MAHATMA GANDHI UNIVERSITY,

PRIYADARSHINI HILLS, KOTTAYAM-686560

Scheme & Syllabus for Undergraduate Programme in Biochemistry

Under

Choice Based Credit System

With Effect from 2017 Admission

MAHATMA GANDHI UNIVERSITY, KOTTAYAM

Undergraduate Programme in Biochemistry (Model I)

Scheme &Syllabus

CONTENTS

ACKNOWLEDGEMENT

The Expert Committee in Biochemistry (UG) and Faculty of Sciences acknowledges honourable Vice Chancellor of Mahatma Gandhi University, for the help and guidance extended during the syllabus restructuring of B.Sc Biochemistry Programme.

We thank Pro Vice Chancellor of Mahatma Gandhi University, for the valuable suggestions.

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THANK YOU

Expert Committee in Biochemistry (UG) and Faculty of Sciences

Kottayam

02-05-2017

INTRODUCTION

The Undergraduate Programme in Biochemistry explores the chemistry of living organisms and the molecular basis for the changes occurring in living cells. It uses the methods of chemistry, physics, molecular biology and immunology to study the structure and behaviour of the complex molecules found in biological material and the ways these molecules interact and communicate within and between cells and organs. The biochemist seeks to determine how specific molecules such as proteins, nucleic acids, lipids, vitamins and hormones function in such processes.

Biochemistry has provided explanations for the causes of many diseases in humans, animals and plants. It can frequently suggest ways by which such diseases may be treated or cured. Biochemistry seeks to unravel the complex chemical reactions that occur in a wide variety of life forms and provides the basis for practical advances in medicine, veterinary medicine, agriculture and biotechnology. It underlies and includes exciting new fields such as molecular genetics and bioengineering.

As the broadest of the basic sciences, biochemistry includes many subspecialties such as neurochemistry, bioorganic chemistry, clinical biochemistry, physical biochemistry, molecular genetics, biochemical pharmacology and immunochemistry. Recent advances in these areas have created links among technology, chemical engineering and biochemistry.

All the core papers in the curriculum must be handled by postgraduates in Biochemistry as per UGC regulations.

AIMS AND OBJECTIVES

The Course aims to prepare students:

- To acquire and apply the relevant biochemical information in order to solve potential biomedical problems.
- Provide students with basic theoretical and practical knowledge of the principal methodologies and techniques for investigation of biomolecules; which can be applied to the investigation and measurement of cell functions.
- Assist students in understanding the scientific methods and help them to develop observation and critical analysis skills, collection, evaluation and classification of data; deducing conclusions; formulating hypotheses.
- Assist students in developing self-learning and the ability to keep knowledge and skills up to date; team work and communication.

The objective of the Course is to provide students with sufficient knowledge of biomolecular structure to understand the determining properties of biological function at the level of cells and the body. This will allow students at a later stage:

- To understand physiology and physiopathology at the molecular level; the molecular basis of diagnosis, therapeutics, disease prevention and health promotion.
- Become familiar with and understand the basic structures and functions of cells in the human body, applying biomedical concepts and terminology.
- Apply biochemical analysis and reasoning in order to solve problems related to physiology and cellular physiopathology.
- Learn to use a biochemical approach in the study of cellular functions that will provide an understanding of future advances in the molecular basis of physiology, physiopathology, diagnostics, therapeutics, disease prevention, health promotion and the continuous updating of knowledge.

ELIGIBILITY CRITERIA FOR ADMISSION TO B. SC. BIOCHEMISTRY PROGRAMME

Pass in plus two or equivalent with biology as a subject or vocational higher secondary in any biological/paramedical/agricultural /related branch.

DURATION OF COURSE

- The duration of U.G. programme in Biochemistry shall be ***6 semesters***.
- There shall be two Semesters in an academic year, the 'ODD' semester commences in June and on completion, the 'EVEN' Semester commences after a semester-break of three days with two months vacation during April and May. (The commencement of first semester may be delayed owing to the finalization of the admission processes.)

A student may be permitted to complete the Programme, on valid reasons, within a period of 12 continuous semesters from the date of commencement of the first semester of the programme.

EVALUATION OF PROJECT

Project- All students are to do a **project in the area of core course.** This project can be done individually or in groups (not more than five students) for all subjects which may be carried out in or outside the campus. The projects are to be identified during the II semester of the programme with the help of the supervising teacher. The report of the project in duplicate is to be submitted to the department at the sixth semester and are to be produced before the examiners appointed by the University. External Project evaluation and Viva / Presentation is compulsory for all subjects and will be conducted at the end of the programme. Along with project report, a report of visit to a research institute/industry must be submitted during the viva.

CONDUCT OF PRACTICAL EXAMINATIONS

Practical examinations will be conducted and evaluated at the end of Even Semesters by a team consisting of an external examiner and internal examiner

Mahatma Gandhi University

B.Sc. Course in Biochemistry (model I) under Choice Based Credit System

Consolidated scheme for all semesters

(Modified scheme)

Theory and project work

Semester	Title with Course Code	Course Category	Hours / week	Credit	Total Credit	Marks	
						Internal	External
First Semester	English I	Common	5	4	17	20	80
	English II	Common	4	3		20	80
	Second Language I	Common	4	4		20	80
	BC1CRT01- Methodology and Evolution of Biochemistry	**Core**	2	2		15	60
	First complementary course I	complementary	2	2		15	60
	Second complementary course I	complementary	2	2		15	60
Second Semester	English III	Common	5	4	17	20	80
	English IV	Common	4	3		20	80
	Second language II	Common	4	4		20	80
	BC2CRT02- Physical aspects of Biochemistry	**Core**	2	2		15	60
	First complementary course II	complementary	2	2		15	60
	Second complementary course II	complementary	2	2		15	60
Third Semester	English V	Common	5	4	17	20	80
	Second language III	Common	5	4		20	80
	BC3CRT03- Methods in Biochemistry	**Core**	3	3		15	60
	First complementary course III	complementary	3	3		15	60
	Second complementary course III	complementary	3	3		15	60
Fourth Semester	English VI	Common	5	4	17	20	80
	Second language IV	Common	5	4		20	80
	BC4CRT04- Biomolecules	**Core**	3	3		15	60
	First complementary course IV	complementary	3	3		15	60
	Second complementary course IV	complementary	3	3		15	60
Fifth Semester	**BC5CRT05- Physiological Aspects of Biochemistry**	**Core**	3	3	16	15	60
	BC5CRT06- Environmental Biochemistry and human rights	**Core**	4	4		15	60

	BC5CRT07-Enzymology and Enzyme Technology	**Core**	3	3		15	60
	BC5CRT08-Metabolism and Bioenergetics	**Core**	3	3		15	60
	Open course: (Three options for the College to choose from) **BC5OP01- Human Health and Nutrition** **BC5OP02- Life style Diseases** **BC5OPT03-Nutritional Biochemistry**	**Core**	4	3		15	60
	Project work	**Core**	Nil	Nil		No Evaluation	
Sixth Semester	**BC6CRT09- Molecular Biology and Genetic Engineering**	**Core**	3	3	16	15	60
	BC6CRT10- Clinical Biochemistry	**Core**	3	3		15	60
	BC6CRT11- Pharmaceutical Biochemistry	**Core**	3	3		15	60
	BC6CRT12- Computational Techniques in Biochemistry	**Core**	3	3		15	60
	Choice based paper I (One among the Three papers students can choose from) **BC6CBT01- Immunology and Immunological Techniques** **BC6CBT02- Biochemical Toxicology** **BC6CBT03- Plant Biochemistry**	**Core**	4	3		15	60
	BC6PRP01-Project work	**Core**	Nil	1		20	80

Project work is a single course spread over fifth and sixth semesters having both internal and external evaluation which will be conducted at the end of the programme.

Note: Along with project report, a report of visit to a research institute/industry must be submitted during the viva.

Choice based open course offered to students of other Departments (V^{th} Semester)

BC5OP01- Human Health and Nutrition- 3 Credits

BC5OP02- Life style Diseases- 3 Credits

BC5OP03-Nutritional Biochemistry- 3 Credits

Choice based core course offered to students of Department of Biochemistry (VI^{th} Semester)

BC6CBT01- Immunology and Immunological Techniques- 3 credits

BC6CBT02- Biochemical Toxicology- 3 credits

BC6CBT03- Plant Biochemistry- 3 credits

Practical

Semester	Title with Course Code	Course Category	Hours / week	Credit	Total Credit	Marks	
						Internal	External
First Semester	**Practical I - Methodology and Evolution of Biochemistry**	**Core**	2	1	3	No Exam	
	First complementary practical I	complementary	2	1			
	Second complementary practical I	complementary	2	1			
Second Semester	**BC2CRP01-Practical II- Physical aspects of Biochemistry**	**Core**	2	1	3	10	40
	First complementary practical II	complementary	2	1		10	40
	Second complementary practical II	complementary	2	1		10	40
Third Semester	**Practical III-Methods in Biochemistry**	**Core**	2	1	3	No Exam	
	First complementary practical III	complementary	2	1			
	Second complementary practical III	complementary	2	1			
Fourth Semester	**BC4CRP02 -Practical IV- Biomolecules**	**Core**	2	1	3	10	40
	First complementary practical IV	complementary	2	1		10	40
	Second complementary practical IV	complementary	2	1		10	40
Fifth Semester	**Practical V-Physiological Aspects of Biochemistry**	**Core**	2	1	4	No Exam	
	Practical VI- Environmental Biochemistry and human rights	**Core**	1	1			
	Practical VII- Enzymology and Enzyme Technology	**Core**	2	1			
	Practical VIII- Metabolism and Bioenergetics	**Core**	3	1			
Sixth Semester	**BC6CRP03-Practical IX- Molecular Biology and Genetic Engineering**	**Core**	2	1	4	10	40
	BC6CRP04-Practical X- Clinical Biochemistry	**Core**	3	1		10	40
	BC6CRP05-Practical XI- Pharmaceutical Biochemistry	**Core**	2	1		10	40
	BC6CRP06-Practical XII- Computational Techniques in Biochemistry	**Core**	2	1		10	40

Consolidated scheme for courses (Model I, II & III) having Biochemistry as a complementary course

Theory

Semester	Title with Course Code	Course Category	Hours/ week	Credit	Total Credit	Marks	
						Internal	External
First	BC1CMT01-Elementary Biochemistry	Complementary	2	2	10	15	60
Second	BC2CMT02- Biomolecules	Complementary	2	2		15	60
Third	BC3CMT03-Enzymology and Metabolism	Complementary	3	3		15	60
Fourth	BC4CMT04- Nutritional and Clinical Biochemistry	Complementary	3	3		15	60

Practical

Semester	Title with Course Code	Course Category	Hours/ week	Credit	Total Credit	Marks %	
						Internal	External
First	Practical I-Elementary Biochemistry	Complementary	2	1	4	No Exam	
Second	BC2CMP01- Practical II-Biomolecules	Complementary	2	1		10	40
Third	Practical III-Enzymology and Metabolism	Complementary	2	1		No Exam	
Fourth	BC4CMP02- Practical IV-Nutritional and Clinical Biochemistry	Complementary	2	1		10	40

Syllabus for B.Sc. Biochemistry-Core

FIRST SEMESTER

Core Course I: BC1CRT01-Methodology and Evolution of Biochemistry

Total hours of instruction: 36. Hours/week: 2. Credit: 2

Objective: To provide an in-depth understanding on the origin and history of biochemistry and to build the basic foundation for studying biochemistry. To familiarize the student with the varied branches of biochemistry and biostatistics.

Unit I: (6 hours)

Introduction to Philosophy of Science - Relationship between History and Philosophy of Science What is Science; laws of science, Formulation of hypothesis; hypothetico-deductive model, inductive model. Access to methodologically based biochemical literature-monographs and series, reference works and handbooks, literature searches, internet as an information resource, documentation of practical work.

Ref: Biochemical methods by Pingoud A, Urbanke C, Hoggett J and Jeltsch A,Chapter 1

Unit II:(6 hours)

History of biochemistry, Contributions of several scientists to biochemistry-Edward Buchner, Francis Crick, James Watson, Emil Fischer, Otto Meyerhoff, Franz Knoop, Hans Kreb, Francis Jacob & Jacques Monod – their discoveries and the classical experiments associated with them. Historical resume-Lavoisier, Fohler, Mechevreul, Emil Fischer,Louis Pasteur, Krebs, Sanger,Watson,Crick,Michaels,Menton etc.

Ref: A history of the Life Sciences: Magner L N 2nd edition, Marcel Dekker, Inc

Text book of Biochemistry: E.S.West, W.R.Todd, H.S. Mason and J.T. Van Bruggen

Unit III: (10 hours)

Definition-Branches of Biochemistry, Brief study of the foundations of biochemistry (cellular, chemical and physical foundationsfundamental study only). Biochemistry as a Molecular Logic of living organism-role and scope of Biochemistry, inter disciplinary areas involving biochemistry, nanotechnology and biotechnology. Biochemistry in service to man-drugs-flavoring agents, enzymes, nutritional supplements, GM Foods

Ref: Text book of Biochemistry: E.S.West, W.R.Todd, H.S. Mason and J.T. Van Bruggen

Unit IV (6 hours)

Fundamentals of biophysical chemistry: Water-structure-properties-weak interactions in aqueous solutions-hydrogen bonding between water molecules- Vander Waal interactions-

Role of water in life .Solutions-Normality-Molarity- Molality, percentage solutions, mole fraction, Simple numerical problems

Ref: Text book of biochemistry, J L Jain S. chand and company Ltd.NewDelhi.

Principles of Inorganic Chemistry, B R Puri, L R Sharma,Kalia MilestonePublishers, NewDelhi -chapter 40

Unit V- (8 hours)

Overview of information technology: Features of modern personal computer and peripherals computer networks and Internet -Overview of operating system and major applications of software. Academic search techniques –, plagiarism - Introduction to use of IT in teaching and learning. Power point features and slide preparation.

Ref: Principles of Biochemistry, by Albert Lehninger, David L Nelson, Michael M Cox, CBSPublishers & Distributors Delhi ISBN 81-239-0295-6

Core Practical I- Methodology and Evolution of Biochemistry

Total hours of instruction: 36 Hours/week: 2. Credit: 1

Objective: To build the basic foundation for studying biochemistry

1. Familiarization of Biochemical Laboratory

2. Preparation of solutions:
   a) Percentage solutions,
   b) Molar solutions
   c) Normal solutions

3. Simple problems for preparation of solutions

References

1. Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p 1- 15
2. Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p 465 –471
3. Hawk's Physiological Chemistry, Bernard L. Oser (ed) TATA McGRAW Hill Publishing Company LTD, New Delhi, p 10- 15.
4. Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8, p 13- 17, p 39 - 43

SECOND SEMESTER

Core Course II: BC2CRT02- Physical aspects of Biochemistry

Total hours of instruction: 36. Hours/week: 2. Credit: 2

Objectives: Introduce the student to basic concepts of acid and bases and its importance in biological systems, colloidal systems and it applications, measuring concentrations of solutions, understanding the principle of different types of reactions and basics of thermodynamics as applied to biological system

Unit-I: (8 hours)

Dissociation of water, ionic product of water, concepts of pH, pOH, simple numerical problems of pH, determination of pH using indicators, pH meter and theoretical calculations. Dissociation of weak acids and electrolytes, Brönsted theory of acids and bases, shapes of titration curve of strong and weak acids and bases. Meaning of Ka and pKa values, Buffers: buffer action, buffers in biological system, Henderson -Hasselbach equation with derivation, simple numerical problems involving application of this equation.

Ref: Biochemistry: A Students survival Guide by Hiram. F. Gilbert (2002) Publishers: McGraw-Hill ISBN 0-07-135657-6 p 241

Unit II: (8 hours)

Meaning of true solution, colloidal solution, and coarse suspension.Distinction between lyophilic and lyophobic sols, Fundamental study of Donnan equilibrium- application in biological system, membrane permeability, separation of colloidal particles, elementary study of charge on colloids, Tyndall effect, application of colloidal chemistry, emulsion and emulsifying agents.

Ref: Introduction to Biophysics by Pranab Kumar Banerjee (2008) Publishers: S. Chand& Company ltd ISBN: 81-219-3016-2 p 32

Unit III: (8hours)

Meaning of normality, molarity, molality, percentage solution, mole fractions, simple numerical problems from the above, Fundamental principles of diffusion and osmosis, definition of osmotic pressure, isotonic, hypotonic and hypertonic solutions, Biological importance of osmosis, General equation for dilute solutions, influence of ionization and molecular size on osmotic pressure.

Ref: - Introduction to Biophysics by Pranab Kumar Banerjee (2008) Publishers: S. Chand& Company ltd ISBN: 81-219-3016-2 p 21

Unit IV: (4 hours)

Classification of isomerism, oxidation reduction reactions, substitution, addition, elimination, condensation and decarboxylation with examples for each, Intra and Intermolecular interactions in biological system: Hydrogen bond, Covalent bond, hydrophobic interaction, disulphide bond, Peptide bonds, glycosidic bond, Phosphodiester linkage, Watson- Crick base pairings, Vander Wall's force.

Ref: Introduction to Biophysics by Pranab Kumar Banerjee (2008) Publishers: S. Chand& Company ltd ISBN: 81-219-3016-2 p 74

Unit V: (8 hours)

Introduction to chemical kinetics, equilibrium reactions, law of mass action, equilibrium constant, definition of catalysis, Basic principles of thermodynamics: free energy, enthalpy, entropy, reversible and irreversible reactions- as applied to biological systems.

Ref: Biochemistry: A Students survival Guide by Hiram. F. Gilbert (2002) Publishers:McGraw-Hill ISBN 0-07-135657-6 p 261

Ref: - Introduction to Biophysics by Pranab Kumar Banerjee (2008) Publishers: S. Chand& Company ltd ISBN: 81-219-3016-2 p 217

Suggested Readings

1. E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, A Text Book of Biochemistry, Oxford and IBH Publishing Co., New Delhi, 1974
2. Lehninger Principles of Biochemistry, Fourth Edition by David L. Nelson Michael M. Cox Publisher: W. H. Freeman; Fourth Edition edition (April 23, 2004) ISBN-10: 0716743396 ISBN-13: 978-0716743392
3. PrinciplesofPhysical Chemistry (2008) by Puri Br, Sharma Lr, Madan S Pathania Vishal Publishing Co, India ISBN: 8188646008ISBN-13: 9788188646005, 978-8188646005
4. TextbookOfMedicalBiochemistry (thirdEdition) (2001) by S.Ramakrishnan Publisher: OrientLongman ISBN: 8125020713, ISBN-13: 9788125020714, 978-8125020714
5. Biochemistry: A Students survival Guide by Hiram. F. Gilbert (2002) Publishers: McGraw-Hill ISBN 0-07-135657-6

Core Practical II-BC2CRP01- Physical aspects of Biochemistry

Total hours of instruction: 36 Hours/week: 2. Credit: 1

Objective: To Resolve quantitative problems concerning the preparation ofsolutions and buffers. Have a basic understanding of principles underlying membrane potential.

1. Preparation of solutions:
   Percentage solutions, Molar solutions, Normal solutions, Dilution of Stock solutions
2. Standardization of pH meter.
3. Measurements of pH of solutions using pH meters.
4. Preparation of buffers using the Henderson Hasselbach equation
5. Experiments with colloidal gels
   - Dialysis (Diffusion through membranes)
   - Diffusion through gels
6. Experiments on Donnan Equillibrium
   - Demonstration of Donnan equilibrium using a membrane
   - Demonstration of Donnan equilibrium without using a membrane

References

1. Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p 1- 15
2. Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p 465 –471
3. Hawk's Physiological Chemistry, Bernard L. Oser (ed) TATA McGRAW Hill Publishing Company LTD, New Delhi, p 10- 15.
4. Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8, p 13- 17, p 39 – 43

THIRD SEMESTER

Core Course III: BC3CRT03- Methods in Biochemistry

Total hours of instruction: 54. Hours/week: 3. Credit: 3

Objective: Explain the basis and general methodology of the molecular separation techniques specified in the course. Explain the application of these techniques to the separation of mixtures with known compositions. Explain the basis and general methodology of the molecular characterization techniques and to introduce students to basics of Bioinformatics and Research methodology

Unit I: (14 hours)

Research methodology and Biostatistics: Methodology of scientific research, nature of scientific methods, design of experiments in biochemistry, significance of statistical methods in biological investigations, sampling techniques, statistical evaluation of results, probability theory, random variables and distribution function, point and interval estimation, multiple linear regression, correlation and analysis of variance and covariance, distribution of student's t-test, Chi-square (X^2), correlation coefficient (r), Computer statistical packages for statistical analysis.

Ref: An Introduction to Biostatistics: A Manual for students in Health Sciences
By P.Sundar Rao, J.Richard Publishers: Prentice-Hall Pvt Ltd ISBN 81-203-1008-X

Unit II: (10 hours)

Chromatography: - principle, procedure and application of partition chromatography, adsorption chromatography, and ion exchange chromatography, gel permeation chromatography, affinity chromatography, GLC and HPLC.

Ref: Introduction to Biophysics by Pranab Kumar Banerjee (2008) Publishers: S. Chand&Company Ltd ISBN: 81-219-3016-2 p 183

Unit III: (10 hours)

Electrophoresis: - Principle, procedure and application of free flow, zone electrophoresis (Paper electrophoresis, Gel electrophoresis, Native PAGE, SDS-PAGE, AGE). Isoelectricfocussing, High voltage electrophoresis, Immunoelectrophoresis.

Ref: Introduction to Biophysics by Pranab Kumar Banerjee (2008) Publishers: S. Chand & Company ltd ISBN: 81-219-3016-2 p 197

Unit IV: (10 hours)

Methods of tissue homogenization, Salt and organic solvent extraction and fractionation, Dialysis, ultra filtration, lyophilization, Centrifugation- principle of sedimentation technique. Different types of centrifuge and rotors, Principle, procedure and application of differential centrifugation, density gradient centrifugation, ultracentrifugation, isopycnic centrifugation.

Ref: Introduction to Biophysics by Pranab Kumar Banerjee (2008) Publishers: S. Chand& Company ltd ISBN: 81-219-3016-2 p 177

Unit V: (10 hours)

Colorimetry and Spectrophotometry: - Beer - Lambert's law, UV and visible absorption spectra, molar extinction coefficient and quantitation. Principle of colorimetry, spectrophotometry, nephelometry, fluorimetry, Atomic absorption and emission spectrophotometry.

Ref: Introduction to Biophysics by Pranab Kumar Banerjee (2008) Publishers: S. Chand & Company ltd ISBN: 81-219-3016-2 p 166

Suggested Readings

1. Physical Biochemistry by David Freifelder Publisher: W.H.Freeman & Co Ltd (September 1976) ISBN-10: 0716705591 ISBN-13: 978-0716705598
2. A Biologist's Guide to Principles and Techniques of Practical Biochemistry by BryanL.Williams, KeithWilson Hodder Education, ISBN 071312461X (0-7131-2461-X)
3. Principles and Techniques of Practical Biochemistry by Keith M. Wilson, John M. Walker Cambridge University Press, ISBN 0521428092 (0-521-42809-2)
4. The Tools of Biochemistry by Cooper, T. G. 1977. Publisher: John Wiley & Sons
5. Biophysical Chemistry Principles & Techniques Handbook (2003) by Avinash
6. Upadhyay, Kakoli Upadhyay, Nirmalendu Nath Publisher: Himalaya Publishing House ISBN: 8178665883 ISBN-13:9788178665887, 978-8178665887
7. Research Methodology For Biological Sciences (2006) by Gurumani N Publisher: Mjp Publishers ISBN: 8180940160 ISBN-13: 9788180940163, 978-8180940163
8. Instrumental Methods Of Chemical Analysis (2006) by M.s. Yadav Publisher: Campus Books International ISBN: 8187815620 ISBN-13: 9788187815624, 978-8187815624
9. Introduction to Bioinformatics (2002) by T.K Atwood and D.J Parry- Smith Publisher: Pearson Education Pvt Ltd ISBN 81-7808-507-0
10. Introduction to Biostatistics: A textbook of Biometry (2004) by Pranab Kumar Banerjee Publisher S. Chand Company Ltd New Delhi
11. Biostatistics (2005) by P.N. Arora, P.K. Malhan Publishers: Himalaya Publishing house ISBN: 81-8318-298-4

Core Practical III- Methods in Biochemistry

Total hours of instruction: 36. Hours/week: 2. Credit: 1

Objectives: To make it possible for the student to have a practical understanding of methodology of the molecular separation techniques specified in the course. Formulate the protocol of a spectrometric determination. Calculate quantities and concentrations of substances from the results of spectrometric determinations.

1. Biochemical separation Techniques
   a. Chromatographic techniques

   b. Separation of amino acids and simple sugars by Paper chromatography (Descending or ascending)

   c. Separation of amino acids and lipids by Thin Layer chromatography Separation of Plant pigments by Column chromatography
2. Centrifugation Technique
   Isolation of crude Cytoplasmic fraction from a biological tissue sample
3. Precipitation Technique
   Ammonium sulfate fractionation of isolated crude cytoplasmic fraction
4. Dialysis of ammonium sulfate fractions
5. Isoelectric Precipitation of Casein
6. Colorimetry and Spectrophotometry techniques
   Verification of Beer Lambert's law.
   Verification of molar extinction coefficient of any known compound.

References

1. Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p 195 – 303
2. Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p 12 - 18

FOURTH SEMESTER

Core Course IV: BC4CRT04-Biomolecules

Total hours of instruction: 54 Hours/week: 3 Credit: 3

Objectives: Describe the structural characteristics of the inorganic components of living matter, the different types of simple organic biomolecules, their biologically important derivatives and the structural units of complex biomolecules. Schematize the molecular structure of the different types of complex biomolecules. Identify from a group of molecular formulae, diagrams or models those which correspond to the different types of biomolecules. Explain the physicochemical properties of the different types of biologically important biomolecules.

Unit I: (14 hours)

Carbohydrates: Classification, monosaccharides, D and L designation, open chain and cyclic structures, epimers and anomers, mutarotation, reactions of carbohydrates (due to functional groups - hydroxyl, aldehyde and ketone). Glycosides, Structure and biological importance of disaccharides (sucrose, lactose, maltose, isomaltose, trehalose), trisaccharides (raffinose, melezitose), structural polysaccharides (cellulose, chitin, pectin) and storage polysaccharides (starch, inulin, glycogen), Glycosaminoglycans, Bacterial cell wall polysaccharides.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain(2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p 73, 91, 100, 114

Unit II: (14 hours)

Lipids: biochemical functions of lipids, Classification of lipids with examples, classification of fatty acids, chemical constants of fatty acids-saponification number, acid number, iodine number and their application. Essential and non-essential fatty acids with examples. Lipoproteins: Types and functions. Compound lipids: storage and membrane lipids. Structure and functions of phospholipids and glycolipids, Steroids: Strucutre of steroid nucleus, cholesterol, ergosterol, stigmasterol, calciferol, Biomembranes: Behavior of amphipathic lipids in water- formation of micelles, bilayers, vesicles, liposomes.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain(2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p 230, 244, 269

Unit III: (14 hours)

Amino acids: Definition, stereoisomerism, structure of 20 'Standard amino acids' - single letter abbreviations of amino acids, classification of amino acids based on charge and polarity, general reactions of amino acids- side chain, carboxyl and amino group-essential and non essential amino acids, ionization of amino acids. Non-standard amino acids, Amino acid derivatives of biological significance-glutathione. Peptides: Formation of peptide bond. Proteins: Classification based on solubility, shape and function. Determination of amino acid composition of proteins, denaturation and renaturation of proteins, Structural organization of proteins- primary, secondary, tertiary and quaternary structures (E.g. Hemoglobin and

Myoglobin), forces stabilizing the structure of protein, Outlines of protein sequencing.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain(2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p 132, 204, 214

Unit IV: (12 hours)

Nucleic acids: Nature of nucleic acids, Structure of purines and pyrimidines, nucleosides, nucleotides, Stability and formation of Phosphodiester linkages, Effect of acids, alkali and nucleases on DNA and RNA, Structure of Nucleic acids- Watson-Crick DNA double helix structure, introduction to circular DNA, super coiling, helix to random coil transition, denaturation of nucleic acids- hyperchromic effect, *T*m-values and their significance, cot curves and their significance, Types of RNA and DNA, Unusual bases in nucleic acids. DNA sequencing: Sanger and Dideoxy methods.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain(2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p 280

Suggested Readings

1. Lehninger Principles of Biochemistry, Fourth Edition by David L. Nelson, Michael M. CoxPublisher: W. H. Freeman; Fourth Edition edition (April 23, 2004) ISBN-10: 0716743396 ISBN-13: 978-0716743392
2. E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, A Text Book of Biochemistry, Oxford and IBH Publishing Co., New Delhi, 1974
3. Biochemistry [with Cdrom] (2004) by Donald Voet, Judith G. Voet Publisher: John Wiley & Sons Inc ISBN: 047119350X ISBN-13: 9780471193500, 978-0471193500
4. Principles Of Biochemistry (1995) by Geoffrey L Zubay, William W Parson, Dennis E Vance Publisher: Mcgraw-hillBookCompany–Koga ISBN:0697142752 ISBN-13: 9780697142757, 978-0697142757
5. Biochemistry 6th Edition (2007) by Jeremy M. BergJohn L. Tymoczko Lubert Stryer Publisher: B.i. Publications Pvt. Ltd ISBN:071676766X ISBN- 13: 9780716767664, 978-716767664
6. Biochemistry (2008) by Rastogi Publisher: Mcgraw Hill ISBN**:**0070527954 ISBN-13**:** 9780070527959**,** 978-0070527959

Core Practical IV- BC4CRP02- Biomolecules

Total hours of instruction: 36. Hours/week: 2. Credit: 1

Objectives: This course aims to provide the students with an opportunity to develop their qualitative analytical skills. It is expected that the student on completion of this course have a sound knowledge on basic protocols for identification of biomolecules.

1. Reactions of Carbohydrates, Amino acids, Proteins and Lipids

A. Carbohydrates: (Glucose, fructose, Galactose, Xylose, Maltose, Lactose, Sucrose, Starch, dextrin, Glycogen maybe given for analysis).
Molisch's test, Iodine test, Test for reducing sugars (Fehling's test, Benedict's test, Barfoed's test), Seliwanoff's test, Bial's test, Mucic acid test, Acid hydrolysis of Sucrose, Osazone test.

B. Amino acids: (tyrosine, tryptophan, cysteine, cystine, methionine, arginine, proline, histidine may be given for analysis)
Ninhydrin test, Xanthoproteic test, Istatin test, Pauly's diazo test, sakaguchi test, Ehrlich's test, Sodium nitroprusside test, Millon's test, Sullivan's test.

C. Proteins: (Casein, Albumin, Gelatin, peptone may be given for analysis).
Biuret test, Ammonium sulfate precipitation test, Sulphosalicylic acid test, Heat coagulation test.

D. Lipids: Fats- tristearin, Fatty acids- palmitic acid, stearic acid, oleic acid, Glycerol, Steroids, cholesterol
Solubility in Organic solvents, saponification test, Acrolein test, Test for unsaturation: with bromine water or dilute potassium permanganate or Hubl's iodine test, salkowski test, Zak's test.

2. Identification of Monosaccharide, Disaccharide, polysaccharide from a mixture following a systematic scheme of analysis (only two component mixture of above mentioned carbohydrates to be given).
3. Identification of amino acids and proteins following a systematic scheme for analysis (single components only need be given)
4. Identification of lipids following a systematic scheme for analysis (single components only need be given)

References:

1. Hawk's Physiological Chemistry, Bernard L. Oser (ed) TATA McGRAW Hill Publishing Company LTD, New Delhi, p 60 – 127, 1317- 1334
2. Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8, p 13- 17, p 49 - 72
3. Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9 p 15- 23, 33- 35, 50 -57.
4. Practical Biochemistry, R.C. Gupta & S. Bhargava (eds) CBS Publishers and Distributors, New Delhi, ISBN 81-239-0124-0 p 9 - 27

FIFTH SEMESTER

Core Course V: BC5CRT05- Physiological Aspects of Biochemistry
Total hours of instruction: 54. Hours/week: 3. Credit: 3

Objectives: Discuss the physiological functions of the biological system. The aim here is to provide an overall, introductory view on some specialized tissues.

Unit I: (8 hours)

Digestion and absorption: Digestion and absorption of carbohydrates, proteins, and lipids. Composition and function of bile, role of bile salts in Lipid digestion and absorption.

Ref: Biochemistry by Debajyoti das. Academic publishers. Kolkata.p 323 – 349

Ref: Text book of Biochemistry by Edward Staunton West, Wilbert R Todd, Howard S Manson and John T Van Bruggen. Macmillan Publishing Company Inc. New York. p 494 – 535.

Unit II: (14 hours)

Biochemistry of Blood: Constituents of blood, types of cells, immunology of blood cells, components of plasma, types of plasma proteins and function, Mechanism of blood clotting (intrinsic and extrinsic pathway) Clotting factors, anticoagulants, fibrinolysis, Structure and function of hemoglobin, Transport of oxygen and carbon dioxide in blood, carbonic anhydrase, chloride shift, oxygen dissociation curve and Bohr effect. Buffer systems of blood.

Ref: - Biochemistry by Debajyoti das. Academic publishers. Kolkata.p 350 – 390

Ref: Text book of Biochemistry by Edward Staunton West, Wilbert R Todd, Howard S Manson and John T Van Bruggen. Macmillan Publishing Company Inc. New York. p 550 – 629.

Unit III: (10 hours)

Structure of nephrons, renal excretory mechanism, composition of urine, regulation of water and electrolyte balance, Role of aldosterone and antidiuretic hormones and mechanism of urine formation, renal regulation of pH.

Ref: Biochemistry by Debajyoti das. Academic publishers. Kolkata.p 614 – 635

Ref: Text book of Biochemistry by Edward Staunton West, Wilbert R Todd, HowardS Manson and John T Van Bruggen. Macmillan Publishing Company Inc. New York.p 665 – 731.

Unit IV: (10 hours)

Biochemistry of Specialized tissues: Muscle- types of muscles, muscle proteins, organization of contractile protein and mechanisms of muscle contraction. Sources of energy for muscle contraction.

Neurons- structure, mechanism of nerve impulse transmission, neurotransmitters, acetylcholine, GABA, serotonin, dopamine

Bone- Role of calcium, phosphorus, vitamin D and hormones in bone metabolism.

Ref: Text Book of Biochemistry by D M Vasudevan and Sreekumari S. Jaypee Brothers, Medical Publishers Pvt Ltd. New Delhi. p 467 – 475.

Ref: Biochemistry by Debajyoti Das. Academic publishers. Kolkata. p 636 – 660

Ref: I llustrated Medical Biochemistry by S M Raja and Bindu Madak. Jaypee BrothersMedical Publishers Pvt Ltd. New Delhi. p 221 – 231

Unit V: (12 hours)

Endocrinology**:** Organization of endocrine system. Classification of hormones -Peptide, amino acid derived and steroid hormones. Mechanism of action of hormones, Brief study of the site of biosynthesis and major physiological functions of insulin, glucagon, epinephrine, thyroxine, growth hormone, thyroid stimulating hormone, gonadotropic hormone, vasopressin, oxytocin, parathyroid hormone and calcitonin. gastrointestinal hormones.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p 835

Suggested Readings

1. Textbook Of Medical Physiology, 11/e With Student Consult Access (2005) by Arthur CGuyton, JohnEHall Publisher**:** Else ISBN: 8181479203 ISBN-13: 9788181479204**,** 978-8181479204
2. HumanPhysiology(2001) by BipinKumar Publisher: CampusBooks International ISBN: 8187815604 ISBN-13: 9788187815600, 978-8187815600
3. HumanPhysiology (2001) by K.C.Sawant Publisher: Dominant Publishers & DistributorsISBN: 8178880202 ISBN-13: 9788178880204, 978-8178880204
4. Human Physiology (2001) by AndrewDavies, AsaGhBlakeley, Cecil Kidd Publisher**:** ChurchillLivingstone ISBN**:** 0443046549, ISBN-13**:** 9780443046544, 978-0443046544
5. Principles ofBiochemistry,6e (1959) by AbrahamWhite, Philip Handler Publisher: TataMcgraw-hillPublishingCompanyLimited ISBN:0070590494 ISBN-13: 9780070590496, 978-0070590496

Core Practical V-Physiological Aspects of Biochemistry

Total hours of instruction: 36. Hours/week: 2. Credit: 1

Objectives: This Practical course introduces the students to analysis of various important body fluids

1. Experiments on saliva

   Digestion of starch by salivary amylase Preparation of Mucin
2. Preparation of Artificial Gastric juice

   From Commercial Pepsin
3. Preparation of Pepsinogen Extract
4. Product of Gastric Digestion
5. Experiments on Gastric Digestion

   Influence of Different Temperature Optimum acidity of Peptic Digestion

   Differentiation between Pepsin and Pepsinogen Quantitative determination of Rennin
6. Determination of pepsin activity with Albumin Substrate
7. Determination of tryptic activity with Casein Substrate

Reference:

1. Hawk's Physiological Chemistry, Bernard L. Oser (ed) TATA McGRAW Hill Publishing Company LTD, New Delhi, p 459- 487
2. Practical Clinical Chemistry, Harold Varley, CBS Publishers and Distributors, New Delhi, p327 – 348

Core Course VI: BC5CRT06- Environmental Biochemistry and Human Rights
Total hours of instruction: 72 Hours/week: 4 Credit: 4

Objectives: This course aims to inculcate in students the need of understanding the basics of environment science and human rights

Unit I (18 hours)

Multidisciplinary nature of environmental studies: Definition, scope and importance, Need for public awareness.

Natural Resources: Renewable and non-renewable resources, Natural resources and associated problems.

a. **Forest resources**: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.
b. **Water resources**: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
c. **Mineral resources**: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
d. **Food resources**: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
e. **Energy resources**: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, Case studies.
f. **Land resources**: Land as a resource, land degradation, man induced landslides, soil erosion and desertification
   - Role of individual in conservation of natural resources.
   - Equitable use of resources for sustainable life styles.

Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids.

Introduction, types, characteristic features, structure and function of the given ecosystem:- Forest ecosystem

Unit II (26 hours)

Biodiversity and its conservation

Introduction, Biogeographical classification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.

India as a mega-diversity nation, Hot-sports of biodiversity

Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India

Environmental Pollution

Definition, Causes, effects and control measures of: -

Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards

Solid waste Management: Causes, effects and control measures of urban and industrial wastes.

Role of an individual in prevention of pollution, Pollution case studies

Disaster management: floods, earthquake, cyclone and landslides.

Social Issues and the Environment

- Urban problems related to energy
- Water conservation, rain water harvesting, watershed management
- Resettlement and rehabilitation of people: its problems and concerns, Case studies
- Environmental ethics: Issues and possible solutions
- Climate change, global warming, acid rain, ozone layer depletion , nuclear accidents and holocaust, Case studies
- Consumerism and waste products
- Environment Protection Act
- Air (Prevention and Control of Pollution) Act
- Water (Prevention and control of Pollution) Act
- Wildlife Protection Act
- Forest Conservation Act
- Issues involved in enforcement of environmental legislation
- Public awareness

References

1. Bharucha Erach, Text Book of Environmental Studies for undergraduate Courses. University Press, IInd Edition 2013 (TB)
2. Clark.R.S., Marine Pollution, Clanderson Press Oxford (Ref)
3. Cunningham, W.P.Cooper, T.H.Gorhani, E & Hepworth, M.T.2001 Environmental Encyclopedia, Jaico Publ. House. Mumbai. 1196p .(Ref)
4. Dc A.K.Enviornmental Chemistry, Wiley Eastern Ltd.(Ref)
5. Down to Earth, Centre for Science and Environment (Ref)
6. Heywood, V.H & Watson, R.T. 1995. Global Biodiversity Assessment, Cambridge University Press 1140pb (Ref)
7. Jadhav.H & Bhosale.V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284p (Ref)
8. Mekinney, M.L & Schock.R.M. 1996 Environmental Science Systems & Solutions. Web enhanced edition 639p (Ref)
9. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co. (TB)
10. Odum.E.P 1971. Fundamentals of Ecology. W.B. Saunders Co. USA 574p (Ref)
11. Rao.M.N & Datta.A.K. 1987 Waste Water treatment Oxford & IBII Publication Co.Pvt.Ltd.345p (Ref)
12. Rajagopalan. R, Environmental Studies from crisis and cure, Oxford University Press, Published: 2016 (TB)
13. Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut (Ref)
14. Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science (Ref)
15. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Stadards, Vol I and II, Enviro Media (Ref)
16. Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication (Ref)
17. Wanger K.D., 1998 Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p (Ref)

Unit III (10 hours)

Biopesticides: Biopesticides in integrated pest management - bioremediation of contaminated soils and wastelands - solid waste - sources and management (composting, vermiculture and methane production), Waste water treatment and bioremediation, environmental mutagenesis and toxicity testing.

Unit IV: (10 hours)

Human Population and the Environment: Population growth, variation among nations, Population explosion – Family Welfare Programmes, Environment and human health, Role of Information Technology in Environment and Human Health

Unit V (8 hours)

Human Rights– An Introduction to Human Rights, Meaning, concept and development, Three Generations of Human Rights (Civil and Political Rights; Economic, Social and Cultural Rights).

Human Rights and United Nations – contributions, main human rights related organs- UNESCO, UNICEF, WHO, ILO, Declarations for women and children, Universal Declaration of Human Rights.

Human Rights in India – Fundamental rights and Indian Constitution, Rights for children and women, Scheduled Castes, Scheduled Tribes, Other Backward Castes and Minorities

Environment and Human Rights - Right to Clean Environment and Public Safety: Issues of Industrial Pollution, Prevention, Rehabilitation and Safety Aspect of New Technologies such as Chemical and Nuclear Technologies, Issues of Waste Disposal, Protection of Environment

Conservation of natural resources and human rights: Reports, Case studies and policy formulation. Conservation issues of western ghats- mention Gadgil committee report, Kasthurirengan report. Over exploitation of ground water resources, marine fisheries, sand mining etc.

References

1. Amartya Sen, The Idea Justice, New Delhi: Penguin Books, 2009.
2. Chatrath, K. J.S., (ed.), Education for Human Rights and Democracy (Shimla: Indian Institute of Advanced Studies, 1998)
3. Law Relating to Human Rights, Asia Law House,2001.
4. Shireesh Pal Singh, Human Rights Education in 21st Century, Discovery Publishing House Pvt.Ltd, New Delhi,
5. S.K.Khanna, Children And The Human Rights, Common Wealth Publishers,1998. 2011.
6. Sudhir Kapoor, Human Rights in 21st Century,Mangal Deep Publications, Jaipur,2001.
7. United Nations Development Programme, Human Development Report 2004: Cultural Liberty in Today's Diverse World, New Delhi: Oxford University Press, 2004.

Suggested Readings:

1. Environmental Chemistry by Soumitro Ghose Publisher: Dominant Publishers & Distributors (2003) ISBN: 8178881381 ISBN-13: 9788178881386, 978-8178881386
2. Environmental Chemistry by Colin Baird, Michael Cann (2008) Publisher: W.H. Freeman &Company ISBN: 1429201460 ISBN-13: 9781429201469, 978-1429201469
3. Environmental Chemistry In Society by James M. Beard (2008) Publisher: Taylor & Francis ISBN: 1420080253 ISBN-13: 9781420080254, 978-1420080254
4. Fundamental Concepts of Environmental Chemistry by G.S. Sodhi (2005) Publisher: Narosa Publishing House ISBN: 8173196923 ISBN-13: 9788173196928, 978-8173196928
5. An Introduction To Environmental Chemistry by J.E. Andrews (2003) Publisher: Blackwell Science Ltd ISBN: 0632059052 ISBN-13: 9780632059058, 978-0632059058
6. Introductory Chemistry For Environmental Science by Harrison R.M, De Mora S. J (1998) Publisher: Cambridge University Press ISBN: 0521586887 ISBN-13: 9780521586887, 978-0521586887
7. Environmental Chemistry by Sindhu P.S (2002) Publisher: New Age International (p) Ltd ISBN: 812241401X ISBN-13: 9788122414011, 978-8122414011

Core Practical VI- Environmental Biochemistry and Human Rights

Total hours of instruction:18 Hours/week: 1 Credit: 1

Field study: (Internal only)

- Visit to a local area to document environmental grassland/ hill /mountain
- Visit a local polluted site – Urban/Rural/Industrial/Agricultural Study of common plants, insects, birds etc
- Study of simple ecosystem-pond, river, hill slopes, etc

Core Course VII: BC5CRT07- Enzymology and Enzyme Technology

Total hours of instruction: 54 Hours/week: 3 Credit: 3

Objectives: This course aims to describe the structural characteristics of enzymes;explain their functional properties and their role in control of metabolism and industrial application of enzymes.

Unit I: (10 hours)

Introduction to enzymes: Holoenzyme, apoenzyme, and prosthetic group. Interaction between enzyme and substrate- lock and key model, induced fit model, Features of active site, activation energy, enzyme specificity and types Enzyme Commission system of classification and nomenclature of enzymes (Class and subclass with one example) Ribozymes, Abzymes. Coenzymes and their functions - NAD, $NADP^+$, FAD, FMN, lipoic acid, TPP, pyridoxal phosphate, biotin and cyanocobalamin.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain(2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p 269

Unit II: (8 hours)

Nature of non-enzymatic and enzymatic catalysis, Measurement and expression of enzyme activity, enzyme assays. Definition of IU, katals, enzyme turnover number and specific activity, Elementary study – isolation of enzymes and the criteria of purity.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain(2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p 349

Unit III: (13 hours)

Enzyme kinetics: study of the factors affecting the velocity of enzyme catalyzed reaction- enzyme concentration, temperature, pH, substrate concentration, inhibitors and activators (explanation with graphical representation). Derivation of Michaelis - Menten equation. Km value determination and its significance, Definition of V_{max} value of enzyme and its significance, Lineweaver- Burk plot (Only for single substrate enzyme catalyzed reaction), Enzyme inhibition: Reversible and irreversible – examples. Reversible- competitive, noncompetitive and uncompetitive inhibition- explanation of inhibition types with double reciprocal plot and examples of each type of enzyme inhibition.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p 372, 384, 385,

Unit IV: (13 hours)

Enzyme regulation – covalently modulated enzymes with examples of adenylation and phosphorylation and allosteric regulation- example Aspartate trascarbamoylase, Isoenzymes- Lactate dehydrogenase and creatine phosphokinase, Zymogen form of enzyme and zymogen activation, Multienzyme complexes and their role in regulation of metabolic pathways.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p 397

Unit V: (10 hours)

Immobilization of enzymes, methods of immobilization, Industrial uses of enzymes: production of glucose from starch, cellulose and dextrans, use of lactase in diary industry, production of glucose fructose syrup from sucrose, use of proteases in food, leather and detergent industry. Diagnostic and therapeutic enzymes (brief study of name of enzyme and role in diagnosis and therapy)

Suggested Readings

1. Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins by Nicholas C. Price, Lewis Stevens, and Lewis Stevens (2000) Publisher: Oxford University Press, USAISBN: 019850229X ISBN-13: 9780198502296**,** 978-0198502296
2. Enzyme Kinetics: A Modern Approach Book: Enzyme Kinetics: A Modern Approach by Alejandro G. Marangoni (2003) Publisher: Wiley-Interscience ISBN: 0471159859 ISBN-13: 9780471159858
3. Enzyme Kinetics and Mechanisms by Taylor Publisher: Spring ISBN: 8184890478 ISBN-13:9788184890471**,** 978-8184890471
4. Enzyme Mechanism by P.K. Shivraj Kumar **(**2007) Publisher: RBSA Publishers ISBN: 8176114235 ISBN-13: 9788176114233**,** 978-8176114233
5. Enzymes and Enzyme Technology by Kumar **(**2009) Anshan Pub ISBN: 1905740875, ISBN-13: 9781905740871**,** 978-1905740871
6. Enzymes in Industry: Production And Applications by Aehle W **(**2007) Publisher**:** John Wiley & Sons Inc ISBN: 3527316892 ISBN-13: 9783527316892**,** 978-3527316892

Core Practical VII - Enzymology and Enzyme Technology

Total hours of instruction: 36. Hours/week: 2. Credit: 1

Objectives: The objective here is to make the students understand the basicsteps involved in extraction and determination of enzymatic activities. Calculate enzymatic activities from experimental data

1. Extraction of enzymes

Acid phosphatase from Fresh Potato (*Solanum tuberosum*)

β- amylase from Sweet potato (*Ipomoea batates*)

Catalase from Bovine /Porcine liver

Urease from Jack bean (*Canavalia ensiformis*)

Phytase from Seeds

2. Enzyme Assay: Enzyme extracted from above source can be used for the assay

Acid phosphatase

β- amylase

Catalase

Urease from Jack bean

Phytase

3. Effect of substrate Concentration on velocity of Enzyme catalyzed reaction:

Determination of K_M and V_{max} using Michaelis- Menten Curve for amylase

References

Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8, p 173- 187

Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p 110 – 155

Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p 184 – 255

Core Course VIII: BC5CRT08-Metabolism and Bioenergetics

Total hours of instruction: 54. Hours/week: 3. Credit: 3

Objectives: Explain the general principals of cellular energy metabolism. Explain andschematize the oxidative pathways of carbohydrates, Lipids, Proteins & Nucleic acids. Explain and schematize the final mitochondrial oxidative pathways: oxidative tricarboxylic cycle and mitochondrial respiratory chain, as well as its coupling to ATP synthesis.

Unit I: (5 hours)

Bioenergetics: Laws of thermodynamics- Role of high-energy phosphates in energy transfer, free energy concept, Biological oxidation, redox potential, phosphate potential, coupled reactions. General features of metabolism: use of intact organisms, bacterial mutants, tissue slices and radioactive isotopes.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p 434

Unit II: (16 hours)

Carbohydrate metabolism: (Reaction sequence with structure, name of enzymes and coenzymes involved expected) Glycolysis, oxidation of pyruvate, fate of pyruvate in alcoholic fermentation, TCA cycle, metabolism of glycogen-, gluconeogenesis, pentose phosphate pathway, glyoxylate pathway, Mitochondrial electron transport, oxidative phosphorylation. Regulation of committed step in each pathway.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain(2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p 458,481,522,

Unit III: (12 hours)

Metabolism of lipids: Biosynthesis of fatty acids, Fatty acid elongation. Detailed study on β-oxidation of palmitic acid and its energy balance sheet, Metabolism of ketone bodies, Cholesterol synthesis (structure not needed) and significance, Synthesis of steroid hormones from cholesterol, Regulation of committed step in each pathway.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain(2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p 564, 594

Unit IV: (12 hours)

Metabolism of proteins: proteolytic enzymes. transamination, oxidative deamination, reductive amination, non-oxidative deamination and decarboxylation of amino acids Urea cycle. Brief outline of metabolism of aromatic amino acids (reaction sequences with structures) metabolic fate of amino acids- glucogenic, ketogenic and gluco-ketogenic, biosynthesis of amino acids, Regulation of committed step in each pathway.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p 641, 687

Unit V: (9 hours)

Metabolism of nucleotide: Biosynthesis of purine and pyrimidine nucleotides –*denovo* and salvage pathway (no structure required) end products of purine andpyrimidine metabolism. Regulation of committed step in each pathway.

Ref: Biochemistry (2008) by Rastogi.Publisher: Mcgraw Hill ISBN**:**0070527954 ISBN13**:** 9780070527959**,** 978-0070527959

Suggested Readings

1. Lehninger Principles of Biochemistry, Fourth Edition by David L. Nelson Michael M. CoxPublisher: W. H. Freeman; Fourth Edition edition (April 23, 2004) ISBN-10: 0716743396 ISBN-13: 978-0716743392
2. E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, A Text Book of Biochemistry, Oxford and IBH Publishing Co., New Delhi, 1974
3. Biochemistry [with Cdrom] (2004) by Donald Voet, Judith G. Voet Publisher: John Wiley & Sons Inc ISBN: 047119350X ISBN-13: 9780471193500, 978-0471193500
4. Principles Of Biochemistry (1995) by Geoffrey L Zubay, William W Parson, Dennis E Vance Publisher: Mcgraw-hill Book Company Konga ISBN: 0697142752; ISBN-13: 9780697142757, 978-0697142757
5. Principles Of Biochemistry, 4/e (2006) by Robert Horton H , Laurence A Moran, Gray Scrimgeour K Publisher: Pearsarson ISBN: 0131977369, ISBN-13:9780131977365, 978-0131977365
6. Biochemistry 6th Edition (2007) by Jeremy M.berg John L.tymoczko Lubert Stryer Publisher: B.i.publicationsPvt.Ltd ISBN:071676766X ISBN- 13: 9780716767664, 978-716767664
7. Biochemistry (2008) by Rastogi Publisher: Mcgraw Hill ISBN:0070527954 ISBN-13: 9780070527959, 978-0070527959

Core Practical VIII: Metabolism and Bioenergetics

Total hours of instruction: 54. Hours/week: 3. Credit: 1

Objectives: To introduce the students to protocols of spectrophotometric determination. Calculate quantities and concentrations of biomolecules from standard curves

A. Separation and Estimation of Carbohydrates: (Any 5 experiments to be done)

1. Isolation and determination of Liver Glycogen
2. Isolation and determination of Starch in Plant Tissue
3. Estimation of Cellulose
4. Estimation of crude fiber
5. Determination of total sugars by ferricyanide method (Colorimetric)
6. Quantitation of total sugars by anthrone method
7. Determination of reducing sugars by Nelson – Somogyi's method
8. Estimation of reducing sugars by dinitrosalicylate method
9. Determination of fructose by Roe's resorcinol method

B. Separation and Estimation of Lipids: (Any 5 experiments to be done)

1. Extraction and estimation of total lipid content from a biological tissue sample
2. Separation and identification of various lipids by Column Chromatography
3. Separation of various components in different lipid fractions by thin layer chromatography
4. Quantitative estimation of different lipid fractions separated by thin layer Chromatography
5. Estimation of Cholesterol by Zak's method
6. Determination of acid value of fats
7. Determination of saponification value of fats
8. Determination of iodine number of oils
9. Determination of peroxide value of oils

C. Separation and Estimation of Proteins and Amino acids: (Any 4 experiments to be done)

1. Determination of Crude protein by micro- Kjeldahl's method
2. Estimation of protein by Lowry's method
3. Determination of protein by Biuret method
4. Determination of free amino acid content in germinating seeds by Ninhydrin method

5. Determination of tyrosine by nitrosonapthol method
6. Estimation of tryptophan by Spies and Chamber's method

D. Separation and Estimation of Nucleic acids (All 3 experiments need to be done)

1. Extraction of total nucleic acid from plant tissue
2. Estimation of DNA by Diphenylamine method
3. Determination of RNA by orcinol method

E. Separation and Estimation of Minerals and Vitamins (Any 4 experiments to be done)

1. Preparation of biological sample for mineral analysis by ashing method
2. Wet digestion procedure of sample preparation for mineral analysis
3. Determination of Phosphorus content in plant material (Colorimetric method)
4. Colorimetric estimation of iron in foodstuffs by ά ά dipyridyl method
5. Estimation of β- carotene in carrots
6. Estimation of ascorbic acid in Lemon juice

References

1. Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8, p 81- 126
2. Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p 15 – 109
3. Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p 49- 181, p 269- 285.

SIXTH SEMESTER

Core Course IX: BC6CRT09- Molecular Biology and Genetic Engineering

Total hours of instruction: 54. Hours/week: 3. Credit: 3

Objectives: Explain the molecular bases of mechanisms of transmission, recombination and protection of genetic information. Describe the gene structure and gene expression mechanism in eukaryotes: transcription, posttranscriptional processes and translation & Protein degradation

Unit I: (14 hours)

Identification of genetic materials, Chemical nature of gene, central dogma of molecular biology, C- value paradox, chromatin organization, Meselson and Stahl experiment, DNA replication in prokaryotes, Mutation and its types, Mutagens- Physical and chemical, Mutagenesis, DNA damage and repair.

Ref: Cell biology, Genetics, Molecular Biology, Evolution and Ecology by P.S. Verma and V. K. Agarwal (2008) Publisher: S. Chand & Company Ltd ISBN: 81-219-2442-1 p 9, 16, 27, 201

Unit II: (16 hours)

Transcription in prokaryotes and posttranscriptional modifications, Genetic code and wobble hypothesis, Reverse transcription, Translation in prokaryotes, Posttranslational modifications. Inhibitors of protein synthesis.

Ref: Cell biology, Genetics, Molecular Biology, Evolution and Ecology by P.S. Verma and V. K. Agarwal (2008) Publisher: S. Chand & Company Ltd ISBN: 81-219-2442-1 p 44, 66, 75

Unit III: (14 hours)

Introduction to cloning-generalised cloning schemes, Types of vectors- plasmids, cosmids, phages. Genomic DNA library, Nucleic acid sequencing methods- Sanger's dideoxymethod, autoradiography, gel electrophoresis. Application of genetic engineering (basic study)

Ref: Genes IX by Benjamin Lewin (2008) Publisher: J&b ISBN:0763752223 ISBN-13: 9780763752224, 978-0763752224

Unit IV: (10 hours)

Introduction to recombinant DNA technology, restriction endonucleases Polymerase chain reaction, DNA finger-printing, blotting techniques.

Ref: Cell biology, Genetics, Molecular Biology, Evolution and Ecology by P.S. Verma and V. K. Agarwal (2008) Publisher: S. Chand & Company Ltd ISBN: 81-219-2442-1 p 91-110

Suggested Readings

1. Cell and Molecular Biology, 3e (2003) by Karp Publisher: Jw ISBN: 0471268909 ISBN-13: 9780471268901, 978-0471268901
2. *Principles of Gene Manipulation and Genomics.* 7th ed. Sandy B Primrose , Richard Twyman (2009) John Wiley & Sons.
3. *Gene Cloning and DNA Analysis: An Introduction*. 6th ed. Terry A Brown. (2010) John Wiley & Sons.
4. *Molecular biology of the Gene.* 6th ed.James D Watson. (2008) Pearson/ Benjamin Cummings.

Core Course Practical IX- BC6CRP03-Molecular Biology and Genetic engineering

Total hours of instruction: 36. Hours/week: 2. Credit: 1

Objective: To introduce the student to simple basic techniques of Molecularbiology

1. Molecular biology Experiments:

DNA isolation - from Plant cell, or Animal cell (goat liver), or Human Blood (Fresh / Stored / Frozen)

Spectrophotometric analysis of isolated DNA sample, Agarose Gel electrophoresis,

Gel documentation & photography DNA molecular size determination

References:

Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p 15 – 109

Core course X: BC6CRT10-Clinical Biochemistry

Total hours of instruction: 54 Hours/week: 3 Credit: 3

Objective: To provide an understanding of future advances in the molecularbases of physiology, physiopathology, diagnostics and therapeutics.

Unit I: (16 hours)

Blood analysis and Hematology: Principles of estimation, normal values and clinical significance of the following parameters of blood -glucose, glycosylated hemoglobin, GTT, insulin levels, uric acid, lipid profiles, acid phosphatase, creatine phosphokinase, Na^+, K^+, Cl^- and phosphate. Principles of determination, clinical significance of the following parameters- Total count, Differential count, Erythrocyte sedimentation rate, packed cell volume and prothrombin time. Brief study of blood groups, anticoagulants, storage and transfusion of blood.

Ref: Text book of Medical Biochemistry by M.N. Chatterjee and Rana Shinde, Jaypee Brothers, Medical Publishers Pvt Ltd. New Delhi. p 284 - 322

Ref: Clinical Biochemistry Principles and Practices by Praful B Godkar, Bhalanipublishing house. Bombay. India. p 115, 110, 111 – 114

Unit II: (20 hours)

Organ function tests: Function of liver, Biochemical mechanism of detoxification with examples. Principles of the following test of liver function and the interpretation of the results- Total protein, albumin, globulin, albumin – globulin ratio, Total and conjugated bilirubin, AST, ALT, alkaline phosphate, Thyroid function test: T3, T4, TSH, Renal function tests: Urea, creatinine, urea clearance test, creatinine clearance test.

Ref: Text book of Medical Biochemistry by M.N. Chatterjee and Rana Shinde, JaypeeBrothers, Medical Publishers Pvt Ltd. New Delhi. p 168 - 202.

Ref: Text Book of Biochemistry by D M Vasudevan and Sreekumari S. Jaypee Brothers,Medical Publishers Pvt Ltd. New Delhi. p 517 - 525.

Ref: Clinical Biochemistry Principles and Practices by Praful B Godkar, Bhalanipublishing house. Bombay. India. p 87- 93

Unit IV: (6 hours)

Clinical correlation of biochemical parameters analyzed in blood analysis, Organ function tests (liver, kidney, and thyroid).

Ref: Text book of Medical Biochemistry by M.N. Chatterjee and Rana Shinde, JaypeeBrothers, Medical Publishers Pvt Ltd. New Delhi. p 168 - 202.

Ref: Text Book of Biochemistry by D M Vasudevan and Sreekumari S. Jaypee Brothers, Medical Publishers Pvt Ltd. New Delhi. p 517 - 525.

Ref: Clinical Biochemistry Principles and Practices by Praful B Godkar, Bhalani publishing house. Bombay. India. p 87- 93

Unit V: (12 hours)

Nutritional and hormonal disorders, Obesity, Starvation, PCM, pellagra, beriberi, scurvy, deficiency of fat soluble vitamins, Hypervitaminosis, Disturbances in metabolism of trace elements - iron, iodine, copper and fluorine. Diabetes mellitus, GTT, hyperinsulinism and hypoglycemia.

Ref: Clinical Biochemistry Principles and Practices by Praful B Godkar, Bhalani publishing house. Bombay. India. p 258 – 271, 233 – 251, 92 – 117.

Ref: Text Book of Biochemistry by D M Vasudevan and Sreekumari S. Jaypee Brothers, Medical Publishers Pvt Ltd. New Delhi. p 428 – 451, 480 – 484, 537 - 549.

Ref: Text book of Medical Biochemistry by M.N. Chatterjee and Rana Shinde, JaypeeBrothers, Medical Publishers Pvt Ltd. New Delhi. p 668 - 808.

Suggested Readings

1. Notes on Clinical Biochemistry by John K. Candlish (1992) Publisher: World Scientific Publishing Company ISBN: 9810210663 ISBN-13: 9789810210663, 978-9810210663
2. Clinical Biochemistry: Metabolic And Clinical Aspects by William J. Marshall, Stephen K. Bangert, Elizabeth S.m. Ed. S.m. Ed. Marshall (2008) Publisher: Elsevier Science Health Science Div ISBN: 0443101868 ISBN-13: 9780443101861, 978-0443101861
3. Biochemistry by John K. Joseph (2006) Publisher: Campus Books International ISBN: 8180301109 ISBN-13: 9788180301100, 978-8180301100
4. Basic Medical Biochemistry: A Clinical Approach by Dawn B., PH.D. Marks, Allan D. Marks Colleen M. Smith (1996) Publisher: Lippincott Williams & Wilkins; illustrated edition ISBN-10:068305595X ISBN-13: 978-0683055955
5. Clinical Chemistry, 6/e Ie by William J Marshall, Stephen K Bangert (2008) Publisher: Else ISBN: 0723434603, ISBN-13: 9780723434603, 978-0723434603
6. Tietz Fundamentals of Clinical Chemistry, 6/e by Carl A Burtis, Edward R Ashwood (2008) Publisher: Else ISBN: 8131213749, ISBN-13: 9788131213742, 978-8131213742

Core Course Practical X-BC6CRP04-Clinical Biochemistry

Total hours of instruction: 54. Hours/week: 3. Credit: 1

Objectives: Apply biochemical analysis and reasoning in order to solve problemsrelated to physiology and cellular physiopathology.

1. Preparation of Blood Serum & Plasma
2. Quantitative estimation in Blood/ Serum:

   Glucose by Nelson – Somogyi Method

   Cholesterol by Zak & Henly's Metod

   Urea by Diacetylmonoxime Method

   Iron by ά ά dipyridyl method

   Total Protein by Biuret Method Albumin: Globulin ratio

   Uric acid using Phosphotungstic acid reagent Bilirubin by van den Bergh reaction

   Hemoglobin content by cyanmethaemoglobin method
3. ESR, PCV, TC/DC count,
4. Clinical Enzymology:

   Assay of serum alkaline phosphatase

   Assay of Serum alanine amino transferases (ALT/SGPT)

   Assay of serum aspartate amino transferases (AST/SGOT)

   Assay of serum Lactate dehydrogenases

References

Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8, p 191 -241

Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p 15 – 109

Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p 49- 181, p 269- 285

Practical Clinical Chemistry, Harold Varley, CBS Publishers and Distributors, New Delhi, p327 – 348

Core Course XI: BC6CRT11- Pharmaceutical Chemistry

Total hours of instruction: 54. Hours/week: 3. Credit: 3

Objectives: To introduce the student the basics about Pharmacology so that thestudent develops an idea about action of drugs that are commonly used for therapy

UNIT I: (6 hours)

Introduction to pharmacology, sources of drugs, dosage forms & routes of administration, principle of drug action, combined effect of drugs, factors modifying drug action, tolerance & dependence, absorption, distribution. Adverse responses and side effects of drugs: allergy, Drug intolerance, Drug addiction, drugs abuses and their biological effects.

Ref: Essential of Medical Pharmacology by Tripathi K.D (2003) Publisher: JaypeeBrothers Medical ISBN: 8180611876, ISBN-13: 9788180611872, 978-8180611872

UNIT II: (10 hours)

Classification of drugs based on sources: mode of administration, site of action, and absorption of drugs, Drugs distribution and elimination, Role of kidney in elimination drug metabolism: chemical pathways of drug metabolism, Phase I and Phase II reactions, role of cytochrome P450, drug metabolizing enzymes.

Ref: Essential of Medical Pharmacology by Tripathi K.D (2003) Publisher: Jaypee Brothers Medical ISBN: 8180611876, ISBN-13: 9788180611872, 978-8180611872

UNIT III: (12 hours)

Chemotherapy: General Principles of Chemotherapy: Chemotherapy of Parasitic infections, Tuberculosis, Leprosy, Malaria, Fungal infections, viral diseases, Introduction to Immunondulators and Chemotherapy of Cancer.

Ref: Essential of Medical Pharmacology by Tripathi K.D (2003) Publisher: Jaypee Brothers Medical ISBN: 8180611876, ISBN-13: 9788180611872, 978-8180611872

UNIT IV: (14 hours)

Mode of action, uses, structure- activity relationship of the following classes of Drug:
Androgens and Anabolic steroids – Testosterone, Stanazolol.
Estrogens and Progestational agents – Progesterone, Estradiol.
Adrenocorticoids – Prednisolone, Dexamethasone, Betamethasone.
Antibiotics-Penicillins, streptomycin, tetracyclines, Cephalosporins.

Ref: Organic Chemistry Vol-1 6th Edition (s) by Finar Il (2008) Publisher: DorlingKindersley (India) Pvt Ltd ISBN: 8177585428 ISBN-13:9788177585421, 978-8177585421

Organic Chemistry Vol-2 5th Edition (s) by Finar I.l Publisher: Dorling Kindersley(India) Pvt Ltd (2008) ISBN: 817758541X, ISBN-13: 9788177585414, 978-8177585414

Indian Pharmacopoeia – Latest edition,British Pharmacopoeia - Latest edition

UNIT V: (12 hours)

Molecular basis of drug action:

a) Receptor: Drug Receptor Interaction: Basic ligand concept, agonist, antagonist, partial agonist, inverse agonist, receptor Theories - Occupancy, Rate & Activation Theories, receptor Binding Assays.

b) Enzyme Inhibition –enzyme Inhibitors as drugs - ACE, leukotrienes, Lipoxygenase, Cycloxygenase, Aromatase, Xanthine oxidase, DNA PolymeraseInhibitors, HIV - Protease / Reverse Transcriptase, Integrase and Cytochrome P-450 Inhibitors.

Drug binding to nucleic acid -- Antimalarial, anti-cancer, antiviral.

Ref: Essential of Medical Pharmacology by Tripathi K.D (2003) Publisher: Jaypee Brothers Medical ISBN: 8180611876, ISBN-13: 9788180611872, 978-8180611872

Suggested Reading

1. Organic Pharmaceutical Chemistry by Harkishan Singh, Kapoor Vk (2004) Publisher: Vallabh Publications/Prakashan ISBN: 8185731209, ISBN-13: 9788185731209, 978-8185731209
2. Organic Chemistry Vol-1 6th Edition (s) by Finar Il (2008) Publisher: Dorling Kindersley (India) Pvt Ltd ISBN: 8177585428 ISBN-13:9788177585421, 978-8177585421
3. Organic Chemistry Vol-2 5th Edition (s) by Finar I.l Publisher: Dorling Kindersley (India) Pvt Ltd (2008) ISBN: 817758541X, ISBN-13: 9788177585414, 978-8177585414
4. Principles Of Organic Medicinal Chemistry by Rama Rao Nadendla (2004) Publisher: New Age International (p) Limited ISBN: 8122415717, ISBN-13: 9788122415711, 978-8122415711
5. Basic & Clinical Pharmacology by Bertram G. Katzung (2006) Publisher: Mcgraw-hill Medical Publishing ISBN: 0071451536 ISBN-13: 9780071451536, 978-0071451536
6. Essential of Medical Pharmacology by Tripathi K.D (2003) Publisher: Jaypee Brothers Medical ISBN: 8180611876, ISBN-13: 9788180611872, 978-8180611872
7. Handbook Of Experimental Pharmacology by Kulkarni SK (2007) Publisher: Vallabh Publications/ Prakashan ISBN: 8185731128, ISBN-13: 9788185731124, 978-8185731124

Core Course Practical XI-BC6CRP05-Pharmaceutical Chemistry

Total hours of instruction: 36. Hours/week: 2. Credit: 1

Objective: The student is expected to have an in-depth practical analysis of naturalproducts on completion of this course

1 Thin Layer Chromatography of Plant Metabolites (any one):

TLC of Volatile Oils

TLC of Alkaloids

TLC of Glycosides

TLC of Flavonoid drugs

2 Extractions, Isolation and Analysis of Phytopharmaceuticals:

Different Extraction Protocols: Infusion, Decoction, Digestion, Maceration, Soxhlet extraction

Selection of suitable extraction Process

Extraction of High Molecular Weight Carbohydrates

Collection and Purification of Exudates

3 Extraction of Total Alkaloids
4 Isolation and Colorimetric estimation of Solanine from Potato
5 Isolation and spectrophotometric analysis of Tannins
6 Estimation of Total Phenols
7 Estimation of Flavanols

References:

1. Herbal Drug Technology, S. S. Agarwal & M. Paridhavi (eds), Universities Press, Hyderadad, India, ISBN 13:978-81-7371-579-2 p 231 - 439
2. Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p 49- 181, p 287 – 302.

Core Course XII: BC6CRT12-Computational Techniques in Biochemistry

Total hours of instruction: 54. Hours/week: 3. Credit: 3

Objectives: To provide the student in depth knowledge in bioinformatics

UNIT I: (12 hours)
Overview of Information Technology- Introduction to Computer, structural organization of computer, software, different types ofsoftware, hardware, Flow chart, operating system, different type of operating system,programming languages, Internet, TCP/IP address, WWW, HTTP, HTML & URLs

UNIT II: (12 hours)
Basic bioinformatics-Introduction to bioinformatics, its importance and scope, Pattern recognition and prediction,data submission tools (Webin, Sequin, Bankit)and data retrieval tools(DBGET, BioRS), data mining of biological databases- NCBI, DDBJ, EMBL, PDB, KRGG. Basic Local Alignment search Tool (BLAST)
Ref: Introduction to Bioinformatics (2002) by T.K Atwood and D.J Parry- Smith Publisher: Pearson Education Pvt Ltd ISBN 81-7808-507-0 p35

UNIT III: (10 hours)
Detailed study of various databanks-Biological databases, primary and secondary sequence databases, NCBI, EMBnet, Genbank,EMBL, DDBJ, PDB and KEGG

UNIT IV: (10 hours)
Genome analysis-Comparative genomics- Sequence alignment and analysis, pairwise alignment (BLAST, flavors of BLAST& FASTA), MSA (ClustalW), scoring matrices, alignment algorithms, tools for alignment of sequences.

UNIT V: (10 hours)
Application of bioinformatics-Docking, Molecular docking, Homology modeling, structure based drug designing.

Databases of drugs: drug bank, Cambridge structural database (CSD). Virtual screening, Application of bioinformatics in drug designing process

Ref: www.drugbank.ca

Ref: www.ccdc.cam.ac.uk/products/csd/

References:

Bioinformatics: Genes, proteins and computers. C.A. Orengo, D.T.Jones and J.M. Thornton
Bioinformatics methods and Application: genomics, proteomics and drug discovery by S.C.Rastogi, N Mendiratta, P.Rastogi

Core Course Practical VI-BC6CRP06- Computational Techniques in Biochemistry
Total hours of instruction: 36. Hours/week: 2. Credit: 1

Objective:-To provide students a practical knowledge on bioinformatic tools.

Bioinformatics:
Internet basics
Introduction to NCBI Web sites
Introduction to Data bases
Alignment of sequences of amino acids using BLAST
Alignment of sequences of amino acids using alignment programme uniport

Ref: Introduction Bioinformatics (2002) by T.K Atwood and D.J Parry- Smith Publisher: Pearson Education Pvt Ltd ISBN 81-7808-507-0 p35

Choice Based Open Course Offered to Students of Other Departments (5th Semester)

Open course I: BC5OPT01-Human Health and Nutrition

Total hours of instruction: 72 Hours/week: 4 Credit: 3

Objectives: To provide the students with an in-depth study on different aspects ofHuman health and nutrition

Unit I: (14 hours)

Basic concept of food, nutrition and health: Concepts of nutrition, classification, protein, fat, carbohydrate, fiber, and vitamin, mineral and trace elements. principal foods-Cereals, pulses, vegetables, fruits, nuts, oil seeds, animal foods, milk and milk products, egg, fish, meat, drinks and spices. Nutritional requirements- concepts, energy, Energy requirements protein quality, fat carbohydrate Balanced diet- for different ages, sex, occupation etc Functions of food, Socio-Economic Aspects of Nutrition, Health status in India, & Kerala, Nutrigenomics and customized nutrition.

Unit II: (12 hours)

Nutritional Programmes: National programmes related to nutrition, Vitamin Adeficiency programme, National iodine deficiency disorders (IDD) programme, Mid-Day meal programme, Integrated child development scheme (ICDS).

Unit III: (10 hours)

Food additives- colors, preservatives, Food adulteration, Household level food preservation and storage, Food labeling.

Unit IV: (12 hours)

Food Processing: (i) Methods of cooking, (ii) Healthy cooking practices, (iii) Food hygiene: Potable water- sources and methods of purification, Food and Water born infections.

Unit V: (24 hours)

Major nutritional deficiency diseases- Protein Energy Malnutrition, Vitamin A deficiency, Iron deficiency anemia, Iodine deficiency disorders, their causes, symptoms, treatment, prevention and government if any. Life style related diseases- hypertension, diabetes mellitus, and obesity- their causes and prevention through dietary/lifestyle modifications. Social health problems- smoking, alcoholism, drug dependence and Aquired Immuno Deficiency Syndrome (AIDS), Obesity andmalnutrition including protein-energy malnutrition, Lifestyle diseases including circulation and coronary heart diseases, Diabetes and inherited metabolic diseases, Food allergy

Suggested Readings

1. Food Additives Characteristics, Detection &, Estimation by Mahindru S N (2000) Publisher: Tata Mcgraw, Hill Publishing, Co Ltd ISBN: 0074637355 ISBN-13: 9780074637357, 978-0074637357
2. Potable Water by S.N. Mahindru (2004) Publisher: Aph, Publishing, Corporation ISBN: 8176487252, ISBN-13: 9788176487252, 978-817648725
3. Food, the Chemistry of Its Components 4th/ed by T. P. Coultate, (2002) Publisher: Royal Society of Chemistry, ISBN:0854046151, ISBN-13: 9780854046157, 978-0854046157
4. Food Hygiene by Kavita Ed Marwaha (2007) Publisher: Daya Publishing House ISBN: 8189729721 ISBN-13: 9788189729721, 978-8189729721
5. Principles of Human Nutrition by Martin Eastwood (2003) Publisher: Atlantic
6. Publishers & Distributors ISBN: 1405120290 ISBN-13: 9781405120296, 978-1405120296
7. Health, Nutrition And Diseases by Chatterjee, G. (2000) Publisher: Rajat Publication ISBN: 8187317566 ISBN-13: 9788187317562, 978-8187317562
8. Nutrition And Dietetics by Shubhangini A Joshi (2007) Publisher: Tata Mgraw Hill ISBN:0070472920 ISBN-13: 9780070472921, 978-0070472921
9. A Handbook of Foods And Nutrition by: F.C. Blank (2007) Publisher: Agrobios (India) (ISBN: 8177541633 ISBN-13: 9788177541632, 978-8177541632
10. Nutrition, Research:, Current, , Scenario, And, , Future Trends by Krishnaswamy Publisher: Oxford, &, Ibh, Publishing, Co., Pvt Ltd ISBN: 8120413245 ISBN-13: 9788120413245, 978-8120413245
11. Chemical Analysis Of Foods And Food Products, by M B Jacobs (1999) Publisher: Cbs ISBN: 8123906439 ISBN-13: 9788123906430, 978-8123906430

Open course II: BC5OPT02-Life Style Diseases

Total hours of instruction: 72 Hours/week: 4 Credit: 3

Objective: To create awareness among students about the various diseases which originate and which could be prevented by controlling the life style. The course also covers the general aspects of diagnosis, methods of prevention and pharmaceutical intervention.

Unit I (14 hours)
Concept of lifestyle diseases- importance of lifestyle factors in preventing disease development,diet, exercise, smoking, alcohol etc. Body mass index, determination and significance Obesity- factors leading to development, prevention, management

Unit II (12 hours)
Diabetes- Type 1 and type2, characteristics, causes, diagnosis, prevention and management

Unit III (18 hours)
Cancer: Characteristics, Causes, Diagnosis, Prevention, Management, familiarization with treatment modalities

Unit IV (14 hrs)
Atherosclerosis and cardiovascular diseases- Myocardial infarction, congestive heart failure, ischemic diseases-Causes, diagnosis and management.

Unit V (14 hours)
Importance of diet and exercise in health- balanced diet, BMR, calorific value, How to reducecholesterol and risk of heart attack through life style changes, use of *life style medicine* to treatdisorders.

Ref: Guide to prevention of lifestyle diseases- M.N. Kumar, R.Kumar, Deep & Deep Publications, ISBN: 817629518

Open course III: BC5OPT03-Nutritional Biochemistry

Total hours of instruction: 72 Hours/week: 4. Credit: 3

Objectives: To provide the students with an in-depth study on different aspects ofHuman nutrition

Unit I: (16 hours.)
Introduction to nutrition science: current trends in nutrition, nutrition in India: RDA, balanced diet, assessment of nutritional status
Energy metabolism: Energy molecules, energy value of foods (gross and physiological fuel value), units of energy; Determination of energy value of foods by direct and indirect calorimetry; Determination of energy expenditure: direct and indirect methods, RQ and its significance; Total energy requirements, factors affecting it. BMR: definition, measurements, and factors affecting it; SDA of foods; Food habits of people and relate it to balanced nutrition

Unit II: (14 hours.)
Nutritional aspects of the carbohydrates- Different dietary types, requirements, utilization andfunctions. Special role of the non starch polysaccharides.
Nutritional aspects of the lipids- Different dietary types, requirements, utilization andfunctions. Essential fatty acids.

Unit III: (14 hours.)
Nutritional aspects of the proteins- essential amino acids, nutritive value of proteins , amino acid imbalance, protein requirements, Protein Energy Malnutrition.

Unit IV: (14 hours.)
Dietary Macro elements, Calcium, Phosphorus, Magnesium. Trace Elements, Iron, Iodine, Zinc, Copper etc.
Food utilization: Ingestion, digestion, absorption transport, storage and disposal of food nutrients (proteins, carbohydrates, fats, vitamins and minerals).

Unit V: (14 hours)
Balanced diet- Recommended dietary allowances for different categories of the human beings.
Life style related diseases- hypertension, diabetes mellitus, and obesity- their causes and prevention through dietary/lifestyle modifications.

Ref: Nutrition and dietetics Davidson S and Pasmor J.R Essentials of food and nutrition M Swaminathan Vol. II, Applied aspects (1974), Ganesh Pub, Madras.
Food science B. Sreelakshmi
The text book of biochemistry (for medical students) DM Vasudevan, Sreekumari S, JAYPEE Brothers New Delhi.
Food facts and principles - Sakunthala Manay, Sadhakshara Swami.
Modern Nutrition Health and Diseases – Goodheart Human nutrition and dietetics-Davidson and Passmore

Choice Based Course Offered to Students of Department of Biochemistry (6th Semester)

Choice based course: BC6CBT01-Immunology and Immunological Techniques

Total hours of instruction: 72 Hours/week: 4 Credit: 3

Objectives: To introduce the students in understanding the basis of the science ofimmunology at the molecular, cellular, and whole-organism levels

Unit I: (12 hours)

Organs of Immune system: Primary and secondary lymphoid organs, Cells of Immune system- lymphoid cells, stem cells, B and T lymphocytes, Null cells, Mononucelar cells, granulocytic cells.

Ref: Elements Of Immunology by S C Rastogi (2006) Publisher: Cbs Publishers &Distributors ISBN**:** 8123907737 ISBN-13: 9788123907734**,** 978-8123907734

Unit II: (15 hours)

Immunity: Innate immunity (Non specific) - Anatomic barriers, Physical barrier, Phagocytic, Inflammatory. Adaptive (Specific) Immunity- Humoral and cell mediated immune responses, Recognition of antigens by B and T lymphocytes. Processing and presentation of antigens, Cellular interaction for generation of humoral and cell mediated response.

Ref: Elements Of Immunology by S C Rastogi (2006) Publisher: CBS Publishers & Distributors ISBN: 8123907737 ISBN-13: 9788123907734, 978-8123907734

Unit III: (15 hours)

Antigens: Factors that influence immunogenicity, epitopes, haptens, Immunoglobulins-Structure of immunoglobulins, Classes of immunoglobulins and their functions. Monoclonal antibody preparation and application. Complement system: The function of complement, complement activation. Major histocompatibility complex (elementary study), Transplantation immunology.

Ref: Elements Of Immunology by S C Rastogi (2006) Publisher: Cbs Publishers &Distributors ISBN**:** 8123907737 ISBN-13: 9788123907734**,** 978-8123907734

Unit IV: (15 hours)

Antigen-antibody interactions: Precipitation reaction, agglutination, ELISA, RIA, Immunoprecipitation, Immunofluorescence, T- cell receptors, maturation, activation and differentiation, B- Cell receptors, maturation, activation and proliferation, Cytokine-structure and function.

Ref: Immunology by Roitt, Publisher: Mosby ISBN: 0702025496, ISBN-13: 9780702025495**,** 9780702025495

Unit V: (15 hours)

Vaccine: Active and passive immunization, types of vaccines. Autoimmune diseases-Definition, Types of immune diseases like systemic lupus erythromatus, Multiple sclerosis, Rheumatoid arthritis, scleroderma, Hyper-sensitivity and allergy

Suggested Readings:

1. Immunology: An Introduction by Ian R Tizard (2006) Publisher: Cengage Learning (Thompson) ISBN: 8131500039, ISBN-13: 9788131500033, 978-8131500033
2. Immunology, and, Immunotechnology, by Chakravarty (2006) Publisher: Oxford University, Press, N, Delhi ISBN: 0195676882, ISBN-13: 9780195676884, 978-0195676884
3. Kuby Immunology, by Thomas J. Kindt, (2006) Publisher: W H Freeman & Co ISBN: 0716785900, ISBN-13: 9780716785903, 978-0716785903
4. Elements of Immunology (2009) by Khan Publisher: Dorling Kindersley (India) Pvt Ltd ISBN: 8131711587 ISBN-13: 9788131711583, 978-8131711583
5. Immunology by K.R. Joshi (2007) Publisher: Agrobios (India) ISBN: 8177541749, ISBN-13: 9788177541748, 978-8177541748
6. Basic, Immunology, 3ed by: Abbas Publisher: Elser ISBN: 8131217477, ISBN-13: 9788131217474, 978-8131217474
7. Immunology, by, P.R., Yadav (2004) Publisher: Discovery, Publishing House ISBN: 8171418570, ISBN-13: 9788171418572, 978-8171418572
8. Immunology, by David A., Marcus, Richard A. Goldsby, Barbara A. Osborne (2003) Publisher: W.H., Freeman & Company ISBN: 0716749475, ISBN-13: 9780716749479, 978-0716749479
9. Immunology by Roitt, Publisher: Mosby ISBN: 0702025496, ISBN-13: 9780702025495, 978-0702025495

Choice based course II: BC6CBT02-Biochemical Toxicology

Total hours of instruction: 72 Hours/week: 4 Credit: 3

Objectives: This course intends to introduce the students into basics of toxicologyand to make them understand the mechanisms by which biological systems are affected by pollutants

Unit I: (15 hours)

Definition and scope of toxicology: Eco-toxicology and its environmental significance, Toxic effects: basis for general classification & nature. Dose- Response relationship: Synergism and Antagonism. Determination of ED_{50} & LD_{50} values Acute and chronic exposure Factors influencing toxicity, Principles and procedures of testing for acute toxic effects: mammalian systems affected & Clinical signs of systemic toxicity.

Unit II: (15 hours)

Toxicity testing: Test protocol, Genetic toxicity testing & Mutagenesis assay.

In vitro test systems: bacterial mutation tests- Reversion test, Ames test, Fluctuationtest, and Eukaryotic mutation test.

In vivo test systems: Mammalian mutation test- Host mediated assay and DominantLethal test. Biochemical basis of toxicity: Mechanism of toxicity: Disturbance of excitable membrane function, Altered Calcium hemostasis, Covalent binding to cellular macromolecules & genotoxicity

Unit III: (15hours)

Environmental consequences of Pesticide toxicology, Toxicology of: food additives, metals, common drugs like Paracetamol.

Common air pollutants and their sources, Air pollution and its effect on Ozone layer, Industrial effluent toxicology and its effect on environment and health Toxic effects on mammalian tissues.

Unit IV: (15hours)

Xenobiotic metabolism: Absorption and distribution, Phase I reaction- Oxidation-reduction, hydrolysis & hydration, Phase II reaction- Conjugation: Methylation, Glutathione and amino acid conjugation. Detoxification.

Unit V: (12 hours)

Overview of regulatory agencies, management of toxicological risks, regulatory approaches, Regulatory system and organization

Suggested Readings

1. Principles of Toxicology by: Karen E. Stine, Thomas M. Brown 2006 Publisher: Crc Press ISBN:084932856X ISBN-13: 9780849328565, 978-0849328565
2. Principles of Biochemical Toxicology by John A. Timbrell Publisher: Informa Healthcare ISBN:0849373026 ISBN-13: 9780849373022, 978-0849373022
3. Environmental Toxicology by Sigmund F. Zakrzewski, (2002) Publisher: Oxford University Press, USA ISBN:0195148118 ISBN-13: 9780195148114, 978-0195148114

Choice based course III: BC6CBT03- Plant Biochemistry

Total hours of instruction: 72 Hours/week: 4 Credit: 3

Objectives: - This course intends to introduce the students into basics of plantbiochemistry. This course will make them aware of the different type of biochemical reactions taking place in plants. Also the students are exposed to the value added products of plants.

Unit I: (12 hours)

Photosynthesis: Ultra structure and organization of chloroplast membranes, lipid composition of chloroplast membranes, electron transport chain. Thylakoid membrane protein complexes. Calvin cycle: Biochemistry of RuBP carboxylase/oxygenase, activation of RUBISCO, oxygenation reaction, stereochemistry of RUBISCO, Hatch and slack pathway, CAM plants; productivity of C4 plants, photorespiration and compensation point, photosynthetic efficiency and plant productivity.

Unit II: (12 hours)

Nitrogen Metabolism: Nitrogen fixation, nitrogenase complex, electron transport chain and mechanism of action of nitrogenase. Structure of 'NIF' genes and its regulation, Hydrogen uptake and bacterial hydrogenases, Nitrate Metabolism: Enzymes of nitrate metabolism, regulation of their synthesis and activity. Ammonium assimilation enzymes: glutamine synthetase, glutamate synthase and GDH.

Unit III: (10 hours)

Plant growth regulators: Auxins, gibberellins, Cytokines, abscicic acid and ethylene-biosynthesis and their metabolic functions, synthetic growth hormones, inhibitors. Biosynthetic origin of secondary metabolites from primary metabolites.

Distinction between primary and secondary metabolites, Occurrence and distribution of secondary metabolites in taxonomically distinct plants, Distribution in various plant parts and at different developmental stages in plants

Unit IV: (18 hours)

Major chemical classes of secondary metabolites: A brief account of the following classes: Alkaloids, terpenoids, flavonoids, phenolics and phenolic acids, steroids, coumarins, quinines, acetylenes, cyanogenic glycosides, amines and non-protein amino acids, gums, mucilages, resins etc. (Structures not necessary. Give examples of the compounds and the plants in which present and their importance).

Importance of secondary metabolites: Protection of the producer plant from predators and insects; importance to man as active principles exerting physiological effects to mammalian systems. Uses of secondary metabolites to man: as drugs, precursors of drugs in pharmaceutical industry, as natural pesticides/insecticides; other uses of secondary metabolites.

Unit V: (20 hours)

General biosynthetic pathways and functions of the following classes of secondary metabolites (structures of intermediates not necessary):

Terpenoids: Isoprene as precurosor, hemi, mono, sesqui, di, triperenes and polyterpenes with examples and important members; their functions.

Phenols: simple phenols, phenol carboxylic acids, phenylpropanes, flavan derivatives, and phenolic glycosides. Broad outline of their biosynthesis and functions in plants and uses

Alkaloids: Definition of true and pseudo alkaloids; phenylethylamines, pyrrolidone alkaloids, piperidine alkaloids, pyridine alkaloids, tropane alkaloids, quinoline and isoquinoline alkaloids, indole alkaloids, purine alkaloids, isoprenoid alkaloids, steroidal alkaloids.

Suggested Readings

1. Plant Metabolism by H.D. Kumar and H.N. Singh (1980) Publisher: Macmillan (Mar 1980) ISBN-10: 0333256387 ISBN-13: 978-0333256381
2. Biotechnology: Secondary Metabolites by K.G. Ramawat, (2000) Publisher: Science Publishers,U.S. ISBN-10: 1578080576 ISBN-13: 978-1578080571
3. Plant Biochemistry by P. M. Dey and J. B. Harborne (Editors) (1997) Publisher: Academic Press ISBN-10: 0122146743, ISBN-13: 978-0122146749
4. Plant Metabolism by David T. Dennis, David H. Turpin, Dr Daniel D. Lefebvre and Dr David B. Layzell (Editors) (1997) Publisher: Longman; ISBN-10: 0582259061, ISBN-13: 978-582259065
5. Plant Biochemistry by Hans-Walter Heldt Professor Em (3ed 2004) Publisher: Academic ISBN-10: 0120883910 ISBN-13: 978-0120883912
6. The Principles of Plant Biochemistry by Murield Wheldale Onslow (1931) Publisher: Cambridge University Press ASIN: B002BJMX1M

Syllabus for B.Sc. Biochemistry as a Complementary Course

FIRST SEMESTER

Complementary course I: BC1CMT01-Elementary Biochemistry

Total hours of instruction: 36 Hours/week: 2 Credit: 2

Objective: To introduce the student basic principle of different types of chemical interactions in biological systems, an understanding on the basics of membrane biochemistry, importance of biochemistry of blood and to have a basic understanding of biochemical separation techniques.

Unit-I Physical Aspects of Biochemistry (10 hours)

Structure of water, Interactions in aqueous systems- covalent bond, hydrophobic interactions, Ionic interactions, hydrogen bond and van der Waals interactions. Ionization of water, strong and weak acids and bases and their dissociation, Henderson-Hasselbalch equation with derivation. Concepts of pH and Buffers. Buffersin biological systems – Phosphate buffer, Bicarbonate Buffer, Hemoglobin buffer.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain, (2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p: 230, 244, 269,

Ref: Lehninger Principles of Biochemistry by Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2008) 5thEdition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freeman and, Company, New York p:43-64.

Unit-II - Membrane Biochemistry (8 hours)

Fluid mosaic model of membrane. Types of membrane proteins (peripheral, integral and amphitropic). Solute transport across membranes (passive transport—simple diffusion and facilitated diffusion, active transport- primary and secondary, uniport, symport, antiport). Osmosis. Fundamental study of Donnan equilibrium-application in biological system.

Ref: Biochemistry fifth edition by campbell farrell (2006) Thomson Brooks cole Ltd p: 34-54

Ref: Biochemistry by J. M. Berg, J. L.Tymoczko, L. Stryer6th edition(2007)W. H. Freeman and Company, New Yorkp: 510-555

Unit-III - Plant Biochemistry (8 hours)

Basic ideas of photosynthesis- Structure of chloroplast, light reaction, cyclic and noncyclic photophoshorylation, dark reaction, fixation of CO_2 and formation of carbohydrate (brief treatment only) C3 and C4 plants, Biological nitrogen fixation.
Distinction between primary and secondary metabolites.
Importance of secondary metabolites-Protection of the producer plant from predators and insect. Give examples of the compounds and the plants in which present and their importance.

Ref: Plant Metabolism: H.D. Kumar and H.N. Singh. Affiliated East-West Press Pvt. Ltd., New Delhi, Madras, Hyderabad and Bangalore. (1993; 2nd edition)

Ref: Plant Biochemistry: P.M. Dey and J.B. Harborne. (Editors.) Harcourt Asia PTE Ltd. Academic Press. (Indian Edition, 2000)

Unit-IV- Techniques in Biochemistry (10 hours)

Colorimetry and spectrophotometry
Chromatography- Paper, TLC, HPTLC, Gel Filtration, Affinity chromatography
Electrophoresis- PAGE, AGE
Blotting Techniques- Western, Southern and Northern Blotting
Introduction to proteomics-MALDI-TOF MS

Ref: Practical Biochemistry Principles and Techniquesby Keith Wilson and John Walker 5th edition (2005), Cambridge University Press, p: 580-681

Ref: Biophysical Chemistry Principles and Techniques by Upadhyay, Upadhyay, Nathhimalaya publishing house (2002), p: 175-270, 344-421, 422-478.

Suggested Readings

1. A Text Book of Biochemistry, E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, Oxford and IBH Publishing Co., New Delhi, 1974
2. Textbook of Medical Biochemistry (third Edition) (Paperback-2001) by S. Ramakrishnan. Publisher: Orient Longman ISBN: 8125020713 ISBN13: 978812502071 4, 8125020714
3. Introduction to Biophysics by Pranab kumar banarjee, S. chand & company Ltd. 2008 Biochemistry third edition by mathews, van Holde, Ahernpearson education
4. Human Physiology by C C Chatterjee 11thedition 1987
5. Biochemistry by Debajyoti das. Academic publishers. Kolkata.
6. Introduction to Biophysics by Pranab kumar Banarjee (2008) S. Chand & Company Ltd

Complementary course Practical I- Elementary Biochemistry

Total hours of instruction: 36 Hours/week: 2 Credit:1

Objective: To resolve quantitative problems concerning preparation of solutions andbuffers and to have an understanding of basic separation techniques.

1. Preparation of solutions:
   Percentage solutions
   Molar solutions
   Normal solutions
   Dilution of Stock solutions
2. Preparation of buffers using the Henderson Hasselbach equation
3. Determination of pH using pH meter (Demonstration)
4. Biochemical separation Techniques

a. Chromatographic techniques (**Any one to be performed**)

Separation of amino acids and simple sugars by Paper chromatography (Descending or ascending)
Separation of amino acids and lipids by Thin Layer chromatography
Separation of Plant pigments by Column/ Thin layer chromatography

b. Electrophoretic techniques (Demonstration)

Analysis of proteins and nucleic acids (PAGE, AGE)

5. Colorimetry and Spectrophotometry techniques
   Verification of Beer Lambert's law

References

1. Hawk's Physiological Chemistry, Bernard L. Oser (ed) TATA McGRAW Hill Publishing Company LTD, New Delhi p 10- 15.
2. Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande, I.K International Pvt. LTD, New Delhi, ISBN 81-88237-41-8, p 13- 17, p 39-43.
3. Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p 1- 15, 195-303
4. Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p 12 - 18

SECOND SEMESTER

Complementary course II: BC2CMT02-Biomolecules

Total hours of instruction: 36 Hours/week: 2 Credit:2

Objective: To describe structural characteristics of simple organic biomolecules andtheir biologically important derivatives indicating the constituent units, linkage between them etc.

Unit I: Carbohydrates (10 hours)

Isomerism of carbohydrates, D and L forms of glyceraldehyde , epimers, mutarotation and its explanation by ring structures, anomers, Structure (linear and cyclic) of glucose, galactose, mannose and fructose. Reducing action of sugars, Structure ((Haworth perspective formula) of disaccharides - maltose, sucrose, lactose) (elucidation of the structures of mono-, di-, and polysaccharides is not included). Structure and important properties of the following Homopolysaccharides – Starch, glycogen, cellulose and chitin. Heteropolysaccharides-hyaluronic acid, heparin.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain, (2008) Publishers: S. Chand &Co Ltd ISBN: 81-219-2453-7 p:73

Ref: Lehninger Principles of Biochemistry by Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2008) 5thEdition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freeman and, Company, New York p: 239-255

Unit II: Lipids (6 hours)

Basic ideas about classification and physiological functions of lipids, Fatty acids – classification, structure of the following fatty acids – stearic acid, oleic acid, linoleic acid. Structure of triacylglycerol. Structure of: phosphatidic acid, lecithin, cephalin, and phosphatidyl serine. Functions of Sphingolipids. Chemical structure and functions of cholesterol and ergosterol. Definition of saponification number, acid number and iodine number of fats.

Ref: Lehninger Principles of Biochemistry by Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2008) 5thEdition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freeman and Company, New Yorkp: 345-356

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand &Co Ltd ISBN: 81-219-2453-7 p: 230

Unit III: Aminoacids and Protein (10 hours)

Name (with one letter and three letter code) and structures of the 20 standard aminoacids occurring in proteins, Representation of amino acid in the zwitter ionic form.Classification and function of Proteins. Elementary study of primary, secondary, tertiary and quaternary structure of proteins.Denaturation of proteins. Specialised proteins – structure and functions of Collagen

Ref: Lehninger Principles of Biochemistry by Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2008) 5thEdition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freeman and Company,

New York. p: 75-90, 127-129

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand &Co Ltd ISBN: 81-219-2453-7 p:132

Unit IV: Nucleic acids (10 hours)

Chemical nature of nucleic acids- Structure of purines and pyrimidines, deoxyribose, ribose, nucleosides, nucleotides. Formation of phosphodiester linkages, Watson-Crick model of DNA-Chargaff rule, Different forms of DNA-A, B and Z DNA. Denaturation of nucleic acids-hyperchromiceffect,*T*m-values and their significance, Structure and function of mRNA, rRNA and tRNA.

Ref: Lehninger Principles of Biochemistry by Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2008) 5thEdition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freemanand Company, New York. p: 273-300

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand &Co Ltd ISBN: 81-219-2453-7 p:280

Suggested Readings

1. A Text Book of Biochemistry by E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, Oxford and IBH Publishing Co., New Delhi, 1974
2. Biochemistry by Donald Voet, Judith G. Voet Publisher: John Wiley &Sons Inc(2004) ISBN: 047119350X ISBN-13: 9780471193500, 978-0471193500
3. Principles Of Biochemistry by Geoffrey L Zubay, William W Parson, Dennis E Vance Publisher: Mcgraw-hill Book Company – Koga(1995) ISBN:0697142752 ISBN-13: 9780697142757, 978-0697142757
4. Principles Of Biochemistry, 4/e by Robert Horton H , Laurence A Moran, Gray ScrimgeourK Publisher: Pearsarson(2006) ISBN: 0131977369, ISBN13:978013197736 5, 978-0131977365
5. Biochemistry (6thEdition) by JeremyM.berg John L.tymoczko Lubert Stryer Publisher:B.i.publicationsPvt.Ltd (2007) ISBN:071676766X ISBN13: 978071676 7664,978716767664
6. Biochemistry by Rastogi Publisher: McgrawHill (2008) ISBN:0070527954 ISBN13: 978 0070527959, 978-0070527959
7. Textbook of Biochemistry for medical studentsby Vasudevan, D. M., Sreekumari, S., &Vaidyanathan, K. (2010). Jaypee Brothers Publishers. p: 76

Complementary course Practical II- BC2CMP01- Biomolecules

Total hours of instruction: 36 Hours/week: 2 Credit:1

Objective: To provide the students an opportunity to develop their qualitative skillsand to have a sound knowledge on basic protocols for identification of biomolecules.

1. Qualitative analysis of a given unknown sample (Carbohydrates/proteins/amino acids/lipids/NPN substance)

i. Reactions of Carbohydrates, Amino acids, Proteins, Lipids and NPN substance

a. Carbohydrates: (Glucose, fructose, Maltose, Lactose, Sucrose, Starch, Dextrin maybe given for analysis).

Molisch test, Iodine test, Test for reducing sugars (Fehling's test, Benedict's test, Barfoed's test), Seliwanoff's test, Bial's test, Mucic acid test, Acid hydrolysis of Sucrose, Osazone test

b. Amino acids: (tyrosine, tryptophan,cysteine, cystine, methionine, arginine, proline, histidine may be given for analysis)

Ninhydrin test, Xanthoproteic test, Istatin test, Pauly'sdiazo test, sakaguchi test, Ehrlich's test, Sodium nitroprusside test, Millon's test, Sullivan's test

c. Proteins: (Casein, Albumin, Gelatin, peptone may be given for analysis).

Biuret test, Ammonium sulfate precipitation test, Sulphosalicylic acid test, Heat coagulation test, test for inorganic phosphate

d. Lipids: Fats (tristearin), Fatty acids (palmitic acid, stearic acid, oleic acid), Glycerol, Steroids, and cholesterol

Solubility in Organic solvents, saponification test, Acrolein test, Test for unsaturation: with bromine water or dilute potassium permanganate or Hubl's iodine test, Salkowski test, Zak's test

e. Non Protein nitrogenous compounds: (Urea, Uric acid, Creatinine)

Urease test, Phosphotungstic acid test and Jaffe's test

ii. Identification of Monosaccharide, Disaccharide, Polysaccharide following a systematic scheme of analysis (Single component from among the above mentioned carbohydrates to be given).

iii. Identification of amino acids and proteins following a systematic scheme for analysis (single components only need be given

iv. Identification of lipids following a systematic scheme for analysis (single components only need be given)

v. Identification of NPN following a systematic scheme for analysis (single components only need be given)

References

1. Hawk's Physiological Chemistry, Bernard L. Oser (ed) TATA McGRAW Hill Publishing Company LTD, New Delhi p 10- 15. , p 60 – 127, 1317- 1334
2. Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande, I.K International Pvt. LTD, New Delhi, ISBN 81-88237-41-8, p 13- 17, p 49-72
3. Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9 p 15- 23, 33- 35, 50 -57.
4. Practical Biochemistry, R.C. Gupta & S. Bhargava (eds) CBS Publishers and Distributors, New Delhi, ISBN 81-239-0124-0 p 9 - 27

THIRD SEMESTER

Complementary course III: BC3CMT03-Enzymology and Metabolism

Total hours of instruction: 54 **Hours/week: 3** **Credit: 3**

Objective: To introduce the student basics of enzyme catalysis and explain the majorpathways of carbohydrate, protein and lipid metabolism.

Unit I -Enzymology (16 hours)

Classification of enzymes- six major classes of enzymes with one example each. Cofactors and coenzymes. Elementary study of the factors affecting velocity of enzyme catalysed reactions- effect of substrate concentration, enzyme concentration, temperature and pH.Michaelis-Menten equation(without derivation). Km and its significance.The Lineweaver-Burk plot.Enzyme specificity- an example each for group specificity, optical specificity, geometrical specificity and cofactor specificity of enzymes.

Ref: Biochemistry by U. Satyanarayana and U. Chakrapani. Fourth Edition, co-published by Elsevier Books and Allied (P) Ltd, ISBN: 978-81-312-3601-7, p:86-101

Ref: Lehninger Principles of Biochemistry by Nelson, D. L., Lehninger, A. L., & Cox, M.M. (2008) 5thEdition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freeman andCompany, New York, p:184-220.

Unit –II Carbohydrate metabolism (16 hours)

Glycolysis (with structure). Fates of pyruvate, lactic acid fermentation, alcohol fermentation. Pyruvate dehydrogenase reaction, Citric acid cycle (with structure), substrate level phosphorylation, electron transport chain and oxidative phosphorylation. Glycogen metabolism-glycogenesis and glycogenolysis.

Ref: Biochemistryby U. Satyanarayana and U. Chakrapani.Fourth Edition, co-published by Elsevier and Books and Allied (P) Ltd, ISBN: 978-81-312-3601-7,p:225-265.

Ref: Lehninger Principles of BiochemistrybyNelson, D. L., Lehninger, A. L., & Cox, M. M. (2008)5thEdition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freeman and Company, New York, p:528-707.

Unit-III Protein metabolism (12 hours)

General aspects of aminoacid metabolism-Decarboxylation, deamination and transamination of aminoacids (without molecular mechanism).Urea cycle (with structure).Glucogenic and Ketogenic amino acids with examples.

Ref: Biochemistry byU. Satyanarayana and U. Chakrapani. Fourth Edition, co-published by Elsevier and Books and Allied (P) Ltd, ISBN: 978-81-312-3601-7, p:144-375.

Ref: Lehninger Principles of BiochemistrybyNelson, D. L., Lehninger, A. L., & Cox, M. M. (2008), 5thEdition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freeman and

Company, New York, p: 677-878

Unit IV- Lipid metabolism (10 hours)

Fatty acid biosynthesis (with structure), Oxidation of fatty acids-Fatty acid activation, carnitine shuttle, β- oxidation (with structure) of fatty acids-explain using palmitic acid and ATP yield . Ketone bodies. Outline study of cholesterol biosynthesis (without structure).

Ref: Biochemistry byU. Satyanarayana and U. Chakrapani. Fourth Edition, co-published by Elsevier and Books and Allied (P) Ltd, ISBN: 978-81-312-3601-7, p: 287-309.

Ref: Lehninger Principles of Biochemistry byNelson, D. L., Lehninger, A. L., & Cox, M. M. (2008), 5thEdition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freeman and Company, New York, p:650-831

Suggested Readings

1. A Text Book of Biochemistryby E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, Oxford and IBH Publishing Co., New Delhi, 1974
2. Harper's Biochemistry by Robert K. Murray , Daryl K. Granner, Peter A. Mayes and Victor W. Rodwell, Publisher: Appleton & Lange; 25th Revised edition edition (1 July 1999), ISBN-10: 0838536840, ISBN-13: 978-0838536841
3. Biochemistry Seventh Edition by Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, Publisher: W. H. Freeman; Seventh Edition edition (December 24, 2010), ISBN-10: 1429229365, ISBN-13: 978-1429229364
4. Biochemistry by Donald Voet, Judith G. Voet, Publisher: John Wiley & Sons (2011), Fourth Edition,ISBN-10: 0071737073, ISBN-13: 978-0071737074
5. Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain, Nithin Jain (2008), Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7

Complementary course Practical - Enzymology and Metabolism

Total hours of instruction: 36 Hours/week: 2 Credit: 1

Objective: To make the student understand the basic steps involved in extraction anddetermination of enzyme activity.

1. Extraction of enzymes: (Minimum of 2 experiments to be done)

Acid phosphatase from Fresh Potato (*Solanumtuberosum*)
β- amylase from Sweet potato (*Ipomoea batatas*)
Urease from Jack bean (*Canavaliaensiformis*)

2. Enzyme Assay: (Minimum of 2 experiments to be done, enzymes extracted from above experiment can be used)

Acid phosphatase
β- amylase
Urease from Jack bean

References

Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8, p: 173-187

Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p: 110 – 155
Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p: 49- 181, 184 – 255

FOURTH SEMESTER

Complementary course IV: BC4CMT04- Nutritional and Clinical Biochemistry

Total hours of instruction: 54 Hours/week: 3 Credit: 3

Objective: To explain and schematize the nutritional and biological importance of vitamins and minerals. Explain the clinical significance of organ based function tests and describesthe biochemical basis of some important metabolic disorders.

Unit I- Nutritional biochemistry (12 hours)

Concepts of nutrition, Nutritional requirements, Principle foods-Cereals,pulses, vegetables, fruits, nuts, milk, egg, meat, fish. Calorific value of foods, Respiratory quotient, Basal metabolic rate. Biological value of proteins, essential and non-essential amino acids and essential and non-essential fatty acids.Sources, nutritional importance and deficiency disorders of vitamin A, D, E, K, C, B1, B2, pyridoxine, nicotinic acid, B12 and folic acid (structure not required). Biological and nutritional importance of macro and micro minerals-calcium, magnesium, sodium, potassium, iron, copper, selenium and their deficiency disorders.

Ref: Textbook of Biochemistry for Medical Students byVasudevan, D. M., Sreekumari, S, &Vaidyanathan, K. (2010). Jaypee Brothers Publishers. p: 74,196, 271-281, 300-315, 317, 320,321, 322.

Unit-II Blood (10 hours)

Constituents of Blood, types of blood cells, components of plasma, types of plasma proteins and functions. Mechanism of blood clotting (Extrinsic and Intrinsic pathway). anticoagulants, fibrinolysis. Structure of hemoglobin.-Types of hemoglobin, sickle cell anemia.

Ref: Essentials of Medical physiology by Sembulingum, Prema sembulingum 5th edition Jaypee (2010) p: 49-150

Ref: Harper"s illustrated Biochemistry by R.K Murrayet al 25th edition (1999) Publisher: Appleton & Langep: 588-632

Unit III- Clinical biochemistry (18 hours)

Basic concepts of clinical biochemistry. Definition and scope of clinical biochemistry in diagnosis. Sample collection and preservation of blood, plasma, serum and urine. Chemical analysis of blood, urine and CSF. Liver function tests - total protein, albumin, globulin, albumin-globulin ratio. Total and conjugated bilirubin, AST, ALT, ALP, GTT. Thyroid function tests- T3 and T4, TSH. Renal functiontests-Urea, creatinine, urea clearance test and creatinine clearance test (Normal values of the above tests must be included).

Ref: Text book of Medical Biochemistry by M.N. Chatterjee and Rana Shinde, Jaypee Brothers,Medical Publishers Pvt Ltd. New Delhi. p: 168 - 202.

Ref: Text Book of Biochemistry by D M Vasudevan and Sreekumari S. Jaypee Brothers, Medical Publishers Pvt Ltd. New Delhi.p: 517 - 525.

Ref: Clinical Biochemistry Principles and Practices by Praful B Godkar, Bhalani publishing house. Bombay. India. p: 87- 93

Unit IV- Biochemical basis of Metabolic disorders (14 hours)

Biochemical basis of Lactose intolerance, Diabetes mellitus, hypoglycaemia, galactosemia, hyperlipidemia, atherosclerosis, ketosis, obesity.

Ref: Clinical Biochemistry Principles and Practices by Praful B Godkar, Bhalani publishing house. Bombay. India. p: 258 – 271, 233 – 251, 92 – 117.

Ref: Text Book of Biochemistry by D M Vasudevan and Sreekumari S. Jaypee Brothers, Medical Publishers Pvt Ltd. New Delhi. p: 428 – 451, 480 – 484, 537 - 549.

Ref: - Text book of Medical Biochemistry by M.N. Chatterjee and Rana Shinde, JaypeeBrothers, Medical Publishers Pvt Ltd. New Delhi. p: 668 - 808.

Suggested Readings

1. Lehninger Principles of Biochemistry, Fourth Edition by David L. Nelson Michael M. Cox. Publisher: W. H. Freeman; (2004) ISBN-10: 0716743396 ISBN-13: 978-0716743392
2. A Text Book of Biochemistry by E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, Oxford and IBH Publishing Co., New Delhi, 1974
3. Biochemistry (2004) by Donald Voet, Judith G. Voet Publisher: John Wiley & Sons Inc ISBN: 047119350X ISBN-13: 9780471193500, 978-0471193500
4. Principles Of Biochemistry (1995) by Geoffrey L Zubay, William W Parson, Dennis E Vance Publisher: Mcgraw-hill Book Company Koga ISBN:0697142752 ISBN-13: 9780697142757, 978-0697142757
5. Principles Of Biochemistry, 4/e (2006) by Robert Horton H , Laurence A Moran, Gray ScrimgeourK Publisher: Pearsarson ISBN: 0131977369, ISBN-13:9780131977365, 978-0131977365
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Complementary course Practical II- BC4CMP02- Nutritional and Clinical Biochemistry

Total hours of instruction: 36 Hours/week: 2 Credit:1

Objective: To introduce the student protocols of quantitative analysis ofbiomolecules using colorimetric technique and to familiarize qualitative analysis of body fluids

1. Estimation of Carbohydrates: (Colorimetric) (Any 2 to be done)
   Quantitation of total sugars by phenol sulphuric acid method
   Estimation of reducing sugars by dinitrosalicylate method
   Determination of fructose by Roe's resorcinol method

2. Separation and Estimation of Lipids: (Colorimetric) (Any 1to be done)
   Estimation of Cholesterol by Zak's method
   Determination of saponification value of fats
   Determination of iodine number of oils

3. Estimation of Proteins and Amino acids: (Colorimetric) (Any 2 to be done)
   Estimation of protein by Lowry's method
   Determination of protein by Biuret method
   Estimation of tryptophan by Spies and Chamber's method

4. Estimation of Minerals and Vitamins (Colorimetric) (Any 1 to be done)
   Colorimetric estimation of iron in foodstuffs by ά άdipyridyl method
   Quantitative determination of thiamine in cereals and food
   Estimation of ascorbic acid in Lemon juice

5. Qualitative tests of urine: Abnormal constituents) (Any 2 to be done)
   Proteins (Coagulation test, sulfosalicylic acid test, test for Bence-Jones proteins)
   Sugars (Benedicts test)
   Haemoglobin (Benzidine test)
   Ketone bodies (Rothera test, Gerhardt's test)
   Bile pigments (Fouchet's test, Gmelin's test) Bile salts (Hay's test)

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