

# **MAR IVANIOS COLLEGE (AUTONOMOUS)**

**(Affiliated to the University of Kerala)**

Re-assessed & Re-accredited (Third Cycle) with 'A' Grade by NAAC

CPE (College with Potential for Excellence) Status Conferred by UGC

Mar Ivanios Vidya Nagar, Nalanchira P.O., Thiruvananthapuram - 695 015



**CAREER RELATED FIRST DEGREE PROGRAMME (FDP)**

**Under**

**CHOICE BASED CREDIT & SEMESTER (CBCS) SYSTEM**

**Group 2 (a)**

**BOTANY AND BIOTECHNOLOGY**

**BIOCHEMISTRY SYLLABUS**

**(2022 Admission Onwards)**

**SEMESTER I**  
**Complementary Course - 1**  
**AUBB131 – Physical aspects of Biochemistry**  
**Credits 3**  
**Contact Hours: 90 (Theory 54 + Practical 36)**

**Objective of the course:** To give basic awareness about the concepts and physical aspects in biochemistry and to develop analytical skills in students in order to prepare them to use instruments.

**Course outcome:** Student will be able to

- Discuss the significance of pH in biological system.
- Prepare solutions of different concentration and pH.
- Describe the principles, theory, protocol and calculations of biochemical techniques.
- List out the importance of bonding and spatial arrangements in biomolecules.

**Course Outline**

**Module I**

**(7 hrs)**

**Acids and bases**

Structural features of water molecule, dissociation of water, ionic product of water, acids and bases, concepts of pH, pOH, theoretical calculations of pH and pOH, dissociation of weak acids, buffers, buffer action and buffer capacity, buffers in biological system, Henderson-Hasselbalch equation, simple numerical problems based on the equation.

**Core Text:**

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

**Module II**

**(7 hrs)**

**Solutions**

Definition and formulae of molarity, normality, molality, percentage solution, mole fraction and parts per million (simple numerical problems based on these), fundamental principles of diffusion, osmosis, osmotic pressure, Van't Hoff's laws of osmotic pressure (simple numerical problems), definition of isotonic, hypotonic and hypertonic solutions, biological importance of osmosis, surface tension and viscosity.

**Core Text:**

- Introduction to Biophysics by Pranab Kumar Banerjee (2008) Publishers: S. Chand & Company ltd ISBN: 81-219-3016-2 page no-21, 32, and 74.
- Essentials of Physical Chemistry by Arun Bahl, and BS Bahl.

**Module III****(7hrs)****Colloids**

Definition of true solutions, suspensions, colloids and crystalloids, distinction between lyophilic and lyophobic colloids, properties of colloids, biological significance of colloids, emulsions and emulsifying agents, Donnan membrane equilibrium and its significance.

**Core Text:**

- Introduction to Biophysics by Pranab Kumar Banerjee (2008) Publishers: S. Chand & Company Ltd ISBN: 81-219-3016-2 page no-21, 32, and 74.
- Essentials of Physical Chemistry by Arun Bahl, and BS Bahl.

**Module IV****(11 hrs)****Techniques in biochemistry I**

Photometry: Beer-Lambert's law, molar extinction coefficient, working of colorimeter and spectrophotometer.

Centrifugation: Principle of sedimentation technique, principle, procedure and application of differential centrifugation, density gradient centrifugation, ultra centrifugation, rate zonal centrifugation, isopycnic centrifugation.

pH meter: Principle and working.

**Core Text:**

- Practical Biochemistry Principles and Techniques, Keith Wilson and John Walker, 4th edition. ISBN0-521-49849-X-9780521498494.
- Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7.

**Module V****(12 hrs)****Techniques in biochemistry II**

Chromatography: Principle, procedure and application of paper, TLC, ion-exchange, affinity and gel filtration chromatography.

Electrophoresis: Principle, procedure and application of zone electrophoresis, paper electrophoresis, gel electrophoresis (native PAGE, SDS - PAGE).

**Core Text:**

- Practical Biochemistry Principles and Techniques, Keith Wilson and John Walker, 4th edition. ISBN0-521-49849-X-9780521498494.

**Module VI****(10 hrs)****Bio-organic chemistry**

Common functional groups (-OH, -SH, -CHO, -C=O, -COOH, -NH<sub>2</sub>, -NH) and their significance in biomolecules. Intra and intermolecular interactions in biological system: Covalent bonds -disulphide bond, peptide bonds, glycosidic bond, phosphodiester linkage. Non-covalent bonds- van der Waal's

force, ionic bonds, hydrophobic interaction, hydrogen bond (Watson- Crick base pairing).  
Classification of isomerism with examples.

#### **Core Text:**

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

#### **Suggested Readings**

- Biophysical Chemistry Principles & Techniques Handbook (2009) by Avinash Upadhyay, Kakoli Upadhyay, Nirmalendu Nath Publisher: Himalaya Publishing House.
- Hawk's Physiological Chemistry (2015), Bernard L. Oser (ed) TATA McGraw Hill Publishing Company LTD, New Delhi p 10- 15.
- Physical Biochemistry by David Freifelder Publisher: W.H.Freeman & Co Ltd. (2016)
- The Tools of Biochemistry by Cooper, T. G. 2011. Publisher: John Wiley & Sons
- Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2016) Publishers: S. Chand & Co Ltd.
- Biochemistry: A Students survival Guide by Hiram. F. Gilbert (2002) Publishers: McGraw-Hill.

## **Practical Semester 1**

### **Title : Introduction to practical biochemistry and Carbohydrate analysis**

**Hours/week: 2**

**No. of contact hours: 36**

#### **1. Introduction to laboratory, lab equipments and techniques in biochemistry**

- Weighing in Chemical balance
- Preparation of solutions -percentage, molar & normal solutions, dilution from stock solution
- Demonstration of dialysis, paper chromatography, thin layer chromatography and PAGE
- Colorimetry and Spectrophotometry techniques
- Verification of Beer Lambert's law
- Verification of molar extinction coefficient of any known compound

#### **2. Qualitative analysis of Carbohydrates.**

- Test for carbohydrates (glucose, fructose, xylose, sucrose, maltose and starch): Molisch's test, anthrone test, fehling's test, Benedict's test, picric acid test, Barfoed's test, Bial's test, Seliwanoff's test, iodine test, hydrolysis of sucrose and starch, Mucic acid test, osazone test.

#### **3. Quantitative Analysis of carbohydrates**

- Estimation of glucose by Nelson-Somogyi method
- Estimation of reducing sugar by anthrone method.

- Estimation of pentose by Orcinol method.
- Estimation of ketose by Roe-Papadopoulos method.

### **References:**

- Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande, I.K International Pvt. LTD, New Delhi.
- Introductory Practical biochemistry (2001), S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi.
- Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5.

**SEMESTER II**  
**Complementary Course - 2**  
**AUBB231 - Biomolecules**  
**Credits 3**

**Contact Hours: 90 (Theory 54 + Practical 36)**

**Objective of the Course:** To familiarize the students with the building blocks of living matter, biomolecules, their structure, components, reactions, derivatives, biological significance and the basic tests to identify them.

**Course Outcome:** Student will be able to

- Explain the composition of living matter
- Discuss the monomeric subunits, function and chemical reactions of macromolecules.
- Classify enzymes and describe functions of enzymes
- Relate the parameters associated with enzyme activity

### **Course Outline**

#### **Module I**

**(10 hrs)**

#### **Chemistry of carbohydrates**

Classification of carbohydrates, optical isomerism, D- and L- series, epimers, aldoses and ketoses, structural relationships of aldoses, ring structure of monosaccharides, anomers, mutarotation, chemical reactions of glucose, glycosides, deoxy sugars, amino sugars, sugar alcohols and sugaracids, osazone, disaccharides, structure and important properties of sucrose, maltose, isomaltose, and lactose, trisaccharide (examples only), structure and important properties of polysaccharides (starch, glycogen, cellulose, and chitin). Qualitative test for carbohydrates.

**Core Text:**

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

**Module II****(9 hrs)****Chemistry of Lipids**

Classification of lipids, structure, properties and reactions of fatty acids, essential fatty acids, general structure and properties of triglycerides, glycerol- acrolein test. Phospholipids- structure and function of phosphatidyl choline and phosphatidyl ethanolamine. Sphingolipids- function of cerebrosides and gangliosides. Steroids- structure of cholesterol and ergosterol. Colour reactions of sterols.

**Core Text:**

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

**Module III****(8 hrs)****Chemistry of Amino acids**

Classification of amino acids, amino acids occurring in proteins, optical activity, UV absorption, Zwitterions, chemical reactions of amino acids – ninhydrin reaction, reaction with dansyl chloride, Sanger's reagent, Edman's reagent, decarboxylation, colour reactions for specific aminoacids.

**Core Text:**

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

**Module IV****(9 hrs)****Chemistry of proteins**

Biological significance and classification- fibrous proteins, globular proteins, conjugated proteins. Physical properties, solubility, isoelectric point, elementary study of primary secondary, tertiary and quaternary structure of proteins, colour reactions- biuret test, precipitation reactions- isoelectric precipitation, addition of neutral salts, fractionation by solvents, addition of positive ions & negative ions and dialysis, denaturation, oligopeptides- glutathione. Hemoglobin- structure and functions.

**Core Text:**

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

**Module V****(8 hrs)****Chemistry of Nucleic acids**

Base compositions, structure of purines and pyrimidines, ribose and deoxy ribose, nucleoside structure, nucleotides- nomenclature, structure of polynucleotide- DNA, RNA primary structure and

inter nucleotide linkage. Watson and Crick double helix model of DNA, different types of RNA.

**Core Text:**

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

**Module VI**

**(10 hrs)**

**Enzymes and enzyme kinetics**

Classification and nomenclature, units of enzyme activity, progress curve, effect of enzyme concentration, substrate concentration- (Michaelis-Menten equation- derivation not expected), Michaelis-Menten constant, enzyme affinity), temperature and pH on reaction velocity of enzyme catalyzed reactions. Enzyme specificity- different types, enzyme activation, enzyme inhibition- competitive and non-competitive, Line weaver-Burk plot, application of LB plot, allosteric regulation (Brief study). Coenzymes.

**Core Text:**

- Biochemistry – U. Satyanarayana, U. Chakrapani , 3rd edition, ISBN 81-87134-80-1.

**Suggested Readings**

- Lehninger Principles of Biochemistry, 7th Edition by David L. Nelson and Michael M. Cox.
- E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, A Text Book of Biochemistry, Oxford and IBH Publishing Co. 4 th Edition
- Principles of Biochemistry 5 th Edition (2017) by Geoffrey L Zubay, William W Parson, Dennis E Vance Publisher: McGraw-Hill Book Company – Koga
- Text Book of Biochemistry, 8th edition by DM Vasudevan and Sreekumari S, JAYPEE Publishers, New Delhi.

## **Practical Semester 2**

**Course title: Analysis of amino acids, proteins and enzymes**

**Hours/week: 2**

**No. of Contact hrs: 36**

**Aim of the course:** To train the students on analysis of amino acids and proteins and to familiarize them with enzyme assays.

### **Course Outline**

#### **1. Qualitative analysis of Amino acids and Proteins Amino acids**

(Any 4 amino acids)

- Tests for amino acids: Solubility, ninhydrin reaction, xanthoproteic reaction, Millons test, Morners test, glyoxalic acid test, Ehrlich's test, nitroprusside test, lead acetate, test for methionine, aldehyde test, Sakaguchi reaction and isatin test.
- Tests for proteins: Solubility, Ninhydrin reaction, Xanthoproteic reaction, Folin's test, Lowry's test, Biuret test, Heat denaturation, TCA precipitation, Alcohol precipitation.

#### **2. Enzyme Assays**

Demonstration of

- Urease/Trypsin
- Kinetics of Urease / Trypsin (Effect of pH, substrate Concentration, enzyme concentration and temperature)
- Progress curve of Urease/Trypsin
- Digestion of carbohydrates –action of salivary amylase

#### **References:**

- Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande, I.K International Pvt. LTD, New Delhi.
- Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh 2001(eds) Narosa Publishing House, New Delhi.
- Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5.



**Aim of the course:** To train the students on analysis of amino acids and proteins and to familiarize them with enzyme assays.

### **Course Outline**

#### **3. Qualitative analysis of Amino acids and Proteins Amino acids**

(Any 4 amino acids)

- Tests for amino acids: Solubility, ninhydrin reaction, xanthoproteic reaction, Millons test, Morners test, glyoxalic acid test, Ehrlich's test, nitroprusside test, lead acetate, test for methionine, aldehyde test, Sakaguchi reaction and isatin test.
- Tests for proteins: Solubility, Ninhydrin reaction, Xanthoproteic reaction, Folin's test, Lowry's test, Biuret test, Heat denaturation, TCA precipitation, Alcohol precipitation.

#### **4. Enzyme Assays**

Demonstration of

- Urease/Trypsin
- Kinetics of Urease / Trypsin (Effect of pH, substrate Concentration, enzyme concentration and temperature)
- Progress curve of Urease/Trypsin
- Digestion of carbohydrates –action of salivary amylase

#### **References:**

- Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande, I.K International Pvt. LTD, New Delhi.
- Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh 2001(eds) Narosa Publishing House, New Delhi.
- Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5.

**SEMESTER III**  
**Complementary Course - 3**  
**AUBB331 – Physiology and Nutritional Biochemistry**  
**Credits 4**  
**Contact Hours: 90 (Theory 54 + Practical 36)**

**Objectives of the course:** The course is intended to introduce the student to the basics of physiological aspects of biochemistry and to familiarize the students with the basics of human nutrition.

**Course outcome:** Student will be able to

- Describe the composition of blood, production of blood cells and mechanisms of blood clotting.
- Explain the correlation between food, energy requirements, and related disorders.
- Write the contribution of minerals, trace elements and biochemical functions of vitamins
- Detail various organ function tests and the detoxification mechanism in the body.
- Illustrate basic concepts of food adulteration.

**Course Outline**

**Module I**

**(10 Hrs)**

**Biochemistry of Blood**

Physical properties and constituents of blood, types of blood cells- RBC, WBC, lymphocytes and platelets. Hemoglobin (structure and function of hemoglobin, types of hemoglobin, abnormal hemoglobin), bile pigments formation, iron metabolism- absorption and transport. Blood clotting (mechanism of blood clotting- intrinsic and extrinsic pathway), clotting factors, anticoagulants, bleeding time, clotting time, hemopoiesis, - blood forming organs, erythropoiesis, leucopoiesis. Blood groups: Classification, chemical basis for blood group specificity. Plasma proteins: types and functions. Hemophilia and jaundice.

**Core Text:**

- Textbook of Medical Physiology, by Arthur C Guyton, John E Hall Prism Saunders 9th Edition ISBN: 81-7286-034-X.

**Module II**

**(10 Hrs)**

**Nutrition**

Vitamins: Definition, classification- fat soluble and water soluble, source, chemical nature (structure not required), functions of vitamins and deficiency diseases.

Nutrition: Caloric value, carbohydrates, fats and proteins, BMR.

Minerals: Outline study of sources and functions of Ca, Na, K, I and Fe.

**Core Text:**

- Biochemistry – U. Satyanarayana, U. Chakrapani , 3rd edition, ISBN 81-87134-80-1.

**Module III****(9 Hrs)****Food Adulterations**

Common food adulterants in milk and vegetable oils. Elementary study on qualitative detection of adulteration in milk- urea, formalin, starch, detergents; edible oils -Argemone oil, crude cotton seed oil, linseed oil, acid number, saponification number and iodine number of fats/ oils. Brief approach on quality control – FSSAI, PFA, FPO, FDA. Essential commodities act: consumer protection act and AGMARK.

**Core Text:**

- Food Science- Chemistry and Experimental Foods. Dr. M Swaminathan, the Bangalore Printing and Publishing Co. Ltd.
- Food Science-Experiments and Applications. Mohini Sethi and Eram S Rao. CBS Publishers and Distributors. ISBN-81-239-0747-8.

**Module IV****(7 Hrs)****Organ function tests and detoxification**

Liver function test. Structure of nephron, formation of urine, renal function test, renal threshold, constituents of urine.

Metabolism of foreign compounds in the liver - oxidation, conjugation, hydrolysis, reduction, examples of each type.

**Core Text:**

- Biochemistry – U. Satyanarayana, U. Chakrapani , 3rd edition, ISBN 81-87134-80-1.

**Module V****(9 Hrs)****Respiration and Acid- Base balance**

Respiration: Partial pressure of gases, chemical and physiological events affecting the diffusion of O<sub>2</sub> and CO<sub>2</sub>, exchange of CO<sub>2</sub> during respiration, transport of gases in blood, carbonic anhydrase, chloride shift, oxygen dissociation curve, Bohr effect. Acid Base balance: body water balance, buffers in blood, respiratory acidosis and alkalosis, metabolic acidosis and alkalosis.

**Core Text:**

- Biochemistry – U. Satyanarayana, U. Chakrapani , 3rd edition, ISBN 81-87134-80-1.

**Module VI****(9 Hrs)****Endocrinology**

Organization of endocrine system, Organization of endocrine system and classification of hormones, functions of adrenalin, nor adrenalin, cortisone, cortisol, corticosterone, deoxycorticosterone, estradiol, thyroxine, TSH, ACTH, Gonadotropin, GH, oxytocin and vasopressin, peptide hormones. (Structure of adrenalin, nor-adrenalin, cortisone, T<sub>3</sub> and T<sub>4</sub> alone required)

**Core Text:**

- Text Book of Biochemistry, 5th edition by DM Vasudevan and Sreekumari S, JAYPEE Publishers, New Delhi, ISBN81-8448-124-1, 9788184481242.

**Suggested Readings:**

- Arthur Vander, James Sherman, and Dorothy Luciano Vander et al.: Human Physiology: The Mechanism of Body Function, Eighth Edition © The McGraw-Hill Companies.
- Human Physiology (2001) by Andrew Davies, GH Blakeley, Cecil Kidd Publisher: Churchill Livingstone
- Human Physiology (2001) by Bipin Kumar Publisher: Campus Books International

**Practical Semester 3**  
**Course title: Analysis of lipids**

**Aim of the course:** To train the students on qualitative and quantitative analysis of lipids.

**Course Outline**

**1. Qualitative analysis of Lipids**

- Test for fatty acids (stearic acid/ oleic acid): Solubility, translucent spot tests, test for unsaturation
- Test for glycerol: solubility, acrolein test, borax-fusion test.
- Test for cholesterol: Solubility, Salkowski reaction, Liebermann-Burchard reaction

**2. Quantitative Analysis of Lipids**

- Estimation of cholesterol by Carr-Drecker method.
- Estimation of cholesterol by Zak's method.
- Determination of acid value.
- Determination of saponification value.
- Determination of iodine number of oil

**References**

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

**SEMESTER IV**  
**Complementary Course - 4**  
**AUBB431 - Metabolism**

**Credits 2**

**Contact Hours: 90 (Theory 54 + Practical 36)**

**Objective of the course:** The course aims at providing an overview of energy production by explaining the general principles of cellular energy metabolism and schematizing the different metabolic pathways.

**Course outcome:**

- List out the steps involved in digestion and absorption of nutrients.
- Describe the metabolism of biomolecules and regulatory mechanisms involved.
- Correlate between energy molecules, reducing equivalents and metabolic pathways.
- Explain central dogma of life and gene expression in prokaryotes.

**Course Outline**

**Module I**

**(11 hrs)**

**Metabolism of carbohydrates**

Digestion of carbohydrates and absorption (outline study). Glycolysis- Reactions, fate of pyruvate, regulation of glycolysis. Citric acid cycle, Gluconeogenesis-reaction pathway, reciprocal regulation of gluconeogenesis and glycolysis. Cori's cycle. Pentose Phosphate Pathway-reactions, biological significance, regulation of pathway. Glycogen metabolism- glycogenesis, glycogenolysis, regulation of glycogen metabolism- allosteric and hormonal regulation. (Only pathway outlines, structures not required). Diabetes mellitus.

**Core Text:**

- Biochemistry – U. Satyanarayana, U. Chakrapani , 3rd edition, ISBN 81-87134-80-1.

**Module II**

**(12 hrs)**

**Metabolism of Lipids**

Digestion and absorption of lipids, composition and function of bile, enterohepatic circulation (outline study). Scheme of  $\beta$ - oxidation, ATP yield in  $\beta$  oxidation (stearate & palmitate as examples) and regulation. Basics of  $\alpha$ - and  $\omega$ - oxidation, ketone body formation, cytoplasmic system of fatty acid biosynthesis and regulation of the pathway, outline study of biosynthesis of cholesterol and bile acids (structure not required). Elementary study of hypercholesterolemia, atherosclerosis and obesity.

**Core Text:**

- Biochemistry – U. Satyanarayana, U. Chakrapani , 3rd edition, ISBN 81-87134-80-1.

**Module III**

**(9 hrs)**

**Metabolism of amino acids and proteins**

Zymogen activation of proteolytic enzymes of GI tract, digestion of proteins and absorption of amino acids-role of glutathione cycle. Reactions involved in the metabolism of amino acids-deamination, transamination and decarboxylation, coenzymes involved in these reactions. Urea cycle (structure not required).

**Core Text:**

- Biochemistry – U. Satyanarayana, U. Chakrapani , 3rd edition, ISBN 81-87134-80-1.

**Module IV**

**(10 hrs)**

**Bioenergetics**

Redox reactions, redox potential and free energy, mitochondrial electron transport chain, coenzymes and prosthetic groups of respiratory chain enzymes- sites of ATP production, P/O ratio, inhibitors of electron transport chain, oxidative phosphorylation- chemiosmotic hypothesis (outlines only), uncouplers of oxidative phosphorylation. Formation of ATP- oxidative and substrate level phosphorylation. High energy compounds with structures (ATP, ADP, Creatine phosphate, 1, 3 bisphosphoglycerate, PEP), role of high energy phosphate groups.

**Core Text:**

- Biochemistry – U. Satyanarayana, U. Chakrapani , 3rd edition, ISBN 81-87134-80-1.

**Module V**

**(12 hrs)**

**Genetic aspects of Metabolism**

Structure of DNA, prokaryotic DNA replication-DNA polymerases, replication forks, Okazaki fragments and accessory proteins. Brief study of structure and types of RNA and their functions. Prokaryotic transcription process. Genetic code- properties of genetic code. Protein biosynthesis in prokaryotes, synthesis of aminoacyl tRNA, initiation-Shine Dalgarno sequence, elongation-aminoacyl tRNA binding, peptide bond formation, translocation followed by termination.

**Core Text:**

- Biochemistry – U. Satyanarayana, U. Chakrapani , 3rd edition, ISBN 81-87134-80-1.

**Suggested Readings**

- Biochemistry by Lubert Stryer, W.H Freeman and Company, New York ISBN 0-7167-2009-4, 4th Edition.
- Lehninger Principles of Biochemistry, 7th Edition by David L. Nelson David L. Nelson Michael M. ox Michael M. Cox (Author) , Publisher: W. H. Freeman; Fourth Edition (2004)
- E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, A Text Book of Biochemistry 4<sup>th</sup> Edition, Oxford and IBH Publishing Co., New Delhi.
- Biochemistry 4<sup>th</sup> Edition (2010) by Donald Voet, Judith G. Voet Publisher: John Wiley & Sons Inc
- Principles Of Biochemistry 5 th Edition (2017) by Geoffrey L Zubay, William W Parson, Dennis E Vance Publisher: McGraw-Hill Book Company – Koga
- Principles Of Biochemistry, 5 th Edition (2011) by Robert Horton H , Laurence AMoran, Gray Scrimgeour K Publisher: Pearsarson

- Biochemistry (2008) by Rastogi Publisher: McGraw Hill.

## **Practical Semester 4**

**Course title: Estimation of amino acids, proteins and nucleic acids**

**Hours/week: 2**

**No. of Contact hours: 36**

**Aim of the course:** To train the students on qualitative and quantitative analysis of amino acids, proteins and nucleic acids.

### **Course Outline**

#### **1. Quantitative Analysis of Amino acids and Proteins**

- Estimation of Tyrosine by Folin-Lowry method.
- Estimation of Protein by Biuret method.
- Estimation of Protein by Folin-Lowry method.

#### **2. Quantitative Analysis of Nucleic Acids**

- Estimation of DNA by diphenylamine method.
- Estimation of RNA by Orcinol method

### **References:**

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

## **SEMESTER IV**

### **Complementary Course - Practical**

### **AUBB43PI - Practical Biochemistry I**

**(Practical of AUBB131, AUBB231, AUBB331 & AUBB431)**

**Credits 2**

**Contact Hours: 144 (Practical hours of AUBB131, AUBB231, AUBB331 & AUBB431)**

#### **Semester 1**

**Title : Introduction to practical biochemistry and Carbohydrate analysis**

#### **1. Introduction to laboratory, lab equipments and techniques in biochemistry**

- Weighing in Chemical balance
- Preparation of solutions -percentage, molar & normal solutions, dilution from stock solution
- Demonstration of dialysis, paper chromatography, thin layer chromatography and PAGE
- Colorimetry and Spectrophotometry techniques
- Verification of Beer Lambert's law
- Verification of molar extinction coefficient of any known compound

#### **2. Qualitative analysis of Carbohydrates.**

- Test for carbohydrates (glucose, fructose, xylose, sucrose, maltose and starch): Molisch's test, anthrone test, fehling's test, Benedict's test, picric acid test, Barfoed's test, Bial's test, Seliwanoff's test, iodine test, hydrolysis of sucrose and starch, Mucic acid test, osazone test.

#### **3. Quantitative Analysis of carbohydrates**

- Estimation of glucose by Nelson-Somogyi method
- Estimation of reducing sugar by anthrone method.
- Estimation of pentose by Orcinol method.
- Estimation of ketose by Roe-Papadopoulos method.

#### **Semester II**

**Course title: Analysis of amino acids, proteins and enzymes**

#### **1. Qualitative analysis of Amino acids and Proteins Amino acids**

(Any 4 amino acids)

- Tests for amino acids: Solubility, ninhydrin reaction, xanthoproteic reaction, Millons test, Morners test, glyoxalic acid test, Ehrlich's test, nitroprusside test, lead acetate, test for methionine, aldehyde test, Sakaguchi reaction and isatin test.
- Tests for proteins: Solubility, Ninhydrin reaction, Xanthoproteic reaction, Folin's



test, Lowry's test, Biuret test, Heat denaturation, TCA precipitation, Alcohol precipitation.

## **2. Enzyme Assays**

Demonstration of

- Urease/Trypsin
- Kinetics of Urease / Trypsin (Effect of pH, substrate Concentration, enzyme concentration and temperature)
- Progress curve of Urease/Trypsin
- Digestion of carbohydrates –action of salivary amylase

## **Semester III**

### **Course title: Analysis of lipids**

#### **1. Qualitative analysis of Lipids**

- Test for fatty acids (stearic acid/ oleic acid): Solubility, translucent spot tests, test for unsaturation
- Test for glycerol: solubility, acrolein test, borax-fusion test.
- Test for cholesterol: Solubility, Salkowski reaction, Liebermann-Burchard reaction

#### **2. Quantitative Analysis of Lipids**

- Estimation of cholesterol by Carr-Drecktor method.
- Estimation of cholesterol by Zak's method.
- Determination of acid value.
- Determination of saponification value.
- Determination of iodine number of oil

## **Semester IV**

### **Course title: Estimation of amino acids, proteins and nucleic acids**

#### **3. Quantitative Analysis of Amino acids and Proteins**

- Estimation of Tyrosine by Folin-Lowry method.
- Estimation of Protein by Biuret method.
- Estimation of Protein by Folin-Lowry method.

#### **4. Quantitative Analysis of Nucleic Acids**

- Estimation of DNA by diphenylamine method.
- Estimation of RNA by Orcinol method