Placed at the meeting of
Academic council
held on 26.03.2018

APPENDIX- AZ
MADURAI KAMARAJ UNIVERISTY
(*University with Potential for Excellence*)

M.Sc. Biochemistry (Semester)

CHOICE BASED CREDIT SYSTEM
REVISED SYLLABUS
(With effect from the academic year 2018-2019 onwards)

1. Introduction of the Programme

The Master of Science in Biochemistry is a full- time programme spread over 2 years and is divided into 4 semesters. The programme of study shall consist of 11 core papers which are compulsory, 3 elective papers, 3 practicals and one project. Each of these carry 100 marks. It has been developed to provide students the opportunity to be trained in recent development in Biochemistry. The course is designed to impart the students a vigorous training in Biochemistry both in theory and experiments. Our approach is a comprehensive one. It is believed that teaching students both how to ask and address questions. This Programme has been designed to expose students knowledge in Biochemistry to contemporary national and international problems. At the end of the course, students are expected to have state- of- the- art quantitative skills valued both in academia and in the corporate world. During the course time, one gets as in-depth knowledge about core subjects like Advances in Biochemistry, Clinical Biochemistry, Molecular Biology and Microbiology.

2. Eligibility for Admission

B.Sc., degree from UGC recognized Universities with Biochemistry/ Botany, Zoology, Biology, Physics, Chemistry, Microbiology, Agriculture, Nutrition & Dietetics as major subjects or an examination accepted as equivalent there to by the syndicate are eligible for seeking admission to M.Sc Biochemistry. Candidates belonging to general category should have secured at least 55% of marks, OBC candidates must have secured 50% marks and SC/ST /Candidates with disability must have passed in the qualifying examination for admission , as prescribed by Government of Tamil Nadu/Madurai Kamaraj University.

2.1. Duration of the Programme : 2 Years

2.2. Medium of Instructions : English

3. Objectives of the Programme

- To offer the knowledge, understanding and skills to PG students.
- To offer a balance between Theoretical and Experimental –Biochemistry.
- To improve the employability of the students
- To develop core competencies on critical thinking skills, hypothesizing and solving problems.

4. Outcome of the Programme

- It serves as a basis to build a purely academic profile for further studies and research in Biochemistry such as M.Phil and Ph.D.
- On successful completion of this course, one can apply for the UGC-NET or JRF exam. The success in these exams makes teaching or research as good options.
- The degree holders can opt for further higher studies and career in various specializations of Biochemistry such as Medical Biochemistry, Molecular Diagnostics, Biosensors, Microbial Biochemistry, Plant Biochemistry and Environmental Biochemistry.

5. Core Subject Papers

Core Subject papers shall consists of 11 papers as listed below.

1. Chemistry of Biomolecules
2. Principles of Biochemical and Biophysical Techniques
3. Enzymes and Enzyme Technology
4. Endocrinology and Metabolic Regulation
5. Microbial Biochemistry and Fermentation Technology
6. Plant Biochemistry
7. Immunochemistry
8. Biostatistics and Bioinformatics
9. Eukaryotic Gene Expression
10. Environmental Biochemistry
11. Clinical Biochemistry

6. **Subject Elective Papers**

Elective papers shall consists of 3 papers as listed below.

1. Cellular Biochemistry and virology
2. Molecular Biology and Genetic Engg.
3. Project work

7. Non-major Electives

1. Clinical Biochemistry

8. Unitization

Each subject Paper consist of five units. One unit (Preferably the 5th unit) will be handled by the students as a part of peer team teaching/learning process.

9. Pattern of Semester Examination

Two-year M. Sc., Biochemistry degree shall be having examinations of 11 core papers, 2 subject- Elective papers and one Non- major elective paper to be conducted in four semesters. Each semester shall consist of five examinations for five subjects. First and third semester examinations shall be conducted in the month of November. The second and fourth semester examinations shall be held in the month of April. Each paper shall carry 100 marks of which 25 marks for internal assessment and 75 marks for external examinations for all the theory papers. For practicals, 40 marks for internal and 60 marks for external.

10. Scheme of Internal Assessment

The components of Internal Assessment marks shall be as follows, for theory.

Test	: 10 Marks (Average of the best two tests)
Assignment	: 5 Marks
Seminar/ Group Discussion	: 5 Marks
Peer Team Teaching	: 5 Marks
Total	**: 25 Marks**

For practical's, 40 marks is for internal.

11. External Examinations

External examination for each Theory paper shall be conducted for 75 marks.

Section A: 10 Multiple choice questions (One question from each unit) (10 × 1= 10 marks)
Section B: 5 either/ or type questions (One question from each unit) (5 × 7 = 35 marks)
Section C: 3 out of 5 questions. This may include 2 problems. (3 ×10=30 marks)

Total : 75 Marks.

12. Question paper pattern

Internal Examination of each paper shall be for 10 marks having the following question pattern.

Section A: 5 Objective type questions (6 × 1= 6 marks)
Section B: 2 questions in either or type (2 × 7= 14 marks)
Section C: One out of 2 questions (1 ×10=10 marks)

Total : 25 Marks

External examination of each paper shall be for 75 marks having the following question paper pattern, for theory papers.

Section A: 10 Objective type questions (2 question from each unit) (10× 1= 10 marks)
Section B: 5 questions in either or type (1 question from each unit) (5 × 7 = 35 marks)
Section C: 3 out of 5 questions (1 question from each unit) (3 ×10=30 marks)
(This may include 2 problems)

Total : 75 Marks.

13. Scheme of Evaluation

Students shall be evaluated on the basis of internal tests, seminar, and assignment, peer- teaching and external examinations. Question paper setters shall be requested to prepare scheme of valuation for all the papers.

14. Passing Minimum

Total Passing Minimum : 50 Marks out of 100 Marks
Internal Assessment : No minimum pass marks out of 25 Marks
External Assessment : 34 Marks out of 75 Marks

14.1. Classification

S.No.	Range of CGPA	Class
1.	40 & above but below 50	III
2.	50 & above but below 60	II
3.	60 & above	I

15. Model Question paper

Maximum Time: 3 hrs Maximum Marks: 75

Section A
Answer All Questions

All multiple choice Questions (10 × 1= 10 Marks)
Two Questions from each Unit
(Questions are numbered from 1 to 10)

Section B
Answer All Questions

(Either/ or type: either (a) or (b)) (5 × 7= 35 Marks)
One question from each Unit
(Questions are numbered from 11 to 15)

Section C
Answer any three Questions

One question from each Unit (3 × 10= 30 Marks)
(Questions are numbered from 16 to 20)

16. Teaching Methodology

Methodology shall consist of stimulation of students' interest, presentation of teaching material, team formation and activities' determination, conduction of activities and discussion and assessment. For the sake of simplicity and easy understand, the methods like problem solving, discussion, lab demonstration and lecture method shall be adopted. The use of ICT shall be co- opted for the visual presentation of the lessons. One unit (mostly 5^{th} unit will be handled by the students).

17. Text Books

The list of text books is given at the end of syllabus of each paper.

18. Reference Books

The list of reference books is given at the end of syllabus

19. Retotaling and Revaluation Provision

Students shall be provided the facility of applying for retotaling the marks within 15 days after the publication of results on payment of a minimum fee fixed by the University and they shall be allowed to apply for revaluation of their papers within 15 days after the publication of results on payment of a fee to be fixed by the University.

20. Transitory Provision (2+2)

Syllabus revision shall be done once in 2 years and afterwards 2 years shall be under transitory provision.

21. Subjects and paper related websites

The related websites for each paper shall be provided at the end of the syllabus wherever necessary.

Appendix A **FIRST SEMESTER**

Sub. Code	S.No	Title of the paper	Weekly content hours	No.of Credits	Examination Hours	Marks		
						Internal	External	Total
	1.	Chemistry of Biomolecules	6	5	3	25	75	100
	2.	Principles of Biochemical and	6	6	3	25	75	100
	3.	Biophysical Techniques	6	6	3	25	75	100
	4.	Enzymes and Enzyme Technology	6	5	3	25	75	100
	5.	**Major Elective** Cellular Biochemistry and Virology Biochemical Techniques and Biochemical Analysis – Practical	6	3	6	40	60	100
Total			30	25				500

Second Semester

Sub. Code	S.No	Title of the paper	Weekly content hours	No.of Credits	Examination Hours	Marks		
						Internal	External	Total
	6.	Endocrinology and Metabolic Regulation	6	6	3	25	75	100
	7.	Microbial Biochemistry and Fermentation	6	5	3	25	75	100
	8.	Technology	6	5	3	25	75	100
	9.	Plant Biochemistry **Major Elective** Molecular Biology	6	5	3	25	75	100
	10.	And Genetic Engg. Microbiology and Molecular Biology Techniques – Practical	6	4	6	40	60	100
Total			30	25				500

Third Semester

Sub. Code	S.No	Title of the paper	Weekly content hours	No.of Credits	Examination Hours	Marks		
						Internal	External	Total
	11.	Immunochemistry	6	6	3	25	75	100
	12.	Biostatistics and Bioinformatics	6	5	3	25	75	100
	13.	Eukaryotic Gene Expression	6	6	3	25	75	100
	14.	Non Major Elective – Clinical biochemistry (Basics)	6	4	3	25	75	100
	15.	Advanced Biochemistry – Practical	6	4	6	40	60	100
Total			30	25				500

FOURTH SEMESTER

Sub.Code	S.No	Title of the paper	Weekly content hours	No. of Credits	Examination Hours	Marks		
						Internal	External	Total
	16.	Environmental Biochemistry	6	4	3	25	75	100
	17.	Clinical Biochemistry	6	4	3	25	75	100
	18.	Project Work	18	7	6	20	80	100
Total			30	15				300
Grand Total			**120**	**90**				**1800**

SEMESTER I

CHEMISTRY OF BIOMOLECULES

UNIT I: Carbohydrates

Carbohydrates –Classification-Monosaccharides, Disaccharides and Polysaccharides-Reactions of Monosaccharides. Homoglycans: Occurrence, structure, properties and biological functions of glycans. A brief account of chitin, fructans, mannans, xylans, arabinans, galactons and galacturonans. Heteroglycans and complex carbohydrates: Occurrence, structure, properties and biological function of mucopolysaccharides, bacterial cell wall polysaccharides with a xylose backbone polysaccharides with glucose and mannose backbone, chemical synthesis of polysaccharides (glycan).

UNIT II: Lipids

Lipids - classification - saturated and unsaturated fatty acids, phospholipids - classification, structure and functions. Ceramides and sphingomyelins. Eicosanoids, structure and functions of prostaglandins, thromboxanes, leukotrienes Types and functions of plasma lipoproteins. Amphipathic lipids - membranes, micelles, emulsions and liposomes. Steroids - cholesterol structure and biological role - bile acids, bile salts.

UNIT III: Proteins

Proteins-Classification - Peptide, polypeptide and protein. Isolation and Purification of Proteins. Functions of protein. Structures- Levels of structure of protein (Primary structure,

Determination, Secondary, Tertiary and Quaternary) conformation of proteins structure their analysis and forces. Molecular modeling.
Properties of proteins in aqueous solutions. Isoelectric pH, acid base properties, electrophoretic mobility, influence of ionic concentration on the protein solubility hydrolysis of proteins, denaturation and renaturation of proteins. Metalloprotein - A case study metal and protein components of metalloprotein. A hierarchy of behavior from metalloprotein. Conformational study on the structure of keratin, collagen and hemoglobin.

UNIT IV: Nucleic acid
Nucleic acid – structure of nucleic acid, structural transition. Chemical and enzymatic methods of sequence analysis, properties of DNA in aqueous solution. Sedimentation behavior, viscosity, hyperchromic effect, melting point of DNA and hydrolysis of nucleic acids. Hybridization techniques and chemical synthesis of nucleic acid.

UNIT-V : Vitamins and Porphyrins
Vitamins - water soluble - thiamine, riboflavin, niacin, pyridoxine, folic acid, ascorbic acid-sources, structure, biochemical functions, deficiency diseases, daily requirements; fat soluble - vitamin A, vitamin D2, vitamin E and vitamin K - sources, structure, biochemical functions, deficiency diseases, daily requirements. Porphyrins & the porphyrin ring system, chlorophyll, hemoglobin, myoglobin and cytochrome.

Reference:

1. Lubert Stryer, W.H. Freeman, 1995 - Biochemistry 5th Edition .
2. Richard A. Harvey (Ph. D.), Richard A. Harvey, Denise R. Ferrier Lippincott Williams & Wilkins, 2011 Biochemistry,
3. Alexander Thomas Cameron, 1928 Textbook of Biochemistry, 1st edition.
4. Fundamentals of Biochemistry by Donald Voet, Judith Voet and Pratt, second edition, 1995
5. Robert K. Murray David Bender Kathleen M Botham , Peter J. Kennelly Victor W. Rodwell , P. Anthony Weil, , 2015,Harpers Illustrated Biochemistry 30th Edition.
6. Principle of Biochemistry - Lehninger Latest Edition
7. Biochemistry – Zubey (2nd Edition).

PRINCIPLES OF BIO-CHEMICAL AND BIOPHYSICAL TECHNIQUES

UNIT I

Principles of electrochemical techniques – measurement of pH by glass electrode and hydrogen electrode. Oxygen electrode – principles, operation of a Clarke electrode and its applications.
Spectroscopic techniques : colorimetry, spectrophotometry – UV & visible, Principle – Beer & Lambert's law, Extinction coefficient. Principle, instrumentation and applications of FT – IR spectroscopy and spectro- fluorimetry, luminometry, Atomic Absorption spectroscopy,

Flame and flameless spectrophotometry. Basic principles of NMR, ESR and mass spectrometry and their biological applications.

UNIT II

Basic principles of sedimentation. Different types of rotors. Low speed and high speed centrifuges. Ultracentrifuge: analytical and preparative ultracentrifuge- instrumentation and applications. Molecular weight determination by centrifugation. Sub cellular fractionation by differential centrifugation. Density – gradient centrifugation- rate zonal and isopycnic. Cell disruption, homogenization and extraction of membrane bound proteins- cell disruption methods- organ and tissue slice techniques, dialysis.

UNIT III

Chromatographic Techniques - Principles and Applications of Paper, TLC, Adsorption, Ion exchanges, Gel filtration, Affinity, GLC, Chromato focusing, HPLC, FPLC.– Basic principles and applications, autoradiograpy. Principle and application Microscopy- Basic principles, components and applications of light, bright field, phase contrast and fluorescence microscopy. Electron microscopy- Principle, preparation of specimens for TEM and SEM and applications.Confocal microscopy. Microtomy. Fixation and staining.

UNIT IV

Electrophoretic Techniques: Polyacrylamide gel electrophoresis, SDS-PAGE, 2D – PAGE, Isoelectric focusing, Isotachophoresis, Agarose gel Electrophoresis, pulse field electrophoresis, high voltage electrophoresis, Capillary Electrophoresis, Blotting techniques and its applications– Western, Northern & Southern.

UNIT V

Isolation of nucleic acids, restriction endonucleases, restriction mapping – nucleic acid probes – Clones probes, oligonuleotide probes and labeling nucleic acid probes. Restriction fragment length polymorphism (RFLP), FISH. - polymerase chain reaction. Vectors-cloning vectors strategies and selection. Expression vectors. Application of cloning and expression vectors in Recombinant DNA Technology.

References:

1. HPLC of Macromolecules (1989) – A practical approach – TWA Oliver IRL .
2. Analytical Biochemistry(1998) – DJ Holine & HAZEL Peck, Longman Group.
3. Quantitative problems in Biochemistry(1983) – Edwin a Dawes Longman Group.
4. Wilson and Walker (2000). A biologists guide to principles and techniques of practical biochemistry. 5th ed. Cambridge University Press 2000.
5. Upadhyay, Upadhyay and Nath(1997). Biophysical Chemistry Principles and Techniques. Himalaya Publ.
6. Sambrook. Molecular Cloning(2001) . Cold Spring Harbor Laboratory.
7. Friefelder and Friefelder(1994). Physical Biochemistry – Applications to Biochemistry and Molecular Biology. WH Freeman & Co.

ENZYMES AND ENZYME TECHNOLOGY

UNIT I

Introduction of enzymes: Holoenzyme, Apoenzyme, coenzymes and cofactors, free energy, activation energy and transition state theory. Active site- Fisher and Koshland models. Enzyme classification- Enzyme Nomenclature and IUB system of enzyme classification, Investigation of sub-cellular compartmentation of enzymes and marker enzymes. Introduction of co-enzymes: Structure and functions –Thiamine pyrophosphate and flavin nucleotides, NAD/ NADP, coenzyme A, Pyridoxal phosphate and Carries of one carbon group: tetrahydrofolate.

UNIT II

Enzyme kinetics –: Pre Steady state and Steady- State enzyme kinetics, MM equation and linear transformation of MM Equation. Eadie-Hofstee and Hanes-Wolf plots. Factors affecting rate of chemical reaction. Bi-Substrate reactions- Single displacement and double displacement reactions. Enzyme inhibition:Reversible and Irreversible inhibition - Competitive, Non-competitive and mixed inhibition. Feedback inhibition.

UNIT III

Enzymes Regulation: Allosteric control of enzyme activity. Concentrated model of Monod et al., and sequential model of Koshland et al .Allosteric kinetics (MWC and KNF models), cooperativity, symmetry and sequential models. Hill's equation. Regulation by covalent modification of enzymes with examples - Glycogen phosphorylase, Zymogen activation (Chymotrypsin).Isozymes- Lactate Dehydrogenase, Alkaline phosphatase.
Active site determination -Lysozymes: A case study – structure, enzymatic activity-mechanism of lysozyme action, the ionization states of side chains.

UNIT IV

Immobilized Enzymes-Principles and techniques of immobilization-commercial production of enzymes-amylases, proteases, cellulase, artificial enzymes, industrial applications, fermentation, enzyme modification, site directed mutagenesis. Immobilized enzymes in industrial processes.

UNIT V

Large scale extraction and purification of enzymes. Extraction by chemical and physical method, isolation and purification of enzymes -Measurement and expression of enzyme activity – enzyme assays, enzyme structure-chemical modification, enzyme purification-various chromatographic techniques. Industrial utilization of enzymes, food, detergents, energy, waste treatment, pharmaceuticals and medicine.

References:

1. Enzymes Biochemistry, Biotechnology and Clinical Chemistry(2001)– Trevor Palmer, Published by Horwood Publishing Chichester, UK.

2. Biochemistry by Donald Voet and Judith Voet, (2004), Published by John Wiley & Sons, US 3rd edition.
3. Principles of Biochemistry by Lehninger, Nelson and Cox(2005), W H Freeman and Company, New York, USA, 4th edition.
4. Douglas S. Clark, Harvey W. Blanch 1995. Biochemical Engineering ,CRC Press.
5. T .Devasena 2010 . Enzymology Oxford Press.
6. Dr. S. Shanmugam ,T.Sathish Kumar 2009. Enzyme Technology, K. International Pvt Ltd,
7. R.M. Buitelaar, C. Bucke, J. Tramper, R.H. Wijffels 1996. Immobilized Cells: Basics and Applications: Elsevier Science 842 pages.

MAJOR ELECTIVE
CELLULAR BIOCHEMISTRY AND VIROLOGY

UNIT I :

Molecular organization: Freeze fracture and fluid mosaic model.Composition: Membrane lipids, membrane protein, membrane receptors, membrane carbohydrates. Properties: Membrane asymmetry: membrane fluidity and molecular mobility of proteins. Isolation and characterization of plasma membrane. Model Membrane Isolation: Techniques of making multi lamellar vesicle, bi layer reconstitution of proteins into vesicles, liposomes. Membrane fusion in fertilization, cell division, exocytosis, endocytosis and infection.

UNIT II

Structure of mitochondria, respiratory chain-enzyme complexes – inhibitors of respiratory chain- energy transfer oxidative phosphorylation – Various theories – proton gradient and ATP synthesis – F1 ATPase – Inhibitors –Microsomal electron transport.

UNIT III

Membrane transport.: Small molecules – Simple diffusion, Donnan Equilibrium, diffusion of changed and unchanged particles, Ficks law, facilitated transport (pores and channels, properties), carriers(specific ionphores). Transport proteins- periplasmic binding proteins, Active transport (Energy for active transport Na pump model). Mechanism (Ca^{2+} pump), secondary active transport – Na^{2+} dependent glucose transport, transport in excitable cells.

UNIT IV

Cell surface, cell junctions: Desmosomes, tight junction, gap junctions, extra cellular matrix: collagen, chemistry and assembly, organization and role in cell adhesion: proteoglycans and glycosaminoglycans, elastin and aggregation: example – Nyxobacteria: Sponges, Communications: Chemical signaling between cells- Histamines, prostaglandins, hormones and neurotransmitters, structure and organization of nervous system. Signal transduction: AMP, G- Protein Complex, Immunoprecipitation; Molecular aspects of cell division – Cell Cycle fusion, mitogens nucleocytoplasmic interaction.

UNIT V

Bacteriophages, Single stranded DNA containing phages X174: Life cycle; lamentous DNA containing - Phages-M12 -Single standard RNA containing Phages – life cycle. Animal viruses: Adenoviruses – Replication and transcription. Polioviruses – Replication and transcription. Plant viruses: TMV –Structure, life cycle Tumor viruses: DNA virus SV 40 – Replication, RNA –Viruses, RSV – Replication, Oncogenes: transformation of cells; activation of oncogenes. Cancer Biology Cell Culture: Cell lines, Cell cycle and cell Transformation. Chemical differences between normal and cancerous cells – surface changes in cancer cells – Chemical carcinogens and radiation. Oncogenesis mechanism.

References:

1. Biochemistry of lipids and membrane : VANCE AND VANCE
2. Molecular biology of the cell – ALBERTS, BRAY, LAWIMS, RAFF.
3. Molecular cell biology – J. AVERS
4. Molecular biology of the gene – WATSON et al (4^{th} edition)
5. Cell and molecular biology –DE ROBERTIS
6. General virology, Luria et al.
7. Animal viruses Fenner et al Acad Press
8. Cellular & Molecular Biology Baltimore, Dainell & Lodish
9. General Microbiology –Powar, Vol II 2^{nd} Edition, 1999
10. Cell & Molecular Biology, Gerald Karp,1999
11. Genes – Benjamn Lewin, Latest Edition

BIOCHEMICAL TECHNIQUES AND BIOCHEMICAL ANALYSIS (PRACTICAL)

Biochemical techniques and biochemical analysis

1. Buffer preparation, pKa value
2. Spectrophotometirc estimation
   Estimation of glucose in blood and urine
   Estimation of protein in blood and urine
   Estimation of cholesterol in blood
   Estimation of bilirubin
3. Characterization of fats – estimation of saponification number, iodine value, acid number.
4. Lipid separation by TLC
5. Serum amino acids separation by paper chromatography
6. Partial purification of enzymes by column chromatography, amylase/ urease /alkaline phosphatase –Demonstration Only
7. Enzyme kinetics : determination of Km and Vmax

SEMESTER II
ENDOCRINOGLOGY AND METABOLIC REGULATION

UNIT I

Characteristics of hormone system. Functions and Mechanism of action of hormones. Hormones and hehaviour, growth factors: Somatomedin and Erythropoetin, Nerve growth factor, epidermal growth factor, fibroblast growth factors. GI tract hormones.

UNIT II

Chemistry, Biosynthesis, secretion, biochemical actions of pituitary, Thyroid, parathyroid, Adrenal and gonadal hormones.

UNIT III

Hormonal regulation of carbohydrate metabolism. Glycolysis and glucogenesis: phosphofructokinase as the key enzyme in glycolysis; role of fructose – 2, 6 diphosphate in liver and muscle; hexokinase and pyruvate kinase as regulatory enzymes in glycolysis , pyruvate dehydrogenase complex and its regulation; tissue involved in gluconeogenesis-regulation. Glycogen metabolism: glycogenesis and glycogenolysis - cAMP and coordinated control. Phosphorylase activation and inactivation - Role of Ca^{2+}. Glucose 6-phosphate dehydrogenase as a regulatory enzyme – regulation of TCA cycle - Mitochondrial regulation of oxidative phosphorylation.

UNIT IV

Fatty acid synthesis: control of acetyl – CoA Carboxylase, role of hormones, effect of diet on fatty acid synthesis. Regulation of biosynthesis of triacylglycerol, cholesterol, phosphatidyl ethanolamine and sphingomyelin. Metabolism of of triacylglycerol during stress; Fatty acid oxidation, Role of carnitine control of oxidation; regulation of kettogenesis. Metabolism of aromatic amino acids. Prostoglandins and thromboxanes.

UNIT V

Amino acid metabolism : Transamination, deamination, transdeamination- Key role of glutamate dehydrogenase. Regualtion of glutamate dehydrogenase and urea cycle – Regualtion of purine and pyrimidine nucleotide biosynthesis. Integration of metabolism - Key junction in metabolism: Glucose-6- Phosphate, pyruvate and acetyl CoA, metabolic profiles of major organs: Brain , Muscle, Liver and Adipose tissues.

References:

1. Regulation in metabolism –Newsholme
2. Principles of Biochemistry – White and others
3. Human Biochemistry – Frisell
4. Lubert Stryer, W.H. Freeman, 1995 - Biochemistry 5th Edition .
5. Robert K. Murray David Bender Kathleen M Botham , Peter J. Kennelly Victor W. Rodwell , P. Anthony Weil, , 2015,Harpers Illustrated Biochemistry 30th Edition.
6. Principle of Biochemistry - Lehninger Latest Edition
7. Biochemistry, Rafi, Universities Press

MICROBIAL BIOCHEMISTRY AND FERMENTATION TECHNOLOGY

UNIT I

Metabolic and energy yielding reactions of sugars – Transport of sugars into the bacterial cell. The bacterial phosphotransferase system. Transport of non-PTS sugars. Membrane bound transport systems- E.Coli lactose permease. Beta-methyl galactoside system. Pathways of glucose degradation: EMP and HMG pathways. Empten- Mayor Hoff and phospholtolase pathways. Aerobic pathways of pyruvate metabolism – TCA cycle, electron transport and glyoxalate cycle, analerosis utilization of one carbon and two carbon compound. Glycerate pathway – serine pathway and the cellulose pathway fermentation. Homolactic and heterolactic fermentation. Interrelationship of EMP, HMP and Entner-Doudoroff pathways.

UNIT II

Metabolism of lipids : Oxidation of fatty acids in microbes oxidation of fatty acids with odd number of carbon atoms; oxidation of branched chain fatty acids; oxidation of aliphatic and aromatic hydrocarbons, biosynthesis of straight chain and branched chain acids; biosynthesis of superchain fatty acids, glycerol dissimilation. Synthesis of triglycerols, phospholipids and glycolipids. Catabolism of phospholipids poly isoprenoid biosynthesis.

UNIT III

Microbial biosynthesis : Biosynthesis of cell wall, synthesis of storage polymers- Glycogen poly Beta hydroxybutyrate and polyphosphate – Secondary metabolites. Biosynthesis of patulin as an example photosynthesis; photosynthetic structures. Types of bacterial photosynthesis. Photosynthetic pigments; photosynthetic electron transport. Photophosphorylation. CO_2 fixation – Calvin and reductive carboxylic acid cycle. Distinction between prokaryotic and eukaryotic photosynthesis.

UNIT I V

Ferementation Technology : Bioreactor design; General techniques of inocula build up and scale-up fermentation; surface and submerged fermentation, solid substrate fermentation; cheap raw material as substrates. Industrial strain improvement, Growth kinetics. Downstream processing of biological separation of cell – foam separation – flocculation filtration – plate filters – rotary vaccum, membrane filtration – ultrafiltration and reverse osmosis chromatographic techniques – adsorption – adhesive spray drier – freeze drying.

UNIT V

Bacteria based Fermentation- acetic acid, propionic acid, lactic acid, streptomycin. Yeast based Fermentation : Yeast based fermentation Formic acid, beer, wine Fungal based: Citric acid, pencillin. Toxins – exo and endo toxins; Fungal toxins; Bacteriocins, Decomposition of organic matter in soli-cellulose, hemicelluloses, lignin and other polysaccharides. Extra cellular enzymes – Adaptation to environment.

References:

1. Biochemistry of Bacterial growth – Joel Mendelstram Keneth Mequil
2. Chemical microbiology – Rose
3. Molecular Biology – Freifielder
4. Microbial Technology – Pepper Vol. I and Vol. II
5. Owen, P.Ward, Modern Biotechnology - Prim Ros 2nd Edition.
6. Industrial Microbiology, L.E. Casida, JR, Recent Edition
7. Principles of Fermentation Technology, Stanbury, P.F., 2nd Edition, 2005.
8. Microbial Physiology and Metabolism, Caldwel,1995

PLANT BIOCHEMISTRY

UNIT I

Plant Cell : Structure. Composition and functions of plant cell organelles, including cell wall and cell membranes. Biosynthesis of cell wall. Plant cell and tissue culture. Transport mechanisms : water movement, ascent of sap, mechanisms for movement of solutes. Translocation in xylem and phloem.

UNIT II

Plant Nutrition : Essential nutrients – inorganic nutrients, their functions, deficient and toxicity symptoms. Nitrogen fixation; Biochemistry of nitrate assimilation – Structural features of Nitrate reductase, nitrite reductase and regulation - sulfur metabolism, sulfur activation and assimilation. Circadian rhythms.

UNIT III

Photosynthesis : Structure and composition of photosynthetic apparatus - light and dark reactions- Cyclic and Non Cyclic Photophosphorylations; Carbon dioxide fixation - C3, C4 and CAM pathways. Biosynthesis of sucrose and starch, Factors affecting the rate of photosynthesis. Photorespiration- Photosynthesis and plant productivity.

UNIT IV

Growth Regulators : Auxins, Gibberellins, cytokinins, ABA-Ethylene Metabolism, function and mechanism of action. Plant growth inhibitiors, Plant Stress, Plant responses to abiotic and biotic stresses Phytochemistry : Plant chemicals and their significance storage carbohydrates, proteins and fats. Secondary plant products and their economic importance – waxes; essential oils, phenolic glycosides, flavoens, anthocyanins and alkaloids. Biosynthesis of alkaloids, terphenoids, phenolics and pigments (general treatment only).

UNIT V

Biochemistry of plant diseases : Plant pathogenesis, initial stages of pathogenesis, mechanisms of pathogenesis – Mechanism of attack. Responses of plants to pathogens – pathological effects of respiration, photosynthesis, cell wall enzymes and water uptake. Disease-resistance mechanisms; phytoalexins. Biochemistry of pathogen specificity. Photomorphogenesis : Photoperiodism – phytochrome, its function in physiology and biochemistry of plant growth and development. Physiology of flowering. Physiology and

biochemistry of fruit ripening. Physiology and biochemistry of senescence. Biochemistry of seed germination.

References:

1. Plant biochemistry – Bonner, Varner.
2. Plant Biochemisty – Conn& stumpf
3. Introduction of plant biochemistry – Goddwin and MFRCER
4. Chloroplast metabolism – HalliWell
5. Photosynthesis – Harry wheeler
6. Pathogenesis – Harry wheeler
7. Plant physiology – Bidwell G S (2^{nd} Edition)

MAJOR ELECTIVE
MOLECULAR BIOLOGY AND GENETIC ENGINEERING

UNIT I

Introduction : DNA as the genetic material - Transformation, transduction, conjugation and recombination genetic code. Mutation: Types of mutations, mutagens, mutagenesis, mutational hot spots, reversion of mutation. DNA Replication- DNA polymerases: Binding proteins: DNA Ligases, topoisomerases and DNAases; Events in the replication fork; termination; regulation of replication – Replication of Bacterial viruses, animal virus and plasmids, mitochondrial DNA, chloroplast DNA. Reverse transcriptase. Antibiotics and replication

UNIT II

Transcription: Prokaryotic DNA dependent RNA polymerase- initiation, elongation and termination of transcription, Rho and sigma factors in transcription, Biosynthesis of mRNA; and tRNA- Maturation- post transcriptional processing. Control of transcription, antibiotics and transcription.

Translation: structure and composition of prokaryotic protein synthesis – amino acid activation, initiation, elongation and termination of post translational modification, control of translation inhibitors of protein synthesis.

UNIT III

DNA repair – photo reactivation, exclusion repair and recombination repair.

Genetic recombination: Types of recombination, breakage and rejoining to form hetero duplexes; exchange between homologous double stranded molecules; Holliday model for homologous recombination asymmetric strand. Transfer model transposable element: Type of bacterial transposition: Gene Regulation prokaryotes : The operon model; lac operon, Ala operon. Trp operon and His operon.

UNIT IV

Generation of DNA fragments for cloning restriction enzymes random shear, complementary DNA, synthetic DNA cloning Vector: Gene transfer vectors, expression vectors, Plasmid vectors – PBR 322 phages vectors – M13 filamentous phage, cosmids,

yeast vector – YIP (simple integrative and autonomous vectors) changing genes – site directed mutagenesis - Ligation of sticky ends, blunt end ligation, homopolymer tailing. Introduction of recombination DNA into host cells: *E.Coli,* yeast, plant cells, mammalian cells and embryo. Techniques involved in transfer of genes. Detection and characterization of recombinants: chromosomal walking, plus and minus screening. Immunochemical methods, hybridization methods – Hybrid release translation (HRT)

UNIT V

Gene manipulation of plants: Gene transfer through Agrobacterium tumefciens and R.Rizogenes: Protoplast fusion; Genetic manipulation in nitrogen fixation – common modulation genes, *Bacillus thruingeiensis*; products delta endotoxin, production of herbicide resistant plants; virus resistant plant; pest resistant plants; biofertilizers; cellulose degradation. Transgenic plants: Experimental procedures of producing transgenic plants. Production of Novel Proteins: Human Insulin, somatostatin interferons, vaccines, blood proteins, lymphokines. Transgenic animals: Method of production, expression of foreign DNA in transgenic mice. Gene therapy : Treating Adenosine Deaminase deficiency (combined immune deficiency).

References:

1. Molecular Biology - David Frifielder
2. Molecualr Biology of Gene – J.D. Watson (4^{th} edition)
3. DNA replication – Kornberg
4. Biochemistry of nucleic acids – Adams
5. Genes IV – Benjamin – Lewin
6. Impact of chemistry on Biotechnology – John Comstock
7. Biotechnology – old & primrose
8. Gene cloning – T.A.Brown
9. Genetic engineering – A.J. Kingman & other
10. Microbial technology – Peppler
11. From genes to clones – Winnacker, E.C. Vol 1987.

MICROBIOLOGY AND MOLECULAR BIOLOGY TECHNIQUES (PRACTICALS)

1. Preparation and use of glass wares, sterilization
2. Preparation of selection and simple microbial culture media
3. Propagation and maintenance of microbial cultures
4. Estimation of metabolites : hydrogen sulfide, acid production , NTG mutagenesis of *E.coli* and selection of drug resistant
5. Electrophoresis
   SDS-PAGE and Native PAGE
   Isolation of plasmid DNA
   Agarose gel electrophoresis
6. Isolation of genomic DNA animal tissue/coconut endosperm

7. Isolation of intact chloroplast and its DNA –Quatification, spectrophotometric analysis, Hyperchromic effect and Tm.
8. Preparation of competent cells.
9. Plasmid DNA transformation of cells amd transformation selection
10. Induction and measurement of β- galactosidase activity

SEMESTER III

IMMUNOCHEMISTRY

Unit I.

Types of immunity – innate and acquired. Humoral and cell mediated immunity. Immunity to infection: Immunological and non immunological surface protective mechanisms, antibacterial resistance antiviral resistance, interfection, antibacterial antigens, self antigens, MHC, Foreign antigen: Essential features of antigenicity – Factors that govern immune response, cross reactivity , Haptens, Tumor antigens, Viral antigens, Bacterial antigens. Cells that trap foreign material myeloid system, mononuclear phagocytic system. Inflammation: Acute and Chronic inflammation.

Unit II

Antibodies: Properties of antibody structure of IgG, isotopes, allotypes,, idiotype, classes, subclasses, Igs as antigens. Monoclonal antibodies (Hybridomas). Ag-Ab complex: chemical basis of Ag-Ab binding, affinity, valence, kinetics of Ag-Ab reactions. Theories of antibody formation; generation of antibody diversity; genetics. Complement system: components of complement activation and its biological consequences – classical, alternative and lectin pathways.

Unit III

Lymphocytes: T and B cells, Lymphocyte, mitogens, response of B cells to antigens.
Interaction between T and B cells. Macrophage co-operation, interleukins and other factors.
Triggering of B cells, plasma cells, memory cell. Response of T cells to antigens – antigens that provide T cell response lymphokines, interleukins, cytotoxicity.

Unit IV

Vaccination – passive and active immunization schedule, antibacterial, antitoxic and viral vaccines. Serology: precipitation, agglutination, immune-electrophoresis, fluorescent antibody techniques, RIA and ELISA. Allergy and hypersensitivity: type I, II, III and IV hypersensitivity unsual and adverse to drugs, drug discovery, drug intolerance.

Unit V

Transplantaion – graft rejection, transplantation antigens, HLA mechanism of graft rejection, prevention of graft rejection, immune suppressive agents immune surveillance.
Acute intolerance (tachyphyrais)
Autoimmunity: mechanism of break down : rheumatoid arthritis; myasthenia gravis, immunity and aging, disorders of immunoglobulin synthesis.

Reference:

1. Immunology (2007) Kuby 6th edition.
2. ROITT's Essential Immunology(2002) Wiley publication 12th edition.

3. L Cooper. Marcel Dekkar (1984) stress, immunity of ageing.
4. Biomedical Methods Hand Book-John M. WalksetRalph Raplay. Humana Press, 2005. Elements of Medical Genetics. II th edition-Muller, Young - Churchill Livingstone, 2002.

5. Nucleic Acid Testing for Human Diseases. Ed. Attila Lorincz. Taylor and Francis Publishers(CRC, NY), 2006.
6. George P. Patrinos, Wilhelm Ansorge, (2009). Molecular Diagnostics.
7. Immunology - A introduction – Tizard
8. Essential immunology – ROITT
9. Stress, immunity of ageing – L Cooper. Marcel Dekkar
10. Immunology – Kannan. MJP Publishers Edition: 2013

BIOSTATISTICS & BIOINFORMATICS (An introductory level)

Unit I

Descriptive statistics and relationship at quantitative variables. Frequency distribution. Diagrammatic and graphics presentation of data. Measurement of central value – mean, median and mode. Measurement of variation – standard deviation and coefficient of variation. Skewness and kurtosis (measurement only). Simple correlation, scatter diagram method. Karl pearson's co – efficient of correlation, rank correlation coefficient , concurrent deviation method. Simple, linear regression, regression equatory and regression lines.

Unit II

Events – probability – addition rule, multiplication rule and conditional rule. Counting methods, permutation and combination. Binomial distribution- random variables properties constant, and importance of binomial distribution . poisons distribution, fitting a poisson distribution – normal distribution, importance, properties, area under normal curve.

Unit III

Interference, estimation and hypothesis testing, Sampling statistics and parameters – sampling distribution of the sample mean, standard error. Confidence interval for the population mean. One and two tail test – level of significance – two group comparisons – students 't' method – paired data. Analysis of frequencies and analysis of variance, X^2 - test and association of attributes , goodness of fit.One way classification and two way classification. Use of Statistics in Research methodology : concept of research, prerequisites of research.

Unit IV

Introduction to structural database: Different structural organization of DNA carbohydrates and protein. Biological databases – general nucleic acid sequence data base – FASTA format – GEN bank – EMBL – Swissprot – TrEMBL – DDBJ – specialized sequence data base. Use of database in biology- principles, examples, database searching and applications,

sequence analysis. Structural Biology: Protein three dimensional structure predictions using experimental X-Ray, NMR and computational methods. Molecular dynamics – concept, calculation, software usage.

Unit V

Homology and diversity – evolutionary basis of sequence alignment, global local alignment – searching for similarity – Dot matrix representation – distance measurements – PAM 250, BLOSUM gap penalty- phylogenetic analysis – basic PERL component and function. High throughput genomics and proteomics.

References:

1. Statistical methods – S.P GUPTA
2. Biostatistics – A formation for analysis in health sciences – DANIEL
3. Bioinformatics Sequence, structure and databanks(2003)- Des Higgins, Willie Taylor
4. Research methodology – R.C KOTHARI
5. Biostatistics (2013) – A formation for analysis in health sciences – DANIEL 9th edition.
6. Instant Notes- Bioinformatics(2003)--- D.R. Westhead, J.H Parish and R.M.Twyman
7. Bioinformatics- Sequence and Genome analysis(2004)- David W Mount (Second Edition)
8. Basic Bioinformaics – Ignacimuthu, 2nd Edition, 2008

EUKARYOTIC GENE EXPRESSION

Unit I

Eukaryotic genome organization chromatin structure nucleosomes – heterochromatin – euchromatin repeat sequences – cot curve analysis – structural DNA sequences – complexity frequency of repetition

Unit II

Eukaryotic gene replication –Topisomerases & various enzymes – DNA repair- role of histones. Gene expression - active chromatin – inactive chromatin. DNA methylation – non histone proteins - Dnase activity. Difference between Prokaryotic and Eukaryotic replication

Unit III

Transcription – precursor – polyadenylation, capping – processing – splicing – editing regulation of transcription – promoters – cis regulatory elements., enhancers, activators-transacting proteins. Role of polyadenylation – maternal stored messengers. Difference between Prokaryotic and Eukaryotic transcription.

Unit IV

Translation – genetic code Eukaryoitc ribosomes and ribosomal RNA translational apparatus – polysomes – post transalation modification – Secretory proteins signal hypothesis – glycosylation. Modualotrs of eukaryotic gene expression – signal transduction mechanisms

oncogenes – hormones, Ca^{2+}, cyclic AMP, metal – heat shock proteins. Difference between Prokaryotic and Eukaryotic translation.

Unit V

Genetic and physical maps, physical mapping and map –based cloning. Southern and fluorescence *in situ* hybridization for genome analysis. Different microarray techniques. BAC arrays, cDNA array, oligo arrays, SNP arrays, Probe selection strategies for microarrays.Limitations of microarrays. DNA sequencing: Dideoxy sequencing method. Automated DNA sequencing & Next generation sequencing.

References

1. Gilbert, S.F. 2014. Developmental Biology ,Sinauer Associates, Incorporated
2. Watson, Baker, Bell Gann.2004 Molecular Biology of the Gene 5 th Edition.
3. Hodge, R. 2009. Developmental Biology: From a Cell to an Organism Infobase Publishing.
4. O'Day, D. 2012. Human Developmental Biology eBookIt.com.
5. Slack, J.M.W. 2012. Essential Developmental Biology,John Wiley & Sons.
6. Benjamin Lewin – Genes Vol.VI
7. Cellular and molecular biology – Baltimore, Darnell & Lodish
8. Molecular biology of the gene – J.D Watson.
9. Genomes – T A Brown, 3rd Edition, 2006.

NON-MAJOR ELECTIVE
CLINICAL BIOCHEMISTRY (BASICS)

UNIT I

Diagnostic importance of urine and hematological parameters: Volume, reducing sugar, Albumin Deposits, pH, Bile salts and bile pigments. Complete haematogram.

UNIT II

Diagnostic importance of blood parameters: Glucose, plasma proteins, urea, creatinine, cholesterol, Uric acid, calcium, phosphorus, electrolytes and diagnostic enzymes.

UNIT III

Biochemistry of Diseases : Diabetes mellitus, Myocardial infarction, Renal failure, Liver failure, Vitamins, minerals and nutrition disorders.

UNIT IV

Genetic Information about diseases : Oncogenes and cancer , inborn errors of metabolism-Recombinant proteins- insulin , growth hormone, albumin , Streptokinase, erythropoitein.

UNIT V

Clinical Chemistry Analyzers : Principles and application of Glucometer, Colorimeter, pH meter, flame photo meter, ELISA, Urine analysis strips. Blood and urine collection, anti coagulants, preservation methods.

References

1. Clinical Biochemistry – Tietz
2. Practical Biochemistry – Harold Varley
3. Immunology – Roit
4. Clinical Biochemistry – Chartterjee
5. Haematology – Ramnik Sood

ADVANCED BIOCHEMISTRY PRACTICALS

1. Western blot analysis – commercial kit, demonstration
2. Restriction analysis and physical mapping of pBR322
3. Southern blot - restriction digest – plasmid pUC 18, hybridize with pBR322
4. Expression of cyt C plasmid in liver,
5. Cloning of DNA fragment in blue script and selecting the clones based on blue, white selection – releasing the fragment / analysis of recombinant plasmid
6. Antibody titre determination.
7. Immunodiffusion.

References

1. Basic DNA and RNA protocols, Adrian .J. Harywood, Human press 1996
2. Cloning vectors – A laboratory manual Vol. I and II , Pauwels PH. Enger BE, Brammar WJ Elsevier scientific publication – 1985
3. DNA cloning Vol 1- 4 - A practical approach . Glover DM and hames SRC press 1995
4. Experimental techniques in bacterial genetics, stanley R. Maloy Jones and Bartlett – 1990
5. PCR technology - principles and application for DNA amplification Henry A. Relish Stockton press, New York 18/989
6. Short Protocols in molecular biology, Sambrook.
7. Short protocols in molecular biology, Ausubel et al Jhon wiley and sons 1992.

SEMESTER IV
ENVIRONMENTAL BIOCHEMISTRY

Unit I

Introduction to environmental biochemistry, organisms and stress factors, temperature as a factor – cold exposure and acclimatization . metabolic deification's role of hormone and nervous system. Heat exposure and adaptation to heat. Pressure a factor –Low pressure and its effects. Enzymes, metabolic rhythms and environment.

Unit II

Air pollution : types of air pollutants. Source effects of vegetation animals and human death; control treatment. Water pollution – sources, effect of pollution on lakes and oceans, water

quality. Land pollutants and their biochemical effects. Solid waste – characteristics of municipal waste: disposal; hazardous waste. Noise pollution and their biological effects.

Unit III

Industrial pollution : sources, characteristics of industrial effluents; general treatment of industrial effluents; collection and analysis of industrial samples. removal of waste water from sugar industry, paper industry, pesticides and tannery industry. Instruments methods fro monitoring industrial pollutants. Marine pollution – pollutants, sources; effects oil pollution control. Thermal pollution : sources : effects and preservation

Unit IV

Pesticides : systemic and non systemic pesticides, structure, mode of action and applications. Behavior in soils, degradation of pesticides by microorganisms, problems of pollution by pesticides. Environmental risks of direct and indirect food additives, foot colors and other contaminants. Occurrence of pesticides in foods.

Unit V

Environmental carcinogens – chemical carcinogens, classification and mode of action, reactions of chemical carcinogens with living systems. Environmental teratogens – teratogenic effects, mechanism of action of teratogens. Environmental mutagens and their effects. Effects of radiation – sources of radiation; radioactive wastes; misshape; waste management. Plastics – industrial and laboratory hazards of plastics and their decomposition.

References:

1. Environmental pollution and control – Vesilind & peirce
2. Air pollution and control – Mouli & subayya
3. Biotechnology and waste water treatment – Fopster
4. Industrial pollution – Kudesia
5. Environmental pollution – Katyal
6. Concepts in radiation cell biology – Grayl whiston
7. Radiation and life – Eric J hall
8. Biochemical effects of environmental pollutants – SSD.LEE
9. Pesticides – R. Cremlyn
10. Toxicology – Klaasseen

CLINICAL BIOCHEMISTRY

Unit I

Disorders of carbohydrate metabolism - Blood sugar level in normal blood, renal threshold, hyper and hypoglycemia and glycosuria – modified glucose tolerance tests – laboratory diagnosis of early and latent diabetes, diabetis coma, secondary degenerative changes associated with diabetes mellitus, glycogen storage disease. Galactosemia, fractosuria, pentosuria, lactose intolerance, hypoglycemic agents.Disorders in lipid metabolism: lipid metabolism in liver and adipose tissue, plasma lipoproteins and hyper lipoproteinemia hyper cholesterolaemia and experimental production in animals, lipedemia associated with ketosis, nephritic syndrome, thyroid disease and liver disease – fatty liver, atherosclerosis and obesity.

Unit II

Disorders of amino acid metabolism - tyrosine, phenylalanine, tryptophan and cysteine – fanconi syndrome. Disorders of protein metabolism – protein deficiency, plasma proteins, significance and variation in diseases – serum mycoprotein, cryoglobulins and cellular enzymes in serum, gama gobulinemia in multiple myeloma, proteinuria. Haemophillia, thalessemia, sickle cell anemia and Wilson's disease. Liver diseases : liver function tests, laboratory findings in jaundice. Criggler Najjar syndrome, cirrhosis, hepatic coma, types of jaundice and diagnosis.

Unit II

Disorders of carbohydrate metabolism - Blood sugar level in normal blood, renal threshold, hyper and hypoglycemia and glycosuria – modified glucose tolerance tests – laboratory diagnosis of early and latent diabetes, diabetis coma, secondary degenerative changes associated with diabetes mellitus, glycogen storage disease. Galactosemia, fractosuria, pentosuria, lactose intolerance, hypoglycemic agents.
Disorders in lipid metabolism: lipid metabolism in liver and adipose tissue, plasma lipoproteins and hyper lipoproteinemia hyper cholesterolaemia and experimental production in animals, lipedemia associated with ketosis, nephritic syndrome, thyroid disease and liver disease – fatty liver, atherosclerosis and obesity.

Unit III

Disorders of nucleic acid metabolism: Gout – primary and secondary. Body fluids : C – reactive protein test, rheumatoid arthritis (RA), immunologic test for pregnancy. Hematology: E.S.R screening test fro sickle cell anemia, prothrombin time. Blood transfusion blood collection and processing and transfusion process. Cerebrospinal fluid (CSF) : composition, clinical investigation of CSF in meningitis, convulsive stages, cerebral hemorrhage and thrombosis. Amniotic fluid: origin, composition, analysis of amniotic fluid.

Unit IV

Kidney and urine:Diabetes insipidus, and renal function in infant, kidney and its relation to blood pressure. Routine qualitative analysis of urine and urinary sediments –renal function test – free water clearances, renal function in acute and chronic glomerulonephritis, acute and chronic renal failure, laboratory tests for peritoneal and hemodialysis. Renal calculi, analysis stress, biochemical findings in recurrence of stones abnormal constitutent of urine of diagnoatic significance (blood, billirubin, ketone bodies, bile salts, porphyrin, uric acid and protein.

Unit V

Gastro intestinal disorders: ulcers, peptic ulcel, gastric ulcer, physiology related to peptic ulcer duodenal ulcer clinical features and medical treatment appendicitis pathophysiology and diagnosis. Disorders of mineral metabolism – Ca,P,Fe and electrolytes and trace elements

References

1. Principles of internal medicine – Harison.
2. Medical laboratory technology Vo. I, II, III – Kanai L. Mukkerje
3. Clinical biochemistry – Varely
4. Clinical chemistry – Normal Tiez
5. Biochemistry – Devlin
6. Text book of Medical Biochemistry – Chatergee
7. Text Book of Medical Physiology – Guyton, 8th Edition