	-	100		40	
Seminar 1	Seminar 1	2	-	2	1			25	25	10		
	TOTAL	18	16	34	25		520	105	625	170	80	

M. Sc. Biochemistry Semester II												
Code	Theory / Practical	Teaching scheme (Hours / Week)				Credits	Examination Scheme					
		Th	Pract	Total	Duration in hrs.		Max. Marks		Total Marks	Minimum Passing Marks		
							External Marks	Internal Ass		Th	Pract	
Core 5	Paper 5: Immunology	4	-	4	4	3	80	20	100	40		
Core 6	Paper 6: Clinical Biochemistry	4	-	4	4	3	80	20	100	40		
Core 7	Paper 7: Cell Biochemistry	4	-	4	4	3	80	20	100	40		
Core 8	Paper 8: Molecular Biology	4	-	4	4	3	80	20	100	40		
Pract. Core 5 & 6	Practical 3: Clinical Biochemistry and Immunology	-	8	8	4	3-8*	100**	-	100		40	
Pract. Core 7 & 8	Practical 4: Cell and Molecular Biology	-	8	8	4	3-8*	100**	-	100		40	
Seminar 2	Seminar 2	2	-	2	1			25	25	10		
	TOTAL	18	16	34	25		520	105	625	170	80	

M. Sc. Biochemistry Semester III												
Code	Theory / Practical	Teaching scheme (Hours / Week)				Credits	Examination Scheme					
		Th	Pract	Total	Duration in hrs.		Max. Marks		Total Marks	Minimum Passing Marks		
							External Marks	Internal Ass		Th	Pract	
Core 9	Paper 9: Advanced Molecular Biology	4	-	4	4	3	80	20	100	40		
Core 10	Paper 10: Biotechnology	4	-	4	4	3	80	20	100	40		
Core Elective 1	Paper 11: A) Toxicology (Biochemical & Environmental Toxicology) OR B) Nutrition (Nutritional Biochemistry)	4	-	4	4	3	80	20	100	40		
Foundation Course 1 (NOTE: Only for students of other M. Sc. Subjects)	Paper 12: Biomolecules and Basic Metabolism	4	-	4	4	3	80	20	100	40		
Pract. Core 9 & 10	Practical 5: Biotechnology and Molecular Biology	-	8	8	4	3-8*	100**	-	100		40	
Pract. Core Elective 1	Practical 6: A) Toxicology (Biochemical & Environmental Toxicology) OR B) Nutrition (Nutritional Biochemistry)	-	8	8	4	3-8*	100**	-	100		40	
Seminar 3	Seminar 3	2	-	2	1			25	25	10		
	TOTAL	18	16	34	25		520	105	625	170	80	

M. Sc. Biochemistry Semester IV												
Code	Theory / Practical	Teaching scheme (Hours / Week)				Credits	Examination Scheme					
		Th	Pract	Total	Duration in hrs.		Max. Marks		Total Marks	Minimum Passing Marks		
							External Marks	Internal Ass		Th	Pract	
Core 11	Paper 13: Advanced Clinical Biochemistry	4	-	4	4	3	80	20	100	40		
Core 12	Paper 14: Advanced Immunology	4	-	4	4	3	80	20	100	40		
Core Elective 2	Paper 15: A) Toxicology (Clinical Research) OR B) Nutrition (Applied Nutritional Biochemistry)	4	-	4	4	3	80	20	100	40		
Foundation Course 2 (NOTE: Only for students of other M. Sc. Subjects)	Paper 16: Enzyme Technology	4	-	4	4	3	80	20	100	40		
Pract. Core 11, 12 & Elective 2	Practical 7: Advanced Clinical Biochemistry & Immunology And A) Toxicology (Clinical Research) OR B) Nutrition (Applied Nutritional Biochemistry)	-	8	8	4	3-8*	100**	-	100		40	
Project	Project	-	8	8	4	3-8*	100**	-	100		40	
Seminar 4	Seminar 4	2	-	2	1			25	25	10		
	TOTAL	18	16	34	25		520	105	625	170	80	

SEMESTER I

Core 1 - Paper 1: Protein Biochemistry

Unit I: Proteins and Mass Spectrometry

Overview of protein structure, protein folding, Ramchandran plot, domains and modules, binding sites within proteins, protein sequencing.

Basics of Mass Spectrometry, Ionization mechanisms- protonation, deprotonation, cationization, transfer of charged molecules to gas phase, electron ejection, electron capture, Mass analyzers-TOF, Ion trap, Quadrupole, Ionization methods-Electron Impact (EI), Chemical Ionization (CI), Fast Atom Bombardment (FAB), Field Description (FD), Electron Spray Ionization (ESI), Matrix Assisted Laser Desorption Ionization (MALDI), Protein Identification using MS.

Unit II: Protein biosynthesis

Eukaryotic translation machinery, structure and assembly of the ribosome, initiation, elongation and termination of translation.

Unit III: Protein sorting and degradation

Intracellular protein sorting, movement of proteins between cellular compartments: gated, transmembrane and vesicular transport. Protein transport and translocation to nucleus, mitochondria, chloroplast, peroxisomes, endoplasmic reticular system. Protein degradation.

Unit IV: Protein Engineering

Design and construction of novel proteins and enzymes, Conformation of proteins in general and enzymes in particular, Effect of amino acids on structure of proteins, Energy status of a protein molecule, Structure function relations of enzymes, Physical methods such as x-ray crystallography for determination of protein structure, Site directed mutagenesis for specific protein function, Basic concepts for design of a new protein/enzyme molecule, Specific examples of enzyme engineering, -Dihydrofolate reductase and Subtilisin.

Suggested References:

1. Modern Protein Chemistry: Practical Aspects Published: September 12, 2001 by CRC Press - 272 Pages Edited By: Gary C. Howard
2. Biochemistry. 5th edition. Berg JM, Tymoczko JL, Stryer L. New York: W H Freeman; 2002
3. Proteins: Structures and Molecular Properties: [Thomas E. Creighton](#) Publisher: W. H. Freeman 1992 Edition: Second Edition
4. Protein Engineering Protocols (Methods in Molecular Biology) [Kristian Müller](#) (Editor), Publisher: Humana Press; Softcover reprint of hardcover 1st ed. 2007 edition (November 10, 2010)
5. Protein Degradation Series, 4 Volume Set (v. 1) [R. John Mayer](#) (Editor), Publisher: Wiley-VCH; 1 edition (March 4, 2008)
6. Structural Aspects of Protein Synthesis [Anders Liljas](#)http://www.amazon.com/Structural-Aspects-Protein-Synthesis-Anders/dp/981238863X/ref=sr_1_1?s=books&ie=UTF8&qid=1323503546&sr=1-1-# (Author) Publisher: World Scientific Pub Co Inc; 1 edition (November 2004)
7. Protein Targeting, Transport, and Translocation [Ross Dalbey](#) (Editor), Publisher: Academic Press; 1 edition (May 13, 2002)
8. Principles of Physical Biochemistry- Kensl.E. van Holde, W. Curtis Johnson, P. Shing Ho, Pearson Prentice Hall, 2nd Edition.
9. Crystallography made crystal clear, 1993. G. Rhodes. Academic Press.
10. Principles and Techniques of Biochemistry and Molecular Biology, 6th Edition, Wilson Keith and Walker John (2005), Cambridge University Press, New York.
11. A textbook of biophysics, R. N. Roy, New Central Publication, 1st edition.

Core 2 - Paper 2: Advanced Enzymology

Unit I: Kinetics and Regulation of enzyme activity

Review of unisubstrate enzyme kinetics, multisubstrate enzyme kinetics, Cooperativity phenomenon, Hill and Scatchard plots, protein-ligand binding and its measurement, detailed mechanism of catalysis of serine protease, carbonic anhydrase, and PEP kinase, Metalloenzymes

Unit II: Allosteric enzymes and multienzyme systems

Allosteric enzymes, sigmoidal kinetics and its physiological significance, symmetric and sequential modes of action and their significance, immobilized enzymes and their industrial applications, study of multienzyme complexes with respect to occurrence, isolation and their properties and polygenic nature eg. pyruvate dehydrogenase and fatty acid synthase.

Unit III: Enzyme regulation

General mechanisms of enzyme regulation: Feed back inhibition and feed forward stimulation, repression and induction of enzymes, reversible and irreversible covalent modifications of enzymes, flexibility and conformational mobility of enzymes, convergent and divergent evolution of enzymes.

Unit IV: Bioenergetics and oxidative phosphorylation

Energy transformation, laws of thermodynamics, Gibbs energy, free energy change, redox potentials, phosphate potential, ion electrochemical potential, proton electrochemical potential, membrane potential, Chemi-osmotic theory, mitochondrial respiratory chain, order and organization of carrier proton gradients, Characterization of Iron- Sulphur proteins and Cytochromes, Q cycle, Respiratory controls and oxidative phosphorylation, ATP synthase complex.

Suggested References:

1. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry-Trevor Palmer
2. Principles of Biochemistry- Lehninger, David L. Nelson and Michael M. Cox
3. Enzymes- Malcolm Dixon and Edwin Webb
4. Harper's Biochemistry- Harper
5. Biochemistry- Western and Todd
6. Cell and Molecular Biology-Gerald Karp
7. Fundamentals of Biochemistry-Donald Voet, Judith G. Voet and Charlotte W. Bratt

Core 3 - Paper 3: Biochemical Research Techniques

Unit I: Research Methodology

1. Introduction to research methodology: History and definition of research, role of theory, hypothesis, sampling, variables, randomness, selection of problem, purpose of research and research reporting
2. Experimental research: Early experimentation, experimental groups, control groups, variables, method of controlling variables, designing and validation of experiments
3. Methods and tools in research: Research tools and its reliability and validity, quantitative and qualitative studies, observation, inquiry forms, Q methodology, data collection, limitations and sources of error
4. Types of data Analysis: Descriptive data analysis, Inferential data analysis, Computer data analysis

Unit II: Biostatistics

Principles and practice of statistical methods in biological research, samples and populations, Basic statistics-average, statistics of dispersion, coefficient of variation, confidence limits, Probability distribution, normal, binomial and Poisson distribution. Mean variants, standard deviations and standard error, correlation and regression, test of statistical significance, and analysis of variance and covariance .

Unit III: Data Retrieval, Scientific Writing and Presentation

1. Information Search & Data Retrieval , Tools for Web Search , Data Retrieval Tools, Data Mining of Biological Databases.
2. Report Writing, Significance of report writing, different steps in report writing, types of report, layout of research paper.
3. Mechanics and precautions of writing research reports for scientific journals, popular magazines, seminars/symposia/ conferences/workshops, poster session.
4. Presentation– Oral & Written Presentations in classrooms, scientific meets & public audience. Defence of research thesis.

Unit IV: Computers

Introduction of computer networks- Topologies and designs; Basics of computer operating systems-windows and Linux; Introduction to Markup language-Hyper Text Markup Language (HTML) and Extensive Markup Language (XML); Spreadsheets and Presentation software.

Systems Biology-An introduction

Introduction to Metagenomics.

Suggested References:

1. Fundamentals of Biostatistics, [Bernard A. Rosner](#), Thomson-Brooks/Cole, 2006
2. Research methodology in social, behavioural and life sciences: Designs, models and methods, Herman J Ader and Gideon Mellenbergh (Ed), SAGE Publications
6. Principles of Genome analysis and genomics, Primrose SB, Twyman RM, Blackwell Science (2002).
7. Biostatistics-A foundation for Health Science, Daniel WW, John Wiley (1983).
8. Statistical Methods, Medhi J, Willey Eastern Limited, (1992).

Core 4 - Paper 4: Plant Biochemistry

Unit I: Plant Cell and Photosynthesis

Structure of plant cell. Structure of plant cell membrane and cell wall.

Structure of chloroplast system. Photosynthetic pigments and their functions, Photo system

I & II. Photosynthetic electron transport and photophosphorylation.

Calvin cycle(C3 plants), Hatch slack pathway (C4 plants), Crassulacean acid metabolism.

Unit II: Plant hormones and Tissue culture

Plant hormones: Biosynthesis, structure and biochemical mode of action of auxins, gibberellins, cytokinins, abscisic acid and ethylene. Other plant growth regulators

Plant tissue culture: Plant cell organs and culture, Somaclonal variation, protoplast isolation, fusion and culture of protoplasts, Application of plant tissue culture

Unit III: Plant respiration and Metabolism

Plant respiration: Carbohydrate, lipid and Protein metabolism. Cyanide sensitive and insensitive respiration.

Nitrogen metabolism: Development and structure of root nodules, Role of nod factors in nodule development. Structure of plant nitrogenase system, Symbiotic nitrogen fixation and its regulation. Formation and assimilation of ammonia

Sulphur metabolism: Sulphate activation, Reduction of active sulphate, Oxidation of inorganic sulphur, incorporation of sulphur into amino acids.

Unit IV: Biochemistry of plant growth & stress physiology:

Biochemistry of seed and bud dormancy, Biochemistry of seed germination, factors affecting seed germination.

Structure and function of Phytochrome and Cryptochrome; Photoperiodism and Vernalization, Hormonal regulation of flowering.

Responses of plant to biotic (pathogens and insects) and abiotic (water, temperature and salt) stresses; Mechanism of resistance to biotic stress and tolerance to abiotic stress

Suggested References:

1. Plant physiology -Taiz & Ziger
2. Biochemistry and molecular Biology of plant-Buchanan
3. Plant physiology -M. Devlin
4. Plant pathology- George N. Agriose
5. Plant breeding- B.D. Singh
6. Germination of seed- A.M .Mayer & A. Mayber
7. Introduction of Plant Physiology -William Hopkins
8. Introduction to plant - Godwin & merser
9. Plant physiology - Mohit Warma

Practical Core 1 & 2 - Practical 1: Protein Biochemistry And Enzymology

1. Estimation of protein by UV Spectrophotometer by E_{280}/E_{260} method
2. Estimation of Riboflavin by Arnold's fluorimetric method
3. Estimation of Thiamine by thiochrome method
4. Separation of proteins by PAGE
5. Separation of proteins by SDS gel electrophoresis
6. Western Blotting
7. Purification of proteins by isoelectric precipitation
8. Molecular weight determination
9. Fractionation of cells by differential centrifugation
10. Assay of marker enzymes
11. To study the essentiality of co-enzymes in enzyme catalyzed reaction
12. Fractionation of human plasma proteins by precipitation
13. Assay of acid and alkaline phosphatase
14. Effect of environmental factors such as pH, temperature and inhibitors on alkaline phosphatase.
15. Measurement of initial velocity
16. To study kinetics of enzyme using Lineweaver-Burk, Eadie-Hofstee and Hanes Plots

Practical Core 3 & 4 - Practical 2: Biochemical Research Techniques And Plant Biochemistry

1. Absorption of water by live & dead seeds.
2. Changes in carbohydrate, protein content during germination.
3. Induction of proteinases, amylases, and lipase during germination.
4. Induction of vitamin C synthesis during germination.
5. Isolation and characterization of trypsin inhibitor.
6. Assay of peroxidase, catalase, phenol oxidase, ascorbic acid oxidase.
7. Isolation of plant DNA & RNA.
8. Estimation of carotene, ascorbic acid, phenols and tannins in fruits and vegetables.
9. Development of callus culture from meristems and leaves.

Seminar 1

SEMESTER II

Core 5 - Paper 5: Immunology

Unit I: The Immune system, Immunoglobulins and TCR

History of Immunology, Innate Immunity: effector mechanisms involved; PAMPs, PRRs, Phagocytosis, Lysis, blocking, extra cellular killing etc . Biochemistry and biology of TLRs, Inflammatory processes, inflammasomes interrelationship between innate and adaptive immunity.

Immunoglobulins and TCR

Immunochemistry: Antigen antibody reaction, its kinetics and thermodynamics; Structure, functions of immunoglobulins; Ig genes and their expression, Generation of Ab diversity. BCR, TCR, Organization and re-arrangement of TCR genes, TCR diversity.

Unit II:

Anatomy of Immune system

Immunological cells, tissues and organs. Maturation, activation and differentiation of B and T cells. MHC genes and their polymorphism, Structure and function of MHC molecules. Clonal selection theory Cell surface molecules : Ig super family, integrins , selectins , chemokine receptors and other accessory molecules, Cytokines and chemokines

Unit III:

Immune response by T and B lymphocytes

Cellular and molecular mechanisms of Ab production, humoral and cell mediated immunity, Antigen processing and presentation, T and B cell interaction. Super antigens.

Unit IV:

Immunological Techniques

Immunochemical techniques including immunodiffusion, RIA, EIA, agglutination, immunofluorescence, immunoelectron microscopy, immunoelectrophoresis. HLA typing, leukocyte migration inhibition technique, delayed hypersensitivity technique, cytotoxicity assay. Monoclonal Ab's, hybridoma and other technologies, Abzymes.

Suggested References:

1. Cellular and Molecular Immunology- 5th Edition, Abul K. Abbas, Andrew Litchman
2. Immunology-5th Edition, Richard A Goldsby, Thomas J. Kindt, Barbara A Osborne, Janis Kuby
3. Immunology- 6th Edition, Ivan Roitt, Jonathan Brostoff, David Male

Core 6 - Paper 6: Clinical Biochemistry

Unit I: Automation in clinical biochemistry, gastric and blood disorders

Automation in Clinical Biochemistry- Instrumental concept, Selection of Instrument, Quality assurance, Control of pre-analytical and analytical variables, External and internal quality control measurements.

Gastric disorders: Disorders of gastric function, method of evaluation, pancreatic diseases, Steatorrhoea, Malabsorption syndrome test for their evaluation.

Blood Disorder: Review of mechanism of coagulation and fibrinolysis, abnormalities in blood coagulation, variation of plasma proteins, abnormalities of blood formation, anemia, haemoglobinopathies, clinical significance of fecal and urine analysis.

Unit II: Endocrinology I

Insulin and glucagon: Various types of hyperglycemia, Diabetes mellitus Ketonemia ,ketonuria , Experimental diabetes , Hypoglycemia, Polyurea, Glucose tolerance test.

Thyroid: Iodine metabolism, Hypo and Hyper thyroidism, B.M.R.and other test for evaluation of thyroid function.

Parathyroid: Calcium and phosphorus metabolism. Abnormalities of Parathyroid function and methods of evaluation.

Unit III: Endocrinology II

Adrenal: Addison's disease and pheochromocytoma, Disorders of steroid metabolism, Test for evaluation of adrenal functions.

Pituitary: Pituitary hormones, Clinical syndromes and their evaluation.

Unit IV: Liver disorders

Liver disorders: Jaundice, fatty liver and liver function tests. Renal function test

Cerebrospinal fluid: Composition in health and disease. Lipid profile in health and disease.

Elements of Clinical Enzymology: Isoenzymes in health and disease.

Clinical significance of GOT, GPT, Creatine kinase, LDH etc.

Biochemical diagnosis of disease by enzymatic evaluation.

Suggested References:

1. Clinical Biochemistry – Metabolic and Clinical aspects. By-William J. Marshall & Stephen K. Angert.
2. Harper's Biochemistry - 27th Ed.Text book of Medical Physiology - By Guyton.
3. Text book of Physiology -By Burn & levy.
4. Biochemistry –By L .Stryer (Freeman & Co.NY.)
5. Biochemistry with clinical correlation- By Thomas Devli.
6. The Metabolic Basis of Inherited Disease 5th Ed.-By John Stanbury.
7. Teitz Fundamentals of Clinical Chemistry –By C.A.Burtis & Ashwood .
8. Biochemistry - By Lehninger.
9. Lehninger's Biochemistry –By Nelson & Cox.
10. Biochemistry –By Stanford.
11. Basic Medical Biochemistry: A Clinical approach- By Smith.
12. Principles of Internal Medicines- By Harrison.T. R.
13. Practical Biochemistry Principles & Techniques- By Wilson & Walker.
14. Practical Biochemistry –By David Plummer.

Core 7 - Paper 7: Cell Biochemistry

Unit I: Cell cycle and regulation

Review of cell cycle, divisional control, regulatory proteins, cyclin/cdk complexes, positive and negative regulation, inhibitory molecules, restriction points, regulation of DNA synthesis, regulation of degradation, check points, cell cycle arrest, role of cyclically activated protein kinases, transcriptional regulation.

Unit II: Cell communication I

General principles of cell communication, extra cellular signals and their receptors, autocrine signaling and role of gap junctions, types of cell receptors, relay of signal and intracellular signal proteins, regulated proteolysis dependent signaling pathways (Notch, Wnt, hedgehog, NF κ B)

Unit III: Cell communication II

Informational transactions in eukaryotic cells- cyclic AMP facet, Study of G-proteins, signaling through G-protein linked cell surface receptors, signaling through enzyme linked cell surface receptors, Calcium messenger system, signaling via GMP.

Unit IV: Cancer

Causes and types of cancer, viral carcinogenesis, tumor suppressors, oncogenes and signal transduction, growth and spread of cancer, molecular basis of cancer therapy, molecular markers.

Programmed cell death and its regulation in normal physiology, regulation and execution of mammalian apoptosis, cytokine signaling and role of apoptosis in tumor genesis.

Suggested References:

1. Molecular Biology of the Cell: Alberts 5th Edition 2007 NCBI Publication
2. Principles of Biochemistry: Lehninger WH Freeman
3. Biochemistry of Signal Transduction and Regulation - Gerhard Krauss Wiley VCH 3rd Revised Edition
4. Molecular Cell Biology: Lodish 6th Edition, WH Freeman & Company
5. The Cell: Cooper 2nd Edition ASM Press
6. Gene IX: Benjamin Lewin Published by Pearson Prentice Hall
7. Cell and Molecular Biology: Gerald Karp
8. Molecular Biology: Robert Weaver 1st Edition, WCB McGraw-Hill
9. Molecular Biology of the Gene: Watson 6th Edition, Pearson Publication
10. Gene Regulation: A Eukaryotic Perspective: David Latchman 5 illustrated , Taylor & Francis, 2005
11. The Cell- G. M. Cooper

Core 8 - Paper 8: Molecular Biology

Unit I: Eukaryotic and Prokaryotic chromosomes

Chromatin structure: Histones, DNA, nucleosome morphology and higher level organization; Functional states of chromatin and alterations in chromatin organization. **Chromosome**

organization: Metaphase chromosomes: centromere and kinetochore, telomere and its maintenance; Holocentric chromosomes; Heterochromatin and euchromatin, position effect variegation; Chromosomal domains (matrix, loop domains) and their functional significance.

Organization of nuclear and organellar genomes; C-value paradox, Repetitive DNA-satellite DNAs and interspersed repeated DNAs, Transposable elements, LINES, SINES, Alu family and their application in genome mapping

Concept of a gene: Conventional and modern views. Fine structure of gene, split genes, pseudogenes, non-coding genes, overlapping genes and multi-gene families.

Unit II: Replication and Recombination

Replication: Review of replication in bacteria, plasmid and viruses, Models of DNA replication. DNA replication in eukaryotes. Eukaryotic DNA polymerases and their roles, origin of replication, Autonomously Replicating Segments (ARS) in yeast, elongation, lagging strand synthesis, and termination.

Recombination: DNA recombination: Homologous, site specific and transposition, Homologous recombination: Holliday Model, Messelsson -Radding Model, Rec BCD pathway.

Site specific recombination: Lambda phage ingration, and excision rearrangement, of immunoglobulin genes.

Transposition: Prokaryotic transposition, Insertion sequence,s, and mere complex transposons (eg Tn3), conservative and replicative transposition. Eukaryotic transposable elements: yeast and Drosophila transposons, retroviruses, and retrovirus like elements.

Unit III: Transcription

Review of prokaryotic transcription, transcription in eukaryotes: Eukaryotic RNA polymerases and their subunit structure, Class I, II and III promoters, Upstream elements, enhancers and silencers, General transcription factors, Class I, II, III genes and their functions elongation factors, TBP structure and its role in transcription, mediators. Structure of transcription activators, zinc fingers, homeodomains, helix loop helix, bZIP, beta barrels.

Unit IV: Viruses

General properties of viruses (size, shape, composition of viral capsid, spikes, envelope and nucleic acids).

Viral classification in brief, Baltimore classification. Structure and composition of DNA viruses (Herpes virus & Adenovirus) and RNA viruses (HIV).

Tumor viruses (HBV, HTLV, HPV) structure and mechanism of oncogenesis.

Structure and life cycle of Lambda and M13 bacteriophages.

Laboratory diagnosis of viral diseases.

Mechanism of action of **Antiviral drugs** (Acyclovir, Foscarnet, Nevirapine, Saquinavir, Oseltamivir).

Suggested References:

1. Molecular Biology of Gene: Watson
2. Gene 7: Benjamin Lewin
3. Cell & Molecular Biology: Devlin
4. Biochemistry: Lehninger, Nelson & Cox
5. Biochemistry: Voet & Voet
6. Molecular Biology: David Frifelder
7. Molecular biology-Lodish, Baltimore.
8. Genetics-Russell.
9. Genetics 1and 2-C.B.Power
10. Molecular biology-Watson
11. Molecular biochemistry –Robert Weaver
12. Microbiology by Davis
13. Virology by Luria
14. Understanding Viruses-Teri Shors, Jones and Bartlett Publishers, Massachusetts, edition 2009.

Practical Core 5 & 6 - Practical 3: Clinical Biochemistry And Immunology

1. Determination of serum and urine Creatinine by Jaff's method.
2. Determination of serum Bilirubin by Malloy & Evllyn method.
3. Determination of serum Chloride by Schales & Schales method.
4. Estimation of blood urea by Nesslerisation method.
5. Estimation of Serum amylase (E.C.3.2.1.1).
6. Estimation of Serum Cholesterol by Single Step Method (Liebermann & Burchard).
7. Determination of Serum Uric Acid by Henry Caraway's method.
8. Determination of Icteric Index, SGOT, SGPT and alkaline phosphatase activity
9. Routine Urine Analysis.
10. Quantitative Estimation of T3, T4 and TSH
11. To determine Urinary VMA (3-methoxy 4 -Hydroxyl Vanillin Mandellic Acid).
12. Glucose Tolerance Test.

Practical Core 7 & 8 - Practical 4: Cell And Molecular Biology

1. Use of Simple, Compound and Phase Contrast Microscopes
2. Isolation, culture and cell counting of lymphocytes
3. Adherent cell line: Trypsinization, cell count, subculturing
4. MTT assay
5. Isolation of DNA from Bacteria and Blood
6. Assessment of purity of DNA by 260/280 ratio
7. Isolation of plasmid DNA: Mini Prep, Midi Prep and Maxi Prep.
8. Restriction digestion of DNA
9. Ligation of DNA
10. Separation of DNA fragments by Electrophoresis.
11. Southern Blotting & Northern Blotting

Seminar 2

SEMESTER III

Core 9 - Paper 9: Advanced Molecular Biology

Unit I: Regulation of eukaryotic gene expression at transcriptional level

Overview of transcription by RNA Polymerases I, II, and III

Anatomy of a protein-coding gene

Basal transcription by RNA polymerase II: Subunits of Pol II; general transcription factors; Activators, How the initiation complex is assembled, How initiation occurs.

Speeding up the process: Enhancers, TAF's and how they work

Regulated transcription: transcription factors: Zinc-fingers (Sp1; the first such factor identified) Leucine zippers, Basic helix loop helix, Homeodomains, DNA binding domains, Activating domains

RNA Elongation: HIV TAT/TAR

RNA polymerase III and regulation of 5S rRNA

Unit II: Regulation of eukaryotic gene expression at post translational, translational and post-translational levels

Regulation at transcriptional level: Effect of cap and polyadenylation on splicing, trans and alternative splicing, RNA editing, mRNA stability and transport

Regulation at Translational level: Global regulation through eIF2 and eIF4E/eIF4E-BP. Specific regulation through 5' UTRs using RNA structure e.g. ODC. Specific regulation through 5' UTR/protein interactions e.g. ferritin in eukaryotes and ribosomal proteins in prokaryotes. Specific regulation through 3' UTRs e.g. 15-LOX

Regulation at post-translational level: Control of the level of active proteins, regulation of proteolysis

Unit III: Regulatory RNAs

Historical background, RNA interference as regulatory mechanism in eukaryotes Slicer and dicer, synthesis and function of RNAi molecules in plants, chromatin remodeling in human disease and diagnosis.

Unit IV: Epigenetics

Background, chromosomal inheritance taking fission yeast as an example, DNA methyltransferases, DNA methylation maintenance, histone modification and regulation of chromatin structure, bivalent histones, DNA demethylation, histone demethylation

Suggested References:

1. Molecular Biology of the Cell: Alberts 5th Edition 2007 NCBI Publication
2. Principles of Biochemistry: Lehninger WH Freeman
3. Biochemistry of Signal Transduction and Regulation - Gerhard Krauss Wiley VCH 3rd Revised Edition
4. Molecular Cell Biology: Lodish 6th Edition, WH Freeman & Company
5. The cell: Cooper 2nd Edition ASM Press
6. Genes IX: Benjamin Lewin Published by Pearson Prentice Hall
7. Cell and Molecular Biology: Gerald Karp
8. Molecular Biology: Robert Weaver 1st Edition, WCB McGraw-Hill
9. Molecular Biology of the Gene: Watson 6th Edition, Pearson Publication
10. Gene Regulation: A Eukaryotic Perspective: David Latchman 5 illustrated , Taylor & Francis, 2005

Core 10 - Paper 10: Biotechnology

Unit I: rDNA technology

Genomic and cDNA libraries, DNA manipulation enzymes, isolation of specific genes.

Gene cloning: REs, vectors-plasmids, cosmids phage vectors, M13 phage vectors, phagemids expression vectors with strong promoters, inducible, vectors produce fusion proteins and their isolation, Eucaryotic expression system, shuttle vectors, YAC, BAC insertion of DNA and its ligation to carrier DNA, introduction of DNA in cells, gene synthesis, gene libraries. Application of recombinant DNA technology in medicine, agriculture industry and environmental sciences.

Unit II: Gene control systems in bacteria and bacteriophage lambda:

Mechanism of induction and repression, constitutive expression various control mechanisms, positive regulation, negative regulation, attenuation, operon hypothesis with special reference to mal/gal, ara and histidine operons, Regulatory mechanisms in bacteriophage lambda.

Regulation of gene expression at various levels (transcription, post transcriptional and translational) DNA-protein interactions: Lambda family of repressor, trp repressor.

Unit III: Biochemical engineering: Biochemical Engineering: Bioreactors and related equipment and instrumentation, types of bioreactor (Batch, semi batch, CSTF, recycle etc), reactor analysis, reactor design, reactor for recombination proteins.

Fermentation technology: Fermentation technology, microbial culture reaction, genetic modification, use of mutants, recombinant DNA technology and application in fermentation technology, microbial growth kinetics, sterilization, fermentation process kinetics, analysis of rate pattern and kinetic groups, fermentation process types, control of environmental variables, recovery of fermentation products, isolation and purification and use of immobilization techniques.

Unit IV: Bioinformatics and Drug Designing

Introduction to Bioinformatics: Applications of Bioinformatics, Bioinformatics resources

Biological Databases: Overview to Biological Databases, Nucleotide Databases (GenBank, DDBJ, ENA), Protein sequence databases (Uniprot, Swiss prot, Prosite, Pfam, Prodom), Protein structure databases (PDB, SCOP, CATH)

Sequence analysis: Sequence similarity search, BLAST, FASTA, CLUSTAL

Genomics: Introduction to Genomics, Comparative Genomic Databases, Objective of Genome Comparisons, Genome Alignments

Proteomics: Overview of Proteomics, Experimental Techniques, Bioinformatics Approaches, Protein-Protein Interaction, Databases and software

Softwares' for Drug Designing, Structure Based Drug Designing, Ligand Based Drug Designing, Virtual Screening, Homology Modeling and Chimera Generation

Suggested References:

1. Molecular Biology of the Cell: Alberts 5th Edition 2007 NCBI Publication
2. Principles of Biochemistry: Lehninger WH Freeman
3. Biochemistry of Signal Transduction and Regulation - Gerhard Krauss Wiley VCH 3rd Revised Edition
4. Molecular Cell Biology: Lodish 6th Edition, WH Freeman & Company
5. The cell: Cooper 2nd Edition ASM Press
6. [Genes IX](#): Benjamin Lewin Published by Pearson Prentice Hall
7. Cell and Molecular Biology: Gerald Karp
8. Molecular Biology: Robert Weaver 1st Edition, WCB McGraw-Hill
9. Molecular Biology of the Gene: Watson 6th Edition, Pearson Publication
10. Gene Regulation: A Eukaryotic Perspective: David Latchman 5 illustrated, Taylor & Francis, 2005. Molecular Biotechnology: Principles and Applications of Recombinant DNA [Bernard R. Glick](#)http://www.amazon.com/Molecular-Biotechnology-Principles-Applications-Recombinant/dp/1555814980/ref=sr_1_6?s=books&ie=UTF8&qid=1323503937&sr=1-6-#(Author), Publisher: Amer Society for Microbiology; 4 edition (December 31, 2009)
11. Principles of gene manipulation and genomics S. B. Primrose, Richard M. Twyman Publisher: Wiley-Blackwell; 7 edition (February 17, 2006)
12. Principles of Fermentation Technology, [P. F. Stanbury](#) (Author), [S. Hall](#) (Author), [A. Whitaker](#) (Author) Publisher: Butterworth-Heinemann; 2 edition (February 19, 1999)
13. Bioinformatics: A practical guide to the analysis of genes and proteins. Baxevanis A.D and Ovellette B.F.F., Wiley-Interscience, (2002).
14. Molecular and Biotechnology. A comprehensive desk reference, R.A. Meyes (Ed.) VCH Publishers Inc. (1995)
15. Textbook of Biotechnology Das H.K., Wiley Dreamtech India Pvt Ltd, (2004).
16. Principles of Genome analysis and genomics, Primrose SB, Twyman RM, Blackwell (2002)

Core Elective 1 - Paper 11: A) Toxicology (Biochemical and Environmental Toxicology)

Unit I: General principles of Toxicology

Definition, Different facets of toxicology and their interrelationships, Classification of toxic agents. Desired and undesired effects.

Various factors affecting toxicity: vehicles, formulation factors, biological half life, volume and concentration, dose, dosage forms, routes of administration / entry, genetic status etc.

Principles of selective toxicity: comparative morphology, comparative biochemistry, comparative cytology.

Toxicity assessment: acute, subchronic, chronic exposure, determination of ED50 and LD50 values, tests for mutagenicity, carcinogenicity, genotoxicity, Ames test.

Unit II: Disposition of Toxicants

Factors affecting disposition of toxicants: absorption, distribution, biotransformation, elimination.

Absorption through gastro-intestinal tract, lungs, skin.

Distribution: storage in tissues, blood-brain barrier, passage across placenta, redistribution.

Biotransformation, Phase I and II reactions, metabolic interrelationship, antidotal therapy.

Excretion: urinary, fecal, exhalation, other routes.

Toxicokinetics: classic and physiologic.

Unit III: A) Non –organ directed toxicity

Chemical carcinogenesis: definition, mechanism.

Genetic toxicology: definition, health impacts and mechanism of induction of genetic alterations.

Developmental toxicology: definition, principles, mechanism and pathogenesis of developmental toxicity.

B) Environmental Toxicology

Air pollution: definition, air pollutants, health effects and risk assessment of air pollution.

Introduction to Ecotoxicology

Unit IV: Target organ toxicity

Skin: skin as a barrier, dermatitis, acne, urticaria

Toxic responses of the blood: blood as a target organ, toxicology of erythron, leukon and platelets.

Toxic responses of the liver: physiology and pathophysiology, factors in liver injury, mechanism of liver injury.

Toxic responses of the respiratory system: lungs structure and functions, pulmonotoxic agents, pathogenesis of chemical induced damage, acute and chronic responses of lungs to injury.

Suggested References:

1. Casarette and Doull's Toxicology by Klaassen CD
2. Biochemical Toxicology of Environmental Agents by Bruine D.
3. Detoxification mechanisms by Williams RT
4. Selective Toxicity by Albert A.
5. Developmental Toxicology by Hood RD.

Core Elective 1 - Paper 11: B) Nutrition (Nutritional Biochemistry)

Unit I: Basic Concepts:

Basic Concept: Energy content of foods. Measurements of energy expenditure: Direct & Indirect calorimetry. Definition of BMR and SDA and factors affecting these. Thermogenic effects of foods. Energy requirements of man and woman and factors affecting energy requirements.

Role of dietary fibers in nutrition.

Unit II: Nutritional Disorders:

Protein Energy Malnutrition (PEM): Aetiology, Clinical features, Metabolic disorders and Management of Marasmus and Kwashiorkor diseases.

Disorders of Mineral Metabolism: Hypercalcemia, Hypocalcaemia, Normocalcemia, Hyperphosphatemia.

Unit III: Starvation and Antinutrients:

Starvation: Techniques for studying starvation, protein metabolism in prolonged fasting, protein sparing treatments during fasting. Concept of high protein, low calorific weight reduction diets.

Antinutrients: Naturally occurring food borne toxicants, protease inhibitors, hemagglutinins, hepatotoxins, allergens, oxalates, toxins from mushrooms, animal food stuffs and sea foods.

Unit IV: Clinical Nutrition and Food Allergies:

Clinical Nutrition: Role of diet and nutrition in the prevention and treatment of diseases: dental caries, Fluorosis, Atherosclerosis & Rheumatic disorders. Inherited metabolic Disorders: Phenylketonuria, Maple Syrup disease & Homocystinuria.

Food Allergies: Definition, role of antigen, host and environment, types of hypersensitivities, diagnosis and treatment of allergy.

Suggested Reading:

1. Basics of clinical nutrition

author- y.k. joshi
jaypee publication

2. Nutrition for the community

Gully baba publishing house

3. Essentials of human nutrition

author-jim mann & stewart truswell
oxford university press

4. Introduction to human nutrition

edited by- professor michael gibney (ucd institute of food and health)
professor susan lanham-new (university of surrey) professor aedin cassidy
(university of east anglia)
professor hester vorster (north-west university, south africa)

<http://www.nutritionociety.org/publications/textbooks/introduction-to-human-nutrition#sthash.tdyscawh.dpuf>

5. Nutrition and metabolism

edited by- professor susan lanham-new (university of surrey)
professor ian macdonald (university of nottingham) professor helen roche
(university college dublin) -

<http://www.nutritionociety.org/publications/textbooks/nutrition-and-metabolism#sthash.iusrjtui.dpuf>

Foundation Course 1 - Paper 12: Biomolecules and Basic Metabolism

Unit I: Carbohydrates and metabolism:

Structure, occurrence and biological importance of monosaccharides, oligosaccharides and polysaccharides.

Metabolism introduction, glycolysis, gluconeogenesis, TCA cycle pathway and regulation

Alternate pathways: HMP, Enter-Doudoroff, glucuronate and glyoxylate pathways, Cori's cycle and futile cycle.

Unit II: Lipids and metabolism:

Lipid definition and classification

Fatty acids –Saturated and unsaturated fatty acids, Essential fatty acids,

Glycerophospholipids, Glycolipids: properties and functions

Metabolism-Oxidation of fatty acids: even and odd numbered, unsaturated and branched chain fatty acids

Degradation and biosynthesis of triacylglycerols and phospholipids, energetic of beta- oxidation,

Cholesterol: biosynthesis, catabolism and regulation

Unit III: Proteins and metabolism:

Classification of amino acids and proteins ,Protein structures : primary, secondary, tertiary and quaternary structure, General metabolic reaction of amino acids:

transamination, oxidative deamination, minor pathways of amino acid degradation: transdeamination, amino acid oxidase, non oxidative deamination.

Degradation and biosynthesis of amino acids, glycogenic and ketogenic amino acids

Urea cycle: pathway and regulation.

Unit IV: Minerals and metabolism:

Major and minor and ultra trace minerals: their occurrence ,functions ,toxicity and interaction with other nutrients.

Iron metabolism and regulation

Calcium and phosphorus metabolism and regulation

Suggested Reading:

1. Biophysical Techniques- Upadhyay, Upadhyay and Nath
2. Principles of Biochemistry- Lehninger, David L. Nelson and Michael M. Cox
3. Enzymes- Malcolm Dixon and Edwin Webb
4. Harper's Biochemistry- Harper
5. Biochemistry- Western and Todd
6. Cell and Molecular Biology-Gerald Karp
7. Fundamentals of Biochemistry-Donald Voet, Judith G. Voet and Charlotte W. Bratt

Practical Core 9 & 10 – Practical 5: Biotechnology And Molecular Biology

- 1) Fermentation
 - i) Isolation of microorganisms from soil demonstrating synthesis capability of desired product, Gram staining (Desired property to be decided by the instructor), and screening
 - ii) Optimization of the lab scale production of the desired product: Effect of temperature, pH, substrate concentration
 - iii) Growth curve: Estimation of cell number, substrate utilization and/or product formation.
- 2) Polymerase Chain Reaction
 - i) PCR amplification from genomic DNA
 - ii) Nested PCR
 - iii) Random Amplification of Polymorphic DNA (RAPD)
- 3) Restriction Fragment Length Polymorphism (RFLP)

Practical Core Elective 1 - Practical 6: A) Toxicology (Biochemical And Environmental Toxicology)

1. Qualitative detection of various toxicants in biological samples:
Phenothiazine derivatives, Organochlorine compounds (Fujiwara test), Phenol, Methanol, Arsenic (As), Antimony (Sb), Selenium (Se), Mercury (Hg), Bismuth (Bi), Fluoride (F), Boron (Bo), Gutzeit test for Antimony (Sb) and Arsenic (As), Spot test for metal toxicants.
2. Quantitative determination of Salicylate, Paracetamol (acetaminophen), Sulphonamide in biological samples.
3. Enzyme assay in toxic conditions:
GOT (AST), GPT (ALT), Acid phosphatase, Alkaline phosphatase, Acetyl cholinesterase etc.
4. Construction of dose-response curves.
5. Determination of LD50 value of a toxicant.
6. Induction of hepatotoxicity / diabetes / skin lesions / teratogenesis.
7. Organ / tissue morphology / histopathology
8. Assay of toxicant biotransformation enzyme-cytochrome P450.
9. Test for teratogenicity / carcinogenicity / Ames test.
10. Assay of biomarkers of environmental pollution / toxicity.

OR

Practical Core Elective 1 - Practical 6: B) Nutrition (Nutritional Biochemistry)

1. Determination of Calcium in food samples.
2. Determination of Inorganic Phosphorous in food samples.
3. Determination of Iron in food samples.
4. Determination of beta carotene in carrots by column chromatography
5. Determination of Ascorbic Acid in food
6. Estimation of Amylase activity
7. Determination of Total Lipids By Sulphophospho vanillin Method
8. Determination of Triglycerides
9. Proximate Analysis of Food Samples.

Seminar 3

SEMESTER IV

Core 11 - Paper 13: Advanced Clinical Biochemistry

Unit I: Aging and Neurological Disorders

Current view and theories of aging, auto immune connection and HLA association, processes of aging and biochemical alteration, DNA damage, protein oxidation and axonal transport in aging, nutritional intervention as anti-aging therapy.

Alzheimer's disease: Causes, symptoms, diagnosis, pathogenesis, genetics, APP, ApoE, PS2, tau protein, risk factors and therapeutic approaches.

Progeria

Parkinson's disease: Causes, symptoms, diagnosis, pathogenesis, genetics and therapeutic approaches

Unit II: Obesity

Theories, lipid metabolism, adipose tissue anomalies.

Genetic basis of familial obesity, effects of neuropeptides and leptin in nutrient partitioning.

Obesity related derangements in metabolic regulation.

Therapeutic approaches

Unit III: Molecular and Metabolic Diseases

Human gene map, genetic diversity, polymorphism, genetic linkage, chromosomal disorder. Monogenetic Disorders: Autosomal dominant, autosomal recessive, X-linked, Multifactorial disorders, Genetic heterogeneity. Allelic heterogeneity, Pathogenesis of genetic disease, Galactosemia, Hemophilia, Sickle cell anemia, Muscular dystrophy, Hypercholesterolemia, Gout, Turner's syndrome.

Unit IV: Reproductive Biochemistry

Overview of reproductive system and reproduction, biochemistry of reproductive disorders (male & female), Influence of various factors in reproduction with special reference to role of prostaglandins and gonadotrophins. Mechanism and methods of birth control and possible biochemical consequences thereof. Biochemical marker's in infertility disorders. Techniques involved in assisted reproductive technology (ART). Culture media and cell culture techniques in ART programme.

Suggested References:

1. Clinical Biochemistry – Metabolic and Clinical aspects By-William J. Marshall & Stephen K. Angert.
2. Harper's Biochemistry - 27th Ed.
3. Text book of Medical Physiology - By Guyton.
4. Text book of Physiology -By Burn & levy.
5. Biochemistry –By L .Stryer (Freeman & Co.NY.)
6. Biochemistry with clinical correlation- By Thomas Devli.
7. The Metabolic Basis of Inherited Disease 5th Ed.-By John Stanbury.
8. Teitz Fundamentals of Clinical Chemistry –By C.A.Burtis & Ashwood .
9. Biochemistry - By Lehninger.
10. Lehninger's Biochemistry –By Nelson & Cox.
11. Biochemistry –By Stanford.
12. Basic Medical Biochemistry: A Clinical approach- By Smith.
13. Principles of Internal Medicines- By Harrison.T. R.
14. Practical Biochemistry Principles & Techniques- By Wilson & Walker.
15. Practical Biochemistry –By David Plummer.

Core 12 - Paper 14: Advanced Immunology**Unit I: Introductory Immunobiology**

Complement system: Alternative and Classical pathway of complement activation

Immune networks: Homeostasis in the immune system-termination of normal immune responses, network hypothesis

In vivo immunity to viruses, bacteria, fungi, protozoa, worms etc

Unit II: Immunological tolerance and Autoimmunity

Immunologic tolerance, T lymphocyte tolerance- central and peripheral, Apoptosis in Lymphocytes-pathways and biochemical mechanisms, effector mechanisms, Tolerance induced regulatory T cells, B lymphocyte tolerance- Central and Peripheral, Homeostasis in the immune, pathogenesis and therapeutic approaches to autoimmunity.

Unit III: Tumor and Transplantation Immunology, Hypersensitivity

General features of tumor immunity, tumor antigens, Immune response to tumor and evasion, Immunotherapy, Types of hypersensitivity, Effector mechanisms of immunologic tissue injury and disease.

Unit IV: Immunodeficiency and Vaccinology

MHC and disease susceptibility, immune deficiency disorders, Active immunization (immune prophylaxis), passive immunization, adjuvants, modern approaches to vaccine development, role of vaccines in the prevention of disease.

Suggested References:

1. Cellular and Molecular Immunology- 5th Edition, Abul K. Abbas, Andrew Litchman
2. Immunology-5th Edition, Richard A Goldsby, Thomas J. Kindt, Barbara A Osborne, Janis Kuby
3. Immunology- 6th Edition, Ivan Roitt, Jonathan Brostoff, David Male

Core Elective 2 - PAPER 15: A) Toxicology (Clinical Research)

Unit I: Pre-Clinical Research:

Animal studies, acute & chronic toxicity of drugs; regulations for number & types of animals, protocols for animal experimentation. Biochemical & histopathological studies of animals after drug administration. Mechanism & cause of death. Routine toxicity studies & special toxicity studies; carcinogenicity, mutagenicity & teratogenicity to be given special emphasis.

Unit II: Phases of Clinical Research

Phases of clinical research, number of volunteers in phase I & types of patients in phase II to IV. Importance of these investigations. Post marketing surveillance (PMS) & pharmacovigilance in case of clinical investigations after marketing authorization. Importance of ethical committee, protocol design, documentation in clinical trials. Bio Availability and Bio Equivalence studies Pharmacokinetics, Pharmacodynamics, Genomic studies

Unit III: Good lab practices

Good Clinical Practices, Good Manufacturing Practices and Good Laboratory Practices Principles of ICH-GCP, History GCP, declaration of Helsinki, Belmont report, Nuremberg code, Tuskegee trial. Schedules Y and its amendments, ICMR Guidelines Composition, functions & operations of IRB/IEC ethics of clinical trials Health Authorities- CDSCO, US-FDA, EMEA and other

Unit IV: Roles and Responsibilities of different stake holders in Clinical Research- Sponsor, CRO, SMO, Ethics Committee, Investigator, CRA, CRC, Patients and other, Departments in Clinical Research- Operations, Business Development, Regulatory, Pharmacovigilance, Data Management, Centralized Monitoring, Quality, Finance. Important documents in Clinical Research and importance of documentation in Clinical Research. Stages in clinical trial-Feasibilities, PSSV, SIV, SMV and Close-out visits, Audits and Inspections

Suggested reading:

1. Clinical Research Coordinator Handbook Norris, Deborrah Plexus Publications 2004/06/01
2. Clinical Research Methodology and Evidence-Based Medicine Babu, Ajit N Anshan 2008/05/30
3. Conducting Clinical Research Judy Stone Biblio Distribution 2006
4. Essentials of clinical research Stephen P Glasser (Edt) Springer Verlag 2008

Core Elective 2 - PAPER 15: B) Nutrition (Applied Nutritional Biochemistry)

Unit I: Clinical nutrition

Role of a dietician: role and responsibilities of a dietitian, nutrition counseling, professional ethics and obligations.

Diet therapy-Rationale for diet therapy (normal diet, modifications of the diet to the light diet, soft diet, full liquid diet, clear liquid, tube feeding); Routes for diet therapy- enteral and parental; use of biochemical parameters in the planning of diets, use of computers in the planning of diets.

Unit II: Nutritional Counseling and Dietetics

Nutritive value of different food groups and changes due to cooking in various food groups.

Storage of foods, food quality and factors affecting food quality. Control of food quality. Use of additives, Classification and applications.

Unit III: Community Nutrition

Opportunities in community Nutrition, Assessing Community Resources, assessing target population, program planning, Assessing community's nutritional resources, Food insecurity, food assistance programs, world hunger and food insecurity. Principles of nutrition education and policy making, national nutrition agenda.

Unit IV: Applied Nutrition and Public Health

Concept of Health, Nutrition and Public Health Nutrition, Demographic trends in India and the significance of certain indices of Health and Nutrition situation of a community (IMR, MMR, TFR, Birth rate, Death rate, Life expectancy etc.) Major nutritional problems in developing countries. Dietary surveys-methods, ways of interpretations and analysis, recommendations based on survey findings. Assessment of nutritional status: biochemical and anthropometry.

Suggested Reading:

6. 1. Clinical nutrition

edited by- professor marinos elia (university of southampton)

professor olle ljungqvist (karolinska institutet & örebro university hospital)

dr rebecca stratton (university of southampton)

professor susan lanham-new (university of surrey) - see more at:

<http://www.nutritionociety.org/publications/textbooks/clinical-nutrition#sthash.w12tfscq.dpuf>

7. Public health nutrition

edited by- professor michael gibney (ucd institute of food and health) professor barrie

margetts (university of southampton) dr john kearney (dublin institute of technology)

professor lenore arab (university of california los angeles)

<http://www.nutritionociety.org/publications/textbooks/public-health-nutrition#sthash.8pvhu1m0.dpuf>

8. Staying healthy with nutrition

author- elson m. Hass, buck levin

9. American dietetic association complete food and nutrition guide

Roberta larson duyff

Foundation Course 2 - PAPER 16: Enzyme Technology

Unit I: Industrial enzymes:

History, sources, uses, screening for novel enzymes, applications, safety and regulatory aspects of industrial enzyme use, Enzyme Nanotechnology in agriculture, cosmetics and industrial processes. strategies to increase/modify enzyme activity and synthesis.

Unit II: Enzyme production:

Media, routine and nanotechnological approaches for isolation and purification of extra-cellular and intra-cellular enzymes, purification- centrifugation, filtration, chromatography, polishing and packaging

Unit III: Industrial use of soluble and immobilized enzymes:

Application of nanotechnology, detergents, food industry, leather and wool, carbohydrate industry, dairy, brewing etc

Enzyme reactors, methods of immobilization and immobilized-enzyme processes such as immobilized invertase, raffinase, lactase, production of amino acids, antibiotics etc.

Unit IV: Biosensors:

Use of enzymes in analysis, types of biosensors
Recent advances and future prospects

Suggested references:

1. Enzymology and Enzyme Technology 2014 by [S.M. Bhatt](#) (S. Chand)
2. Enzyme Technology 2006 by [Ashok Pandey](#) (Editor), [Colin Webb](#) (Editor), [MARCELO FERNANDES](#) (Editor) Springer
3. Biocatalysts and enzyme technology 2012 Klaus Buchholz, volkar Kasche and Uwe Theo Bomscheuer (Wiley VCH)

Practical Core 11 & 12 and Elective 2 - Practical 7: Advanced Clinical Biochemistry and Immunology and A) Toxicology (Clinical Research) OR B) Nutrition (Applied Nutritional Biochemistry)

1. Demonstration of dialysis using blood filtrate (Protein Separation)
2. Immunology
 - a. Quantitative Estimation of Antibody
 - b. Precipitation Techniques : Double Immunodiffusion, Single (Radial) Immunodiffusion
3. Electrophoretic Techniques :Immuno-electrophoresis,Rocket Immunoelectrophoresis, Immuno-diffusion
4. To assay cathepsin D, ATPase (Na/K/Ca/Mg), Lipid peroxidase enzymes
5. Assay of Acetylcholine esterase activity in rat brain
6. Assay of monoamine oxidase.
7. Fractionation of tissues and assay of proteins
8. Assay of ornithine amino transferase
9. Glutathione Estimation

PROJECT

Seminar 4
