

KANNUR UNIVERSITY

(Abstract)

B.Sc Biochemistry Programme-Revised Scheme & Syllabus of III to VI Semesters of the Courses effective from 2009 admission under Choice based Credit Semester System-implemented -Orders Issued.

ACADEMIC BRANCH

No.Acad/C2/754/2007(2)

Dated, K.U.Campus. P.O ,08-06-2010.

Read: 1.U.O. No.Acad/C2/754/2007(3) dated 10-07-2009.

2. Minutes of the meeting of the Board of Studies in Chemistry (UG) held on 30-10-2009.
- 3.Letter dated 21-05-2010 from the Chairman, BOS Chemistry (UG).

ORDER

1.The Scheme(full) and Syllabus of Core (I and II Semesters) and Complementary Courses of B.Sc Biochemistry Programme under Choice based Credit Semester System were implemented in this University with effect from 2009 admission, as per paper read(1) above.

2.The Board of Studies in Chemistry (UG) vide paper read (2) above has recommended to revise the scheme and finalise the syllabus of the Core (III to VI Semesters), General(III & IV Semesters) and Open Courses of B.Sc Biochemistry Programme for implementation with effect from 2009 admission.

3. The Chairman, BOS in Chemistry (UG), vide paper (3) above has forwarded the revised scheme and finalised Syllabi of the Core (III to VI Semesters),General(III & IV Semesters) and Open Courses for B.Sc Biochemistry Programme under Choice based Credit Semester System, for implementation with effect from 2009 admission.

4. The Vice Chancellor, after examining the matter in detail, and in exercise of the powers of the Academic Council as per section 11(1) of Kannur University Act 1996 and all other enabling provisions read together with, has accorded sanction *to implement the revised scheme and syllabi of Core (III to VI Semesters), General (III & IV Semesters) and Open Courses of B.Sc Biochemistry Programme in line with Choice based Credit Semester System, with effect from 2009 admission*, subject to report to the Academic Council.

5. The revised scheme and syllabi of Core (III to VI Semesters),General (III & IV Semesters) & Open Courses for B.Sc Biochemistry Programme under Choice based Credit Semester System, implemented with effect from 2009 admission are appended.

6. Orders are issued accordingly.

7. The U.O read above stands modified to this extent.

Sd/-

To:

REGISTRAR

The Principals of Colleges offering B.Sc Biochemistry Programme.

Copy To:

- 1.The Examination Branch (through PA to CE) Forwarded/By Order
- 2.The Chairman, BOS Chemistry (UG)
3. PS to VC/PA to PVC/PA to Regr SECTION OFFICER
- 4.The Computer Programmer(to publish in the website)
5. DR/AR I Academic 6. SF/DF/FC.



# **KANNUR UNIVERSITY**

**REVISED SCHEME**

**&**

***SYLLABUS (III to VI Semesters)***

**FOR**

**UNDERGRADUATE PROGRAMME**

**IN**

## **BIOCHEMISTRY**

**(CORE/GENERAL/OPEN COURSES)**

**UNDER**

**CHOICE BASED CREDIT SEMESTER SYSTEM**

***w.e.f 2009 ADMISSION***

**Scheme(Core Courses)**

Semester	Course Code	Title of the Course	Hours/ week	Credits
III	3BO3BCH	Biomolecules	3	3
	3BO4BCH	Biochemistry Practical -I	2	-
	3BO5BCH	Biochemistry Practical –II	2	-
IV	4BO6BCH	Physiological Aspects of Biochemistry	3	3
	4BO4BCH	Biochemistry Practical –III	2	2
	4BO5BCH	Biochemistry Practical –IV	2	2
V	5BO7BCH	Bioenergetics & General Metabolism	5	5
	5BO8BCH	Computational techniques in Biochemistry	4	4
	5BO9BCH	Immunology & Immunological Techniques	4	4
	5B10-14BCH	Biochemistry Practical -V	8	-
	5B15BCH	Project	2	-
VI	6B16BCH	Genetic engineering	5	5
	6B17BCH	Clinical Biochemistry	4	4
	6B18BCH	Elective	4	4
	6B10-14BCH	Biochemistry Practical –VI	5	10
	6B15BCH	Project	5	4

**Scheme( Elective)**

No	Semester	Course Code	Title of the Course	Contact Hrs/week	Credits
1	VI	6B18BCH	Pharmaceutical Chemistry	4	4
2	VI	6B18BCH	Biochemistry Of Health and Nutrition	4	4
3	VI	6B18BCH	Fermentation and Food Technology	4	4

### **Scheme Common(General) Courses**

<b>No</b>	<b>Semester</b>	<b>Course Code</b>	<b>Title of the Course</b>	<b>Contact Hr/week</b>	<b>Credits</b>
1	III	3A05BCH	Cellular Biochemistry	4	4
2	III	3A06BCH	Molecular Biology	4	4
3	IV	4A09BCH	Biophysical & Biochemical Techniques	4	4
4	IV	4A10BCH	Enzymology	4	4

### **Scheme (Open Courses)**

<b>No</b>	<b>Semester</b>	<b>Course Code</b>	<b>Title of the Course</b>	<b>Contact Hrs/week</b>	<b>Credits</b>
1	V	5D01BCH	Nutritional Biochemistry	2	2
2	VI	6D02BCH	Plant Biochemistry	2	2

## 3A05BCH Cellular Biochemistry

Credit: 4

Total hours of instruction: 72

Hours/Week: 4.

### **Module -I. Cell- structural organization and functions of Intracellular Organelles (15 Hrs.)**

Discovery of cell and Cell Theory, Comparison between plants, animal and microbial cells. Cell wall, Nucleus, mitochondria, chloroplast, ribosomes, endoplasmic reticulum, Golgi bodies, lysosomes and peroxysomes.

### **Module -II. Membrane structure and functions (15 Hrs.)**

Plasma membrane- structure and composition -Fluid mosaic model, lipid bilayer. Transport across membranes. Exocytosis, Endocytosis, Simple diffusion, facilitated transport- definition, types with examples. Symport, uniport and antiport, Active transport- Primary active transport, secondary active transport, sodium/potassium-ATPase.

### **Module -III. Cell division and Cell cycle (10 Hrs.)**

Mitosis and meiosis, their regulation, steps in Cell cycle and control of cell cycle.

### **Module -IV. Cellular communication (16 Hrs.)**

Cell- cell interaction and cell matrix interaction, extracellular matrix, proteoglycan and collagen, Cell – cell adhesion, catherins, desmosomes, gap junction and tight junction.

### **Module –V. Cancer (16 Hrs.)**

Apoptosis- Difference between apoptosis and necrosis, outline study of apoptotic pathways, role of Caspases proteins in apoptotic pathways, malignant cells-Properties of malignant cells.

### **References**

1. Cell biology, Genetics, Molecular Biology, Evolution and Ecology by P.S. verma and V. K. Agarwal (2008) Publisher: S. Chand & Company Ltd, New Delhi.
2. Cell and Molecular Biology: E.D.P. Robertis and De Robertis
3. Molecular Cell Biology: H. Lodish, J. Parnell and C. A. Kaiser ,WH. Freeman and company New York and London



## 3A06BCH Molecular biology

Credit: 4

Total hours of instruction: 72

Hours/Week: 4.

### **Module -I. Nucleic Acids (13 Hrs.)**

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, denaturation of nucleic,  $T_m$ -values and their significance, A, B, and Z forms of DNA, Types of RNA (t-RNA, r-RNA, m-RNA).

### **Module -II. DNA Replication in Prokaryotes: (15 Hrs.)**

Central dogma of molecular biology, DNA replication – conservative, semiconservative and dispersive types. DNA replication in prokaryotes: DNA polymerases, other enzymes and protein factors involved in replication. Mechanism of replication.

### **Module -III: Transcription in Prokaryotes (16 Hrs.)**

RNA polymerase, promotors, initiation, elongation and termination of RNA synthesis, inhibitors of transcription. Reverse transcriptase, post transcriptional processing of RNA in eukaryotes. Genetic code – Basic features, biological significance of degeneracy, Wobble hypothesis.

### **Module -IV: Mechanism of Translation in Prokaryotes (12 Hrs.)**

Charged RNA, f-met – tRNA, initiator codon, Shine-Dalgarno consensus sequence, formation of 70S initiation complex, role of EF-Tu, EF-Ts, EF-G and GTP, non-sense codons and release factors, RF1 and RF2.

### **Module -V: Regulation of Gene Expression (16 Hrs.)**

Regulation of gene expression in prokaryotes – Enzyme induction and repression, Operon concept, Lac operon, Trp operon.

Regulation of gene expression in eukaryotes.

### **References:**

1. Cell biology, Genetics, Molecular Biology, Evolution and Ecology by P.S. Verma and V. K. Agarwal (2008) Publisher: S. Chand & Company Ltd.
2. Molecular Biology of the Gene by James D Watson, Tania A Baker, Stephen P.
3. Cell and Molecular Biology, 3e (2003) by Karp.
4. Lehninger's principles of Biochemistry -: D. L. Nelson and M. M. Cox , Worth Publishers, 41 Madisons Avenue New York, USA.



## 3BO3BCH Biomolecules

Credit: 3

Total hours of instruction: 54.

Hours/Week: 3.

### **Module -I. Carbohydrates (12 Hrs.)**

Definition and classification. Isomerism of carbohydrates, relationship of D and L forms of glyceraldehyde, examples of epimers, mutarotation and its explanation, anomeric forms, classification of monosaccharides, linear and cyclic structure (glucose, galactose, mannose, ribose and fructose).

Disaccharides- structure, occurrence, chemistry and functions of sucrose, lactose, trehalose, maltose, isomaltose and cellobiose.

Homopolysaccharides: Occurrence, structure, chemistry and functions of cellulose, starch, glycogen, chitin and insulin.

Heteropolysaccharides: Occurrence, types, composition and function

### **Module -II. Lipids (12Hrs.)**

Definition, basic ideas about the biochemical functions of lipids. Classification of lipids with examples, classification of fatty acids. Physical and chemical properties of fatty acids- saponification number, acid number, rancidity of fats and iodine number- their applications. Essential and non-essential fatty acids with examples. Compound lipids: storage and membrane lipids. Structure and functions of phospholipids and glycolipids, Steroids: Structure of steroid nucleus, Cholesterol.

### **Module -III. Amino acids and Proteins (12 Hrs.)**

Amino acids: Definition, stereoisomerism, Three letter and 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.

Proteins: Peptides- Formation of peptide bond. Elementary study of primary, secondary, tertiary and quaternary structure of proteins- (E.g. Hemoglobin and Myoglobin), forces stabilizing the structure of protein, Classification of proteins based on solubility, shape and function. Outlines of protein sequencing.

### **Module -IV: Vitamins (8 Hrs.)**

Vitamins: Definition, classification- fat soluble and water soluble- sources, chemical nature (without structure), functions of vitamins.

### **Module -- V: Chemistry of Bioactive substance (10Hrs)**

Glutathione, prostaglandins, interleukins, gamma amino butyric acid (GABA), Adrenaline, dihydroxy phenyl alanine (DOPA), Cyclic AMP.

### **References:**

1. Lehninger's Principles of Biochemistry: - D. L. Nelson and M.M. Cox, Worth Publishers, 41 Madisons Avenue New York, USA.
2. Text Book of Biochemistry: E.S. West, W.R. Todd, H.S. Mason and J. T. Van Bruggen
3. The text book of biochemistry (for medical students) DM Vasudevan, Sreekumari S, JAYPEE Brothers NEW DELHI.

4. Principles of Biochemistry Geoffrey L Zubey, William W parson Pennis E Vance,WMC Brown publishers.
5. Biochemistry: Lubert Stryer. and Hall, J.E., Library of congress cataloguing-in publication Data, Bery, Jeremy mark ISBN.
6. Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd.



## 3BO4BCH Biochemistry Practical -I

Credit: 0

Total hours of instruction: 36

Hours/Week: 2.

- 1) Preparation of solutions:
  - a) percentage solutions,
  - b) Molar solutions
  - c) Normal solutions
  - d) Preparation of buffers.
- 2) Standardization of pH meter
- 3) Measurements of pH of solutions using pH meters
- 4) p<sup>H</sup> metry: Acid base titration curves. Measurement of pK<sub>a</sub> of amino acids.
- 5) Principles of colorimetry and verification of Beer-Lambert law.
- 6) Identification of different stages of mitosis and study of morphology of metaphase chromosomes from Onion root meristems.
- 7) Identification of different stages of meiosis from suitable material.
- 8) Lane-Eynon titration for reducing sugars.
- 9) Estimation of amino acid- titration method

### References:

- 1) Practical Biochemistry: Plummer
- 2) Practical Biochemistry: K.E. Van Holde.
- 3) Introductory Practical Biochemistry (2001). Ed. S.K. Sawhney and Randhir Singh, Narosa Publishing House, New Delhi.
- 4) Practical Biochemistry Sadasivam and Manickam.
- 5) The chemical analysis of food and food products: Morris B.Jacobs, CBS-New Delhi.
- 6) Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana.



## 3BO5BCH Biochemistry Practical -II

Credit: 0

Total hours of instruction: 36

Hours/Week: 2.

- 1) Qualitative analysis Of Carbohydrates: - Fehling's test, Benedict's test, Barfoed's test, Molisch's test, Bial's test, Seliwanoff test, Iodine test, Osazone test.
- 2) Qualitative analysis Of Amino acid: - Million's test, Xanthoproteic reation, Pauly's test, Sakaguchi reaction, Sulphur reaction, Ninhydrin, Biuret.
- 3) Qualitative analysis Of lipids
- 4) Verification of Beer- Lambert's Law.
- 5) Estimation of Glucose Benedict's method
- 6) Amino acid estimation by ninhydrin method
- 7) Determination of reducing sugars by Nelson – Somogyi's method
- 8) Protein estimation by Biuret method.
- 9) Protein estimation by Lowry *et.al* method.
- 10) Cholesterol estimation by Zak's method or any other convenient method.

### References:

1. Practical Biochemistry: Principles and techniques: K. Wilson and J. Walker.
2. Practical Biochemistry by David Plummer
3. Introductory Practical Biochemistry by S.K. Sawhney and R.Singh.
4. Biochemical methods by S.Sadasivan, A.Manickam, New Age international publishers.



## 4A09BCH Biophysical and Biochemical Techniques

Credit: 4

Total hours of instruction: 72

Hours/Week: 4.

### **Module - I. (10 Hrs.)**

Methods of tissue homogenization (tissue homogenizer). Salt and organic solvent extraction and fractionation, lyophilization. Dialysis, Reverse dialysis, ultra filtration.

### **Module -II. (12 Hrs.)**

Chromatography:- principle, types of chromatography -adsorption chromatography, ion exchange chromatography, gel chromatography, affinity chromatography, GLC and HPLC.

### **Module- III. (10 Hrs.)**

Electrophoresis- theory. Paper electrophoresis, Agarose gel electrophoresis, SDS-PAGE, Immuno electrophoresis, Isoelectric focussing. Gel documenter, Autoradiography.

### **Module -IV. (12Hrs.)**

Centrifugation: - Principle of sedimentation technique. Principle, procedure and application of differential centrifugation, density gradient centrifugation, ultracentrifugation.

### **Module -V. (16Hrs.)**

UV and visible absorption spectra, Laws of light absorption- Beer - Lambert's law. Light absorption and its transmittance, application of visible and UV spectroscopic techniques, Principle and applications of NMR, ESR, Mass spectroscopy, Fluorescent and emission spectroscopy.

### **Module -VI. (12Hrs.)**

Important stable radioisotopes used in biochemical research.  $P_{32}$ ,  $I_{125}$ ,  $I_{131}$ ,  $Co_{60}$ ,  $C_{14}$  etc. Radiation hazards and precautions taken while handling radioisotopes. Measurement of radioactivity by GM counter and Scintillation counter.

### **References:**

1. Introduction to Biophysics by Pranab Kumar Banerjee (2008) Publishers: S. Chand & Company .
2. A text book of Biophysics by R.N. Roy, New Central Book Agency Pvt. Ltd, Calcutta.
3. Biophysical Chemistry by Upadhyay, Upadhyay & Nath , Himalaya Publishing House, Bangalore.
4. Biophysics by Mohan Arora, Himalaya Publishing House, Bangalore.
5. Separation chemistry by R.p Budhiraja, New age international (P) Ltd, New Delhi.



## 4A10BCH Enzymology

Credit: 4

Total hours of instruction: 72

Hours/Week: 4

### **Module-1. (22Hrs.)**

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 Commission system of classification and nomenclature of enzymes (Class and subclass with one example) Ribozymes.

Structure of the following coenzymes and the reactions where these participate with one example.- NAD, NADP+, FAD, FMN, lipoic acid, TPP, pyridoxal Phosphate and biotin.

### **Module-2. (10Hrs.)**

Measurement and expression of enzyme activity-enzyme assays. Definitions of IU, Katal, and enzyme turn over number. Factors affecting enzyme activity: enzyme concentration, substrate concentration, pH and temperature.

Derivation of Michaelis –Menten equation for uni-substrate reactions.  $K_m$  and its significance. LineWeaver-Burk plot (Only for single substrate enzyme catalyzed reaction)

### **Module-3. (10Hrs.)**

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

Brief study of activation of zymogen form of enzyme with eg: as chymotrypsin. Allosteric enzymes -aspartyl transcarbamylase as an allosteric enzyme.

### **Unit 5 Module-4. (16 Hrs.)**

Enzyme specificity-an example each for substrate specificity, stereo specificity, cofactor specificity of enzymes. Methods for isolation, purification and of enzymes.

### **Module-5. (14 Hrs.)**

Immobilization of enzymes, methods of immobilization. Industrial uses of enzymes: in food, leather and detergent industry. Diagnostic and therapeutic enzymes (brief study of name of enzyme and role in diagnosis and therapy)

### **References:**

1. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry by Trevor Palmer, Philip Bonner ,Publisher: Horwood Publishing Limited.
2. Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins by Nicholas C. Price, Lewis Stevens, and Lewis Stevens, Publisher: Oxford University Press, USA.
3. Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd.
4. Text Book of Biochemistry: E.S.West, W.R.Todd, H.S. Mason andJ .T. Van Bruggen, Oxford & IBH publishing Co-Pvt. Ltd.
5. The Chemical Kinetics of Enzyme action by K.J. Laidler and P.S. Bunting, Oxford University Press London.



## 4BO6BCH Physiological Aspects of Biochemistry

Credit: 3

Total hours of instruction: 54

Hours/Week: 3.

### **Module-1. (10 Hrs.)**

Biochemistry of Blood: Constituents of blood, types of cells: Erythrocytes - structure and function, WBC - types, differential count, functions. Platelets and functions. Components of plasma, types of plasma proteins and function, Blood groups: the ABO system, the Rh-system. Mechanism of blood clotting (intrinsic and extrinsic pathway) Clotting factors, anticoagulants, fibrinolysis.

### **Module-2. (12 Hrs.)**

Structure of respiratory system. transport of oxygen , role of hemoglobin, dissociation curve of oxyhemoglobin and its significance, transport of CO<sub>2</sub> and chloride shift. Bohr's effect, Haldane's effect.

Various buffer systems of the blood: Acidosis and alkalosis, role of lung and kidney in regulation of acid-base balance.

### **Module- 3 (10 Hrs.)**

Structure of nephron, composition and mechanism of urine formation, glomerular filtration, tubular reabsorption of glucose, water and electrolytes, tubular secretion.

Regulation of water and electrolyte balance, role of kidneys and hormones in their maintenance.

### **Module-4. (10 Hrs.)**

Classification of muscles- Structure of skeletal, smooth and cardiac muscles. Actin, myosin, tropomyosin, troponin, Z disc and H line components. The sliding filament mechanism and subcellular ion movements during the contraction cycle in skeletal muscles.

### **Module-5: (12 Hrs.)**

Neurons- structure, mechanism of nerve impulse transmission, neurotransmitters, synapses: chemical and electrical synapses, the reflex action and reflex arc.

Endocrinology: Brief study of the site of biosynthesis and major physiological functions of insulin, glucagon, epinephrine, thyroxine, glucocorticoids, mineralocorticoids, androgen, estrogen, growth hormone, vasopressin, oxytocin, parathyroid hormone and calcitonin.

### **References:**

1. Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008)  
Publishers: S. Chand & Co Ltd .
2. Essentials of Medical Physiology, by K.Sambulingam & P.Sambulingam, jaypee brothers  
New Delhi.
3. Human Physiology (2001) by Bipin Kumar Publisher: Campus Books International.



## 4BO4BCH Biochemistry Practical- III

Credit: 2

Total hours of instruction: 36

Hours/Week: 2.

- 1) Assay of  $\alpha$ - amylase activity in saliva.
- 2) Assay of acid phosphatase activity from fresh Potato (*Solanum tuberosum*)
- 3) Calculation of specific activity of acid phosphatase .
- 4) Effect of enzyme concentration on enzyme activity.
- 5) Effect of substrate concentration on acid phosphatase activity and determination of its  $K_m$  value.
- 6) Effect of pH on enzyme activity and determination of optimum pH.
- 7) Effect of Temperature on Enzyme activity.

\*Enzyme Assay: Enzyme can be extracted from:

- $\beta$ - amylase from Sweet potato (*Ipomoea batates*)
- Catalase from Bovine /Porcine liver
- Urease from Horse gram.

### References:

1. Introductory Practical Biochemistry by S.K.Sawhney & R. Singh (2000). Narosa Publishers
2. Practical Biochemistry by David Plummer (1990). Tata Mc-Graw Hill
3. Biochemical Methods by Sadasivam & Manickam (1996) New Age International (P) Ltd.
4. Modern Experimental Biochemistry, 3<sup>rd</sup> edition, by R. Boyer (2002) Addison-Wesley Longman.
5. A Lab. Manual in Biochemistry by J. Jayaraman (1996) New Age International (P) Ltd.



## 4BO5BCH Biochemistry Practical- IV

Credit: 2

Total hours of instruction: 36

Hours/Week: 2.

1. Separation of amino acids and sugars using paper chromatography
2. Separation of amino acids and sugars using thin layer chromatography
3. Separation of proteins by agarose gel electrophoresis(Demonstration)
4. Estimation of reducing sugars by dinitrosalicylate method
5. Determination of fructose by Roe's resorcinol method
6. Determination of saponification value of fats
7. Determination of iodine number of oil
8. RBC and WBC count/yeast cells using Haemocytometer.
9. Determination of human blood group antigens & Rh factor.
10. Isolation of DNA
11. Isolation of total RNA from yeast cells.

### References:

1. Practical Biochemistry: Principles and techniques: K. Wilson and J. Walker.
2. Practical Biochemistry by David Plummer
3. Introductory Practical Biochemistry by S.K. Sawhney and R.Singh.
4. Biochemical methods by S.Sadasivan, A.Manickam, New Age international publishers.
5. Modern Experimental Biochemistry, 3rd edition, by R. Boyer (2002) Addison-Wesley Longman.
6. A Lab Manual in Biochemistry by J. Jayaraman (1996) New Age International (P) Ltd.



## 5BO7BCH Bioenergetics & General Metabolism

Credit: 5

Total hours of instruction: 90

Hours/Week: 5.

### **Module -1: Introduction to Metabolism: (18 Hrs.)**

General features of metabolism, experimental approaches to study metabolism: use of intact organism, microorganisms, tissue slices and radioactive isotopes.

**Bioenergetics:** First and second law of thermodynamic, internal energy, enthalpy, entropy, concept of free energy, standard free energy change of a chemical reaction, redox potentials, ATP and high energy phosphate compounds.

### **Module-2: Carbohydrate Metabolism: (16 Hrs.)**

Photosynthesis: a brief review. Reaction and energetics of glycolysis. Alcoholic and lactic acid fermentation. Reactions and energetics of TCA cycle. Regulation of glycolysis and TCA cycle. Gluconeogenesis.

Glycogenesis and glycogenolysis. Regulation of glycogen metabolism. Reactions and physiological significance of pentose phosphate pathway.

### **Module-3: Electron Transport Chain and Oxidative Phosphorylation: (14 Hrs.)**

Structure of mitochondria, organization and sequence of electron carriers, sites of ATP production, inhibitors of electron transport chain. Oxidative phosphorylation: chemi-osmotic theory, structure of ATP synthase, proton pump and driven ATP synthesis, Inhibitors of ATP synthesis and uncouplers of oxidative phosphorylation.

### **Module: 4 Metabolism of proteins: (22 Hrs.)**

Digestion and absorption of proteins, Protein-turn over, proteolytic enzymes. transamination, oxidative deamination, reductive amination, non-oxidative deamination and decarboxylation of amino acids. Urea cycle.

Inborn errors of amino acid metabolism, phenyl ketonuria, alkaptonuria and albinism.

### **Module: 5 Metabolism of lipids: (20 Hrs.)**

Introduction, hydrolysis of triacylglycerols, transport of fatty acid into mitochondria,  $\beta$  oxidation of fatty acids, ATP yield from fatty acid oxidation, *De novo* synthesis of fatty acids. Synthesis of triglycerides. Metabolism of ketone bodies.

### **References:**

1. Lehninger's Principles of Biochemistry: - D. L.Nelson and M.M. Cox, Worth Publishers, 41 Madisons Avenue New York, USA.
2. Text Book of Biochemistry: E.S.West, W.R.Todd, H.S. Mason and J .T. Van Bruggen,Oxford & IBH publishing Co-Pvt.Ltd.
3. The text book of biochemistry (for medical students) DM Vasudevan, Sreekumari S, JAYPEE Brothers New Delhi.
4. Principles of Biochemistry Geoffrey L Zubey, William W parson Pennis E Vance,WMC Brown publishers.
5. Biochemistry: Lubert Stryer. and Hall, J.E., Library of congress cataloguing-in publication Data, Bery, Jeremy mark ISBN.
6. Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd.



## 5BO8BCH Computational Techniques in Biochemistry

Credit: 4

Total hours of instruction: 72

Hours/Week: 4.

### **Module: 1 Overview of Information Technology: (14 Hrs)**

Introduction to Computer, structural organization of computer, software, different types of software, hardware, Flow chart, operating system, different type of operating system, programming languages, Internet, TCP/IP address, WWW, HTTP, HTML & URLs

### **Module: 2 Basic bioinformatics (12 Hrs)**

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 and its methods.

### **Module: 3. Detailed study of various databanks (15 Hrs)**

Biological databases, primary and secondary sequence databases, NCBI, EMBnet, Genbank, EMBL, DDBJ, PDB and KEGG

### **Module: 4. Genome analysis (14 Hrs)**

Comparative genomics- Sequence alignment and analysis, pairwise alignment (BLAST, flavors of BLAST& FASTA), MSA(ClustalW), scoring matrices, alignment algorithms, tools for alignment of sequences

### **Module: 5 Application of bioinformatics (17 Hrs)**

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. for module 5**

- [www.drugbank.ca](http://www.drugbank.ca)
- [www.ccdc.cam.ac.uk/products/csd/](http://www.ccdc.cam.ac.uk/products/csd/)

#### **Reference:**

1. Introduction to Bioinformatics: T.K. Attwood, D.J. Parry-Smith ,PEARSON Education Ltd.
2. Bioinformatics: Sequence and Genome analysis. David W. Mount
3. Bioinformatics: Genes, proteins and computers. C.A. Orengo, D.T.Jones and J.M. Thornton
4. [www.drugbank.ca](http://www.drugbank.ca)
5. [www.ccdc.cam.ac.uk/products/csd/](http://www.ccdc.cam.ac.uk/products/csd/)
6. Bioinformatics methods and Application: genomics, proteomics and drug discovery by S.C.Rastogi, N Mendiratta, P.Rastog
7. Essentials of drug designing ;V.kothekar, Dharuv publications, New Delhi.



## **5BO9BCH Immunology and Immunological Techniques**

Credit: 4

Total hours of instruction: 72

Hours/Week: 4.

### **Module -I (10 Hrs.)**

Introduction to immune system: Components of immunity: Innate immunity- Anatomic, physiological, phagocytic and inflammatory barriers; Adaptive immunity, Active and passive immunization, types of vaccines.

### **Module-II (13 Hrs.)**

Organs of Immune system: Central and peripheral lymphoid organs. Cells of Immune system- stem cells, MHC, maturation of B and T lymphocytes, macrophages, natural killer cells. Primary and secondary immune responses. A brief account on Humoral and cell-mediated immune responses.

### **Module -III (12 Hrs.)**

Antigens: Factors that influence antigenicity, epitopes, haptens, Immunoglobulins- Structure of immunoglobulins, Classes of immunoglobulins and their functions. Monoclonal antibody and hybridoma technology. Abzymes.

### **Module IV (13 Hrs.)**

Antigen-antibody interactions: Precipitation reaction;-lattice hypothesis, applications (immunodiffusion, immuno electrophoresis and VDRL test) Agglutination reaction and its applications( ELISA, RIA, Immunofluorescence, widal and CFT)

### **Module V (12 Hrs.)**

Complement system: The function of complement, complement activation. Hyper-sensitivity- Gell and Coombs classification- type I: Anaphylactic hypersensitivity, type II: Antibody-mediated cytotoxic hypersensitivity, type III: Immune complex mediated hypersensitivity, type IV: cell mediated delayed hypersensitivity.

### **Module VI (12 Hrs.)**

Autoimmune diseases- Definition, causes and types of immune diseases like systemic lupus erythematosus, hemolytic anemia, Rheumatoid arthritis, Insulin depended diabetic mellitus.

### **References:**

1. Immunology – Kubey
2. Essential Immunology –Peter J Delves, Seamus J. martin, Dennis R Burton, Ivan M. Roitt, Blackwell Publishing, Massachussts, USA.
3. Elements Of Immunology by S C Rastogi (2006):Publisher: CBS Publishers & Distributors.
4. Text book of Microbiology by Ananthanarayan and C K J Paniker: Publishers: Orient Longman.



## 5B10-14BCH Biochemistry Practical -V

Credit: 0

Total hours of instruction: 144

Hours/Week: 8.

1. Experiments on saliva :Digestion of starch by salivary amylase
2. Estimation of protein –Bradford’s method.
3. Demonstration of Enzyme linked immunosorbant assay (ELISA)-dot ELISA
4. Purification of proteins by ammonium sulfate precipitation
5. Dialysis for protein purification.
6. Separation of photosynthetic pigments using TLC.
7. Immuno electrophoresis-Double immuno electrophoresis(demo only)
8. Widal test
9. Determination of free amino acid content in germinating seeds.
10. Estimation of DNA by diphenylamine method.
11. Estimation of RNA by orcinol method.
12. Estimation of vitamin –A
13. Estimation of ascorbic acid in Lemon juice

### References:

- 1) Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi.
- 2) Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana .
- 3) Practical biochemistry, R.C. Gupta, S. Bhargava, CBS publishers, New Delhi.
- 4) Biochemical Methods by Sadasivam & Manickam (1996) New Age International (P) Ltd.
- 5) A Handbook of Practical and Clinical Immunology 2nd ed G.P. Talwar and S.K. Gupta (eds) (2005) Publishers: CBS Publishers and distributors.



## 5B15BCH Project Work

Credits:0

Total hours of instruction: 36

Hours/Week:2.

## 6B16BCH Genetic Engineering

Credits: 5

Total hours of instruction: 90

Hours/Week: 5.

### Module-I (15 Hrs)

Introduction to genetic engineering. Restriction endonucleases-nomenclature & types with examples, cleavage patterns. Joining of DNA molecules.

Gene cloning basic steps. Gene transfer methods-physical, chemical methods and vector mediated.

### Module-II (15 Hrs.)

Vectors-properties. Plasmid vectors (pBR322, pUC18/19, phage M13, SV40, Ti-plasmids), Cosmids and Expression vectors.

### Module-III (10 Hrs.)

Screening of recombinant cells-genetic methods, immunological method, nucleic acid hybridization, HRT & HART.

### Module-IV (15 Hrs.)

DNA amplification-PCR, DNA sequencing-Maxam & Gilbert's method, Sanger's method and automatic sequencing. Construction of DNA Libraries- genomic & cDNA.

### Module-V (20 Hrs.)

Applications of recombinant DNA technology- DNA finger printing in forensic medicine, for vaccine production, disease diagnosis, for disease prevention & treatment And production of transgenic plants and animals.

### Module-VI (15 Hrs.)

Gene therapy, types of gene therapy (somatic cell gene therapy, germ line gene therapy, enhancement genetic engineering, eugenic engineering).

### Reference:

1. A text book of biotechnology, RC Dubey, S.Chand and Company Ltd, New Delhi.
2. Principles of gene manipulation and genomics, by R.N Old, S.B.Primrose & Thyman, Backwell Publishing, UK.
3. Biotechnology, B.D Singh, Kalyani publishers, New Delhi.
4. Genetics ,P.K Guptha, Rasthogi Publications, Meerut
5. Cell biology, Genetics, Molecular Biology, Evolution and Ecology by P.S. Verma and V. K. Agarwal (2008) Publisher: S. Chand & Company Ltd.
6. Gene cloning & DNA analysis (fifth edition), T. A. Brown, Blackwell publishing.



## 6B17BCH Clinical Biochemistry

Credit: 4

Total hours of instruction: 72

Hours/Week: 4.

### **Module-I. Basic Concepts of Clinical Biochemistry (12 Hrs.)**

Collection and preservation procedures of blood, plasma, serum, cerebrospinal fluid, urine, faeces, pleural fluid, peritoneal fluid and semen.

### **Module-II. Diseases Related To Metabolism (15 Hrs.)**

Carbohydrate Metabolism: Hypo and hyperglycemia, glycogen storage disease, Diabetes Mellitus .GTT (Glucose Tolerance Test), galactosuria , fructosuria.

Amino Acid Metabolism: Phenyl Ketonuria, alkaptonuria, cystinuria, tyrosinemia, Albinism.

Lipid Metabolism: Disorders of lipid metabolism- plasma lipoproteins, lipoproteinemias, fatty liver, hyper cholesterolemia, atherosclerosis.

### **Module-III. Blood analysis and Hematology: (15 Hrs.)**

Principles of estimation, normal values and clinical significance of the following parameters of blood -glucose, hemoglobin, uric acid, lipid profiles, acid phosphatase, creatine phosphokinase, Na<sup>+</sup>, K<sup>+</sup>,Cl<sup>-</sup> and phosphate.

Principles of determination, clinical significance of the following parameters- Total count, Differential count, Erythrocyte sedimentation rate, packed cell volume and prothrombin time.

### **Module-IV. Organ function tests: (18 Hrs.)**

Liver Function Test: Metabolism of bilirubin – Jaundice, Types, Clinical Features – Test based on bile pigments – plasma proteins in health and diseases – PT, PTT, INR.

Gastric Function Test: Collection of gastric contents, Examination of gastric residium,

Kidney Function Test: Clearance test – Urea, Creatinine, PAH test, concentration and dilution tests. Urine formation, normal and abnormal constituents of urine.

### **Module-V. Clinical Enzymology (12 Hrs.)**

Definition of functional and non-functional plasma enzymes – Isoenzymes and diagnostic tests.

Enzyme pattern in health and diseases with special reference to plasma lipase, amylase, choline esterase, SGOT, SGPT, LDH and CPK.

### **Reference:**

1. Clinical Chemistry First Edition (1999), MN.Chatterjea ,Jaypee Publications.
2. Harpers Illustrated Biochemistry 26th Edition (2003) Robert K.Murray, Darnyl K.Granner, Peter A.Mayes & Victor W.Rodwell, McGraw Hill.
3. A Handbook of Practical and Clinical Immunology 2nd ed G.P. Talwar and S.K. Gupta(eds) (2005) Publishers: CBS Publishers and distributors.



## 6B10-14BCH Biochemistry Practical –VI

Credit: 10

Total hours of instruction:90

Hours /Week:5

1. Biochemical analysis of blood;
  - Quantitative estimation of glucose
  - Urea
  - total protein
  - cholesterol
  - Creatinine
  - bilirubin (Conjugated and unconjugated)
2. Serum enzyme analysis AST, ALT, ALP (avoid kit method)
3. Biochemical analysis of urine;
  - Heat & acetic acid test
  - Benedict's test
  - Fouchet's test
  - Hay's test
4. Hematology;
  - Determination of hemoglobin
  - Erythrocyte sedimentation rate
  - Clotting time.
5. Liver function test-SGPT & SGOT
6. Paper electrophoresis of serum proteins.
7. Transformation and selection of transformed cells (demo only)

(Conduct Practicals related to elective paper)

### References:

- 1) Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi.
- 2) Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers,Ludhiana .
- 3) Practical biochemistry,R.C. Gupta,S.Bhargava,CBS publishers, New Delhi.
- 4) Biochemical Methods by Sadasivam & Manickam (1996) New Age International (P) Ltd.
- 5) A Handbook of Practical and Clinical Immunology 2nd ed G.P. Talwar and S.K. Gupta (eds) (2005) Publishers: CBS Publishers and distributors.



## **6B15BCH Project Work**

Credits:4

Total Hours of instruction: 90

Hours/Week: 3.

### **Industrial Study Tour**



## Scheme( Elective)

No	Semester	Course Code	Title of the course	Contact Hrs/week	Credits
1	VI	6B18BCH	Pharmaceutical Chemistry	4	4
2	VI	6B18BCH	Biochemistry Of Health and Nutrition	4	4
3	VI	6B18BCH	Fermentation and Food Technology	4	4

### **6B18BCH Pharmaceutical Chemistry**

Credit: 4

Total hours of instruction: 72

Hours/Week: 4.

#### **Module-I: (15 Hrs)**

Introduction to pharmacology, sources of drugs, dosage forms & routes of administration. Classification of drugs based on sources: mode of administration, site of action, and absorption of drugs

#### **Module-II:(15Hrs)**

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.

#### **Module-III: (12 hours)**

Adverse responses and side effects of drugs: allergy, Drug intolerance, Drug addiction, drugs abuses and their biological effects.

#### **Module-IV: (15 hours)**

Chemotherapy: General Principles of Chemotherapy: Chemotherapy of Parasitic infections- Tuberculosis, Leprosy, Malaria, Fungal infections, viral diseases.

#### **Module- V: (15hours)**

Mode of action and uses of the following classes of Drug (structure not expected)

- Adrenocorticoids – Prednisolone, Dexamethasone, Betamethasone.
- Antibiotics-Penicillins, Semi-synthetic, penicillins, streptomycin, tetracyclines,
- Cephalosporins,Chloramphenicol.

#### **Reference:**

- 1) Essential of Medical Pharmacology by Tripathi K.D (2003) Publisher: Jaypee Brothers Medical.
- 2) Organic Chemistry Vol-1 6th Edition (s) by Finar II (2008) Publisher: Dorling Kindersley (India) Pvt Ltd
- 3) Principles Of Organic Medicinal Chemistry by Rama Rao Nadendla (2004) Publisher: New Age International (p) Limited.

4) Basic & Clinical Pharmacology by Bertram G. Katzung (2006) Publisher: Mcgraw-hill Medical Publishing.

**Suggested websites:**

- [www.drugbank.ca](http://www.drugbank.ca)
- [www.cdc.cam.ac.uk/products/csd/](http://www.cdc.cam.ac.uk/products/csd/)



## **6B18BCH Biochemistry Of Health and Nutrition**

Credit: 4

Total hours of instruction: 72

Hours/Week: 4.

### **Module-I: (8Hrs.)**

Health: Definition of health by WHO. Indicators of health. Nutritional status indicators

### **Module-II: (12Hrs.)**

Nutrition-Concepts of macro and micro nutrients, essential nutrients. Food as source of energy, methods of determining energy value of foods- calorimetry, physiological fuel value, and daily requirement of energy, high and low calorie diets.

Thermal equivalent of oxygen, respiratory quotient, Basal metabolic rate (BMR) factors affecting BMR.

### **Module-III: (13 Hrs.)**

Nutritional aspects of the carbohydrates-- Different dietary types, requirements, utilization and functions. Special role of the non-starch polysaccharides.

Nutritional aspects of the lipids-- Different dietary types, requirements, utilization and functions. Essential fatty acids.

### **Module-IV: (12Hrs.)**

Nutritional aspects of the proteins-- classification of amino acids and proteins, essential amino acids, amino acid imbalance, protein requirements. Protein Energy Malnutrition

### **Module-V: (12 Hrs.)**

Minerals: Nutritional significance. Dietary Macro elements: Calcium, Phosphorus, Magnesium, Na & K Trace Elements: Iron, Iodine, Zinc, Copper etc. Iron deficiency anemia.

### **Module-VI: (15 Hrs.)**

Food processing and loss of nutrients during processing and cooking. Naturally occurring Anti-nutrients. 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.

### **References:**

- 1) Nutrition and dietetics Davidson S and Pasmor J.R
- 2) Essentials of food and nutrition M Swaminathan Vol. II, Applied aspects (1974), Ganesh Pub, Madras.
- 3) Preventive and social medicine: K. Park
- 4) Food science B. Sreelakshmi

- 5) The text book of biochemistry (for medical students) DM Vasudevan, Sreekumari S, JAYPEE Brothers New Delhi.
- 6) Food facts and principles - Sakunthala Manay, Sadhakshara Swami.
- 7) Modern Nutrition Health and Diseases - Goodheart.
- 8) Text book of Biochemistry - White, Handler and Smith.



## 6B18BCH Fermentation and Food Technology

Credit: 4

Total hours of instruction: 72

Hours/Week: 4.

### Module-I: (15 Hrs.)

Fermenters; design of fermenters, maintenance of aseptic conditions, aeration and agitation. Types of fermentation-submerged and SSF.

### Module-II: (12 Hrs.)

Methods and parameters of cultivation of microorganisms, media for industrial fermentation (synthetic and crude).

Characteristics of industrial microorganisms. Strain improvement -use of mutants, recombination & recombinant DNA technology.

### Module-III: (15 Hrs.)

Downstream processing; recovery and purification of fermentation products, effluent treatment.

### Module-IV: (14 Hrs.)

Fermented foods: Bread, vinegar, soy sauce and cheese. Production of Beer & Wine. SCP, its uses and production with examples.

### Module-V: (16 Hrs.)

Biochemistry of food spoilage-changes in nitrogenous organic compounds; carbohydrates, organic acids, lipids and pectic substances.

Principles of food preservations-asepsis, use of temperature, drying, chemical preservation & radiation.

### Reference:

1. Principles of Fermentation technology, PF Stanbury, A Whitaker, SJ Hall (1997)
2. Molecular biology and biotechnology- edited by JM Walker and FB Gingold, Royal society of Chemistry (1988).
3. Food Microbiology, W.C.Frazier, Dennis C. Westhoff, The McGraw Hill companies.



Sd/-

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## Scheme (Open Courses)

No	Semester	Course Code	Title of the Course	Contact Hrs/week	Credits
1	V	5D01BCH	Nutritional Biochemistry	2	2
2	VI	6D02BCH	Plant Biochemistry	2	2

### **5D01BCH Nutritional Biochemistry**

Credit: 2

Total hours of instruction: 36

Hours/Week: 2.

#### **Module-I: (8 Hrs.)**

Nutrition - Concepts of macro and micro nutrients, essential nutrients and their classification.

Food as source of energy, physiological fuel value, and daily requirement of energy, high and low calorie diets. Thermal equivalent of oxygen, respiratory quotient, Basal metabolic rate (BMR) factors affecting BMR.

#### **Module-II: (10 Hrs.)**

Nutritional aspects of the carbohydrates- Different dietary types, requirements, utilization and functions. Special role of the non starch polysaccharides.

Nutritional aspects of the lipids- Different dietary types, requirements, utilization and functions. Essential fatty acids.

#### **Module-III: (8 Hrs.)**

Nutritional aspects of the proteins- essential amino acids, nutritive value of proteins , amino acid imbalance, protein requirements, Protein Energy Malnutrition.

#### **Module-IV: (10 Hrs.)**

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.

#### **References:**

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



## 6D02BCH Plant Biochemistry

Credit: 2

Total hours of instruction: 36

Hours /Week: 2.

### Module-I: (8 Hrs.)

Photosynthesis : Ultrastructure and organisation of chloroplast membranes, light harvesting complexes; mechanism of electron transport, photoprotective mechanisms; carbon dioxide fixation- $C_3$ ,  $C_4$  and CAM pathways.

### Module-II: (8 Hrs.)

Nitrogen Metabolism : Nitrogen fixation, nitrogenase complex and mechanism of action of nitrogenase. Molecular biology of nitrogen fixation-nod, nif and fix genes.

### Module-III: (10Hrs.)

Distinction between primary and secondary metabolites.

Importance of secondary metabolites-Protection of the producer plant from predators and insect.

A brief account of the following classes of secondary metabolites: Alkaloids, terpenoids, flavonoids, phenolics, steroids, quinines and acetylenes (Structures not necessary). Give examples of the compounds and the plants in which present and their importance.

### Module-IV: (10Hrs.)

Uses of secondary metabolites to man as drugs, precursors of drugs in pharmaceutical industry, as natural pesticides/insecticides; other uses of secondary metabolites.

### References:

1. Plant Metabolism: H.D. Kumar and H.N. Singh. Affiliated East-West Press Pvt. Ltd., New Delhi, Madras, Hyderabad and Bangalore. (1993; 2<sup>nd</sup> edition)
3. Plant Biochemistry: P.M. Dey and J.B. Harborne. (Editors.) Harcourt Asia PTE Ltd. Academic Press. (Indian Edition, 2000)
4. Plant Metabolism: D.T. Dennis, D.H. Turpin, D.D.Lefebvre and D.B. Layzell (Editors). Addison Wesley Longman Ltd., 2nd Edition, 1997.
5. The Biochemistry of Plants. A Comprehensive Treatise. Vol. 7. Secondary Plant Products.: E.E. Conn (Editor) Academic Press (Pub.) (1981).
6. Encyclopedia of Plant Physiology. New Series. Vol. 8. Secondary Plant Products: E.A. Bell and B.V. Charlwood (Editors). Springer-Verlag (Pub.) (1980)



Sd/-

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