



St. Joseph's College for Women (A)
Gnanapuram, Visakhapatnam
Syllabus and core structure for academic year 2024-25
COURSE STRUCTURE

Year	Semester	Course	Title	No. Hrs/ Week	No. of Credits
I	I	1	Introduction to Classical Biology	5	4
		2	Introduction to Applied Biology	5	4
	II	3	Biomolecules – (T)	3	3
			Biomolecules – (P)	2	1
		4	Cell Biology – (T)	3	3
Cell Biology- (P)	2		1		
II	III	5	Analytical techniques- (T)	3	3
			Analytical techniques- (P)	2	1
		6	Basic Microbiology- (T)	3	3
			Basic Microbiology- (P)	2	1
		7	General Physiology- (T)	3	3
			General Physiology- (P)	2	1
		8	Genetics - (T)	3	3
			Genetics - (P)	2	1
	IV	9	Bioenergetics and Metabolism of Carbohydrates and Lipids- (T)	3	3
			Bioenergetics and Metabolism of Carbohydrates and Lipids- (P)	2	1
		10	Clinical Biochemistry- (T)	3	3
			Clinical Biochemistry- (P)	2	1
		11	Immunology - (T)	3	3
			Immunology - (P)	2	1
III	V	12	Nutritional Biochemistry - (T)	3	3
			Nutritional Biochemistry - (P)	2	1
		13	Enzymology- (T)	3	3
			Enzymology- (P)	2	1
		14	Molecular biology - (T)	3	3
			Molecular biology - (P)	2	1
	15	Metabolism of Nitrogen compounds - (T)	3	3	
		Metabolism of Nitrogen compounds - (P)	2	1	
VI	Long term Internship/ Apprenticeship				
IV	VII	16	Recombinant DNA technology - (T)	3	3
			Recombinant DNA technology - (P)	2	1
		17	Endocrinology - (T)	3	3
			Endocrinology - (P)	2	1
		18	Biomedical Correlation of Diseases - (T)	3	3
			Biomedical Correlation of Diseases - (P)	2	1
IV	VIII	19	Applied Biochemistry - (T)	3	3
			Applied Biochemistry - (P)	2	1
		20	Fundamentals of Biostatistics & Bioinformatics - (T)	3	3
			Fundamentals of Biostatistics & Bioinformatics - (P)	2	1
		21	Plant and Environmental Biochemistry - (T)	3	3
Plant and Environmental Biochemistry - (P)	2		1		

Multidisciplinary Courses
w.e.f. AY 2023-24
SEMESTER-I
PRINCIPLES OF BIOLOGICAL SCIENCES

Credits: 2

2 hrs/week

Learning Objectives: By the end of this course the learner can:

1. Acquire logic to evaluate fundamental biological concepts at various levels of biological organisation including the molecular, cellular, organismal and systems levels.
2. Communicate fundamental biological knowledge between tiers of biological organisation.
3. Apply common biological principles across all levels of biological organization.
4. Learn the applications of Biotechnology

Learning Outcomes: On completion of this course students will be able to:

1. Understand the relationship between structure and function at all levels.
2. Recognise the mechanisms underlying biological evolution, its patterns, and its significance as biology's overarching unifying principle.
3. Understand the contributions of biology to the resolution of medical, ethical, social, and environmental concerns in human affairs.
4. Illustrate the applications of Biotechnology

UNIT-I Diversity of Life

- 1.1 Introduction to Biology, Branches of Biology, Basic Principles of Biology
- 1.2 Biological Classification-Two kingdom and Five kingdom classification, Viruses, Viroid's and Lichens
- 1.3 Diversity in the living world, Taxonomic categories, Taxonomic aids
- 1.4 Plant organization-The form, structure and function of plant vegetative and reproductive organs, Classification of Plant Kingdom,
- 1.5 Basis of Animal Classification, Classification of Animal Kingdom

UNIT-II Biomolecules and metabolism

- 2.1 Ultra structure of cell and Cell organelles (Structure and Functions), Plant cell vs Animal cell
- 2.2 Plant Physiology: Photosynthesis, Respiration, Transportation, Mechanisms of Nitrogen fixation.
- 2.3 Plant growth and development, physiology of flowering.
- 2.4 Human Physiology: Digestion, Respiration, Circulation
- 2.5 Male and female reproductive organs, gametogenesis, fertilization.

UNIT-III Principles of Biology

- 3.1 Genetics: Mendel's laws of inheritance, Genetic disorders- Colour blindness, Sickle cell anaemia.
- 3.2 Evolution: Geological time scale for evolution of plants and vertebrates, Origin and evolution of plants and man
- 3.3 Common Human Diseases: causing organism, prevention and treatment- malaria, dengue, AIDS, cancer, corona.

3.4 Common Plant Diseases: causing organism, prevention and treatment- Black spot, Leaf spots, Powdery mildew, Blight, Canker.

3.5 Biotechnology: Tools and process of recombinant DNA technology, Applications of biotechnology in agriculture, food industry, medicine and transgenic animals.

Text Books

1. Pandey, B.P. (2013) College Botany, Volume-I, S. Chand Publishing, New Delhi.
2. Kotpal, R.L.2022. Modern textbook of zoology, Vertebrates. (Rastogi Publ., Meerut).
3. Verma P.S., Agarwal V.K., 2006. Cell biology, genetics, Molecular Biology, Evolution and Ecology. S. Chand publishers, New Delhi, India.

Reference Books

1. Sreekrishna V. 2005. Biotechnology –I, Cell Biology and Genetics. New Age International Publ. New Delhi, India.
2. Rastogi, S.C., 2019. Essentials of animal physiology. 4th Edition. New Age International Publishers

St. JOSEPH'S COLLEGE FOR WOMEN (AUTONOMOUS), VISAKHAPATNAM

Pathway 2 Course

w.e.f. AY 2023-24

I Semester

INTRODUCTION TO APPLIED BIOLOGY

Credits: 4

Hours/Week: 5

Course Objectives: By the end of this course the learner can:

1. Narrate the basics of Microbiology and Immunology
2. Illustrate outlines of Biomolecules and their physiological role
3. Explain contributions of Biotechnology in various fields
4. Describe the principles of advanced Immunotechniques
5. Perform Data collection, basic concepts of data interpretations, retrieval of biological data from few databases and their interpretation.

Course Outcomes: On completion of this course students will be able to:

1. Understand characteristics of the classes of microorganism and their importance and learn outline concepts of immunology and the defence system
2. Learn importance of biomolecules and identify few of them
3. Recognize the role of Biotechnology in various fields
4. Understand the applications of immunotechniques in diagnostics
5. Collect data, interpret it and also perform retrieval of biological data from listed sources

Unit 1: Essentials of Microbiology and Immunology

1.1. History and Major Milestones of Microbiology; Contributions of Edward Jenner, Louis Pasteur, Robert Koch and Joseph Lister.

1.2. Groups of Microorganisms – Structure and characteristics of Bacteria, Fungi, Archaea and Virus.

1.3. Applications of microorganisms in – Food, Agriculture, Environment, and Industry.

1.4. Immune system – Immunity, types of immunity, outlines of immune cells and organs of immune system.

Unit 2: Essentials of Biochemistry

2.1. Biomolecules I – Carbohydrates, Lipids- general introduction to Classification and biological role

2.2. Biomolecules II – Amino acids- classification, Essential amino acids and importance & Proteins- Classification, basics of the levels of organization and biological importance

2.3. Biomolecules III – Nucleic acids -DNA and RNA- Types and importance

2.4. Basics of Metabolism – Anabolism and catabolism- Outlines

Unit 3: Essentials of Biotechnology

3.1. History, scope, and significance of biotechnology. Applications of biotechnology in Plant, Animal, Industrial and Pharmaceutical sciences.

3.2. Environmental Biotechnology – Bioremediation and Biofuels, Biofertilizers and Biopesticides.

3.3. Genetic engineering – Gene manipulation using restriction enzymes and cloning vectors; Physical, chemical, and biological methods of gene transfer.

3.4. Transgenic plants – Stress tolerant plants (biotic stress – BT cotton, abiotic stress – salt tolerance). Transgenic animals – Animal and disease models.

Unit 4: Analytical Tools and techniques in biology – Applications

4.1. Applications in forensics – PCR and DNA fingerprinting

4.2. Immunological techniques – Immunoblotting and ELISA.

4.3. Monoclonal antibodies – Applications in diagnosis and therapy.

4.4. Eugenics and Gene therapy

Unit 5: Biostatistics and Bioinformatics

5.1. Data collection and sampling. Measures of central tendency – Mean, Median, Mode.

5.2. Measures of dispersion – range, standard deviation and variance. Probability and tests of significance.

5.3. Introduction, Genomics, Proteomics, types of Biological data, biological databases NCBI, EBI, Gen Bank; Protein 3D structures, Sequence alignment

5.4. Accessing Nucleic Acid and Protein databases, NCBI Genome Workbench

REFERENCES

1. Gerard J., Tortora, Berdell R. Funke, Christine L. Case., 2016. Microbiology: An Introduction. 11th Edition. Pearson publications, London, England.

2. Micale, J. Pelczar Jr., E.C.S. Chan., Noel R. Kraig., 2002. Pelczar Microbiology. 5th Edition. McGraw Education, New York, USA.

3. Sathyanarayana U., Chakrapani, U., 2013. Biochemistry. 4th Edition. Elsevier publishers.

4. Jain J.L., Sunjay Jain, Nitin Jain, 2000. Fundamentals of Biochemistry. S. Chand publishers, New Delhi, India.

5. R.C. Dubey, 2014. Advanced Biotechnology. S. Chand Publishers, New Delhi, India.

6. Colin Ratledge, Bjorn, Kristiansen, 2008. Basic Biotechnology. 3rd Edition. Cambridge Publishers.

7. U. Sathyanarayana, 2005. Biotechnology. 1st Edition. Books and Allied Publishers pvt. Ltd., Kolkata.
8. Upadhyay, Upadhyay and Nath. 2016. Biophysical Chemistry, Principles and Techniques. Himalaya Publishing House.
9. Arthur M. Lesk. Introduction to Bioinformatics. 5th Edition. Oxford publishers.
10. AP Kulkarni, 2020. Basics of Biostatistics. 2nd Edition. CBS publishers.

ACTIVITIES

1. Identification of given organism as harmful or beneficial.
 2. Observation of microorganisms from house dust under microscope.
 3. Finding microorganism from pond water.
 4. Visit to a microbiology industry or biotech company.
 5. Visit to a waste water treatment plant.
 6. Retrieving a DNA or protein sequence of a gene
 7. Performing a BLAST analysis for DNA and protein.
 8. Problems on biostatistics.
 9. Field trip and awareness programs on environmental pollution by different types of wastes and hazardous materials.
 10. Demonstration on basic biotechnology lab equipment.
 11. Preparation of 3D models of genetic engineering techniques.
 12. Preparation of 3D models of transgenic plants and animals.
- [NOTE: In the colleges where there is availability of faculty for microbiology and biotechnology, those chapters need to be handled by microbiology and biotechnology faculty. In other colleges, the above topics shall be dealt by Botany and Zoology faculty

St. JOSEPH'S COLLEGE FOR WOMEN (AUTONOMOUS), VISAKHAPATNAM

Pathway 2 Course

w.e.f. AY 2023-24

II Semester

Course No-3: BIOMOLECULES

Credits: 3

Hours/Week: 3

Course Objectives: By the end of this course the learner can:

1. Use various solvents, prepare different types of buffers based on need
2. Identify and classify carbohydrates based upon their properties.
3. Identify lipids and understand their physiological role
4. Learn and interpret the various organizations of protein structure
5. Correlate knowledge on nucleic acids with their physiological role and analyse quality of porphyrins and appreciate their biological significance

Course Outcomes: On completion of this course students will be able to:

1. Correlate the Physico - Chemical properties of Biomolecules to their structures
2. Compare and contrast the structure and functions of oligosaccharides and polysaccharides
3. Identify and establish the functional groups of Biomolecules such as Carbohydrates and Lipids
4. Explain the structure of peptide bond formation, and levels of protein structure
5. State the central dogma of molecular biology; recognize the structure of nucleic acids compare and contrast -DNA and RNA

UNIT-I

1. Fundamentals of Biochemistry:

- 1.1 History, scope and avenues of Biochemistry.
- 1.2 Water as a biological solvent.
- 1.3 Measurement of pH, Buffers, Biological relevance of Buffers.
- 1.4 Outlines of surface tension, adsorption and osmosis and their biological relevance.

UNIT-II

2. Carbohydrates:

- 2.1 Classification, monosaccharides, D and L designation, open chain and cyclic structures, epimers and anomers, mutarotation.
- 2.2 Reactions of carbohydrates (due to functional groups - hydroxyl, aldehyde and ketone. Amino sugars, Glycosides.
- 2.3 Structure and biological importance of disaccharides (sucrose, lactose, maltose, isomaltose, trehalose), trisaccharides (raffinose, melezitose).
- 2.4 Structural polysaccharides (cellulose, chitin, pectin) and storage polysaccharides (starch, inulin, glycogen). Glycosaminoglycans.

UNIT – III

3. Lipids:

- 3.1 Classification, saturated and unsaturated fatty acids, structure and properties of fats and oils (acid, saponification and iodine values, rancidity).
- 3.2 General properties and biological role of phospholipids.
- 3.3 Prostaglandins- basic structure, types and biological role.
- 3.4 Lipoproteins- types and functions.

UNIT-IV

4. Amino Acids and Proteins:

- 4.1 Classification, structure, stereochemistry, chemical reactions of amino acids due to carbonyl and amino groups.
- 4.2 Titration curve of glycine and pK values.
- 4.3 Essential and nonessential amino acids, non-protein amino acids.
- 4.4 Peptide bond - nature and conformation.
- 4.5 Naturally occurring peptides - glutathione, enkephalin. Proteins:
- 4.6 Classification based on solubility, shape, and function.
- 4.7 Determination of amino acid composition of proteins.
- 4.8 General properties of proteins, denaturation, and renaturation of proteins.
- 4.9 Structural organization of proteins- primary, secondary, tertiary, and quaternary structures (Eg. Hemoglobin and Myoglobin).

UNIT-V

5. Nucleic acids and porphyrins:

- 5.1 Types of RNA and DNA. Structure of purines and pyrimidines, nucleosides, nucleotides. Stability and formation of phosphodiester linkages.
- 5.2 Effect of acids, alkali and nucleases on DNA and RNA.
- 5.3 Structure of Nucleic acids- Watson-Crick DNA double helix structure, denaturation and renaturation of nucleic acids,
- 5.4 T_m-values and their significance, cot curves and their significance.
- 5.5 Structure and properties of porphyrins: Heme, cytochromes and chlorophylls.

Recommended Books

1. Fundamentals of Biochemistry –Jain, J.L., Jain, S., Jain, N. S. Chand & Co.
2. Biochemistry – Satyanarayana. U and Chakrapani. U, Books & Allied Pvt. Lt
3. Nelson.D.L. and Cox.M..M -Lehninger's Principles of Biochemistry- Freeman & Co.- 7 th Edition

II SEMESTER

Course No-3 BIOMOLECULES PRACTICALS

Credits -1

COURSE OBJECTIVES

To enable students to –

- Learn qualitative analysis of monosaccharides and disaccharides
- Prepare buffers as per the need of the experiment

- Analyse amino acids and lipids Qualitatively
- Analyse protein sample by various methods
- Determine amino acid and protein composition of samples quantitatively

COURSE OUTCOMES

Student will be able to-

- Prepare buffers selectively as per the need of the experiment or biomolecule
- Differentiate carbohydrate by using qualitative tests
- Establish methods to differentiate various amino acids
- Analyse the quality of a given oil
- Develop absorption spectra for proteins and DNA and quantitate them

List of Experiments

1. Preparation of buffers (acidic, neutral, and alkaline) and determination of pH.
2. Qualitative identification of carbohydrates- glucose, fructose, ribose/xylose, maltose, sucrose, lactose, starch/glycogen.
3. Qualitative identification of amino acids- histidine, tyrosine, tryptophan, cysteine, arginine.
4. Qualitative identification of lipids- solubility, saponification, acrolein test, Salkowski test, Lieberman-Burchard test.
5. Preparation of Osazones and their identification
6. Estimation of proteins in biological samples:
 - a. Biuret method.
 - b. Folin-Lowry method.
 - c. UV method.
 - d. Bradford's dye binding method
7. Estimation of amino acid by Ninhydrin method.
8. Estimation of tyrosine by Million's –reaction

Recommended Books

1. Fundamentals of Biochemistry –Jain, J.L., Jain, S., Jain, N. S. Chand & Co.
2. Biochemistry – Satyanarayana. U and Chakrapani. U, Books & Allied Pvt. Lt
3. Nelson.D.L. and Cox.M..M -Lehninger's Principles of Biochemistry- Freeman & Co.- 7 th Edition

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w.e.f. AY 2023-24

III Semester

ANALYTICAL TECHNIQUES

BCH Mi1 3801(3)

Credits: 3

Hours/Week: 3

Course Objectives: By the end of this course the learner can:

1. Identify usage of homogenization methods
2. Learn Principles of Electrophoresis and their applications.
3. Gain Knowledge on centrifugation methods and principles involved
4. Understand calorimetry and spectrophotometry
5. Imbibe knowledge on radioisotopes and measurements

Course Outcomes: On completion of this course students will be able to:

1. Perform tissue homogenization based on sample sources and use appropriate chromatography techniques
2. Perform electrophoresis and separate samples based on their properties
3. Compare various centrifugation methods available and their principles involved
4. Illustrate Beer-Lambert's Law and generate Absorption maxima for biological samples
5. Explain the applications, hazards and precautions of various radioisotopes

UNIT-I

1. Methods of tissue homogenization and Chromatography

- 1.1 Salt and organic solvent extraction and fractionation.
- 1.2 Dialysis, Reverse dialysis, ultra filtration, lyophilization.
- 1.3 Chromatography: principle, procedure and application of partition chromatography, adsorption chromatography, ion exchange chromatography, gel chromatography, affinity chromatography, GLC and HPLC.

UNIT-II

2. Electrophoresis:

- 2.1 Basic introduction to free flow, zone electrophoresis.
- 2.2 Principle, procedure and application of Paper electrophoresis
- 2.3 Principle, procedure and application of Gel electrophoresis (PAGE, SDS-PAGE and capillary electrophoresis)
- 2.4 Principle, procedure and application of Isoelectric focusing
- 2.5 Outlines of Principle, procedure and applications of High voltage electrophoresis, Pulse field electrophoresis, Immunoelectrophoresis.

UNIT-III

3. Centrifugation:

- 3.1 Principle of sedimentation technique.
- 3.2 Different types of centrifuges and rotors.
- 3.3 Principle, procedure and application of differential centrifugation,

- 3.4 Principle, procedure and application of density gradient centrifugation and types,
3.5 Principle, procedure and application of ultra centrifugation,

UNIT-IV

4. Colorimetry and spectrophotometry:

- 4.1 Laws of light absorption -Beer - Lambert's law.
4.2 Principle and instrumentation of colorimetry and spectrophotometry.
4.3 Molar extinction coefficient and quantitation.
4.4 Principle of fluorometry and Atomic absorption spectrophotometer

UNIT-V

5. Radioisotopes:

- 5.1 Important stable radioisotopes used in biochemical research. P³², I 125, I131, Co 60. C 14 etc.
5.2 Radiation hazards and precautions taken while handling radioisotopes.
5.3 Principle and application of RIA.
5.4 Measurement of radioactivity by GM counter

Reference Books

1. Physical Biochemistry- Application to Biochemistry and Molecular Biology: Friefelder D. WH Freeman and Company
2. Principles and Techniques of Biochemistry and Molecular Biology: - Ed. K. Wilson and J. Walker, Cambridge University Press.
3. The Tools of Biochemistry: Cooper T.G., John Wiley and Sons Publication.
4. Biophysical chemistry. Principles and Techniques: Upadhayay A, Upadhayay K and Nath N., Himalaya publishing house.
5. Experimental Biochemistry. Cark Jr J. M. and Switzer R.L, W.H. Freeman and Company.
6. Research Methodology for Biological Sciences: Gurumani. N. M.J.P. Publishers., Chennai, India.
7. Instrumental Methods of Chemical Analysis: Chatwal. G and Anand.S., Himalaya Publishing House, Mumbai, India.
7. A Biologist's Guide to Principles and Techniques of Practical Biochemistry: Williams. B.L. and Wilson. K. (ed.) Edward Arnold Ltd. London
8. Jayaraman, J. (2011). Laboratory Manual in Biochemistry, New Age International (P) Ltd.
9. Sadasivam, S. and Manickam, A. (2005). Biochemical Methods, Second edition, New Age International (P) Ltd.

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w.e.f. AY 2023-24

III Semester

Course No-2: ANALYTICAL TECHNIQUES

BCH- Mi1 3851 (2)

Credits: 2

Hours/Week: 2

Course Objectives: By the end of this course the learner can:

1. Identify Ascorbic acid in fruits
2. Learn Principles of basic agarose gel Electrophoresis
3. Estimate vitamins and minerals
4. Understand lipid characterization protocols
5. Learn working of Soxhlet equipment

Course Outcomes: On completion of this course students will be able to:

1. Estimate Vitamin C content in food samples
2. Extract and estimate plant pigments and vitamins
3. Estimate phosphate content in food and microbial samples
4. Analyse and characterise quality of lipids
5. Extract oil and organic molecules by Soxhlet method

List of Experiments

1. Estimation of ascorbic acid
2. Separation and estimation of total carotenoids and β -carotene
3. Extraction and estimation of vitamin A, vitamin E, niacin and free amino acid concentration.
4. Estimation of phosphorus by Fiske and Subbarow method
5. Characterization of fats – estimation of saponification number, iodine number, acid number and R. M. Number
6. Extraction of Phytoconstituents by Soxhlet and quantification

Reference Books

1. Physical Biochemistry- Application to Biochemistry and Molecular Biology: Friefelder D. WH Freeman and Company
2. Principles and Techniques of Biochemistry and Molecular Biology: - Ed. K. Wilson and J. Walker, Cambridge University Press.
3. The Tools of Biochemistry: Cooper T.G., John Wiley and Sons Publication.
4. Biophysical chemistry. Principles and Techniques: Upadhyay A, Upadhyay K and Nath N., Himalaya publishing house.
5. Experimental Biochemistry. Cark Jr J. M. and Switzer R.L, W.H. Freeman and Company.

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IV Semester

Course No-3: BIOENERGETICS AND METABOLISM OF CARBOHYDRATES AND LIPIDS

Credits: 3

Hours/Week: 3

Course Objectives: By the end of this course the learner can:

1. Learn principles of Thermodynamics
2. Acquire knowledge on Electron transport chain and Oxidative phosphorylation
3. Understand fundamental concepts of Carbohydrate metabolism
4. Learn biosynthesis and degradation of lipids
5. Imbibe knowledge on phospholipids, sphingolipids and cholesterol

Course Outcomes: On completion of this course students will be able to:

1. Illustrate energy flow in biological systems
2. Narrate the complete concept of Electron transport chain and Oxidative phosphorylation
3. Explain carbohydrate metabolic pathways and inborn errors associated with it
4. Illustrate biosynthesis and degradation of lipids
5. Explain role of liver in metabolic pathways

UNIT-I

1. Principles of thermodynamics:

- 1.1 Free energy, enthalpy and entropy.
- 1.2 Free energy changes in biological transformations in living systems.
- 1.3 Redox potential, phosphate group transfer potential and ATP
- 1.4 High-energy compounds
- 1.5 Oxidation and reduction reactions.

UNIT-II

2. Electron Transport chain and Oxidative phosphorylation

- 2.1 Introduction to Oxidative phosphorylation
- 2.2 Outlines of Reducing equivalents,
- 2.3 Electron transport chain and its carriers-Complex I, II, III, IV;
- 2.4 Mitchell's Hypothesis—experimental verification (brief), Determination of P:O ratio
- 2.5 ATP synthesis by F₁-F₀ ATP synthase, E. Racker's experiment, Relation of proton movement and ATP synthesis.
- 2.6 Oxidation and reduction enzymes, utilization of oxygen by oxygenase's, superoxide dismutase and catalase.
- 2.7 Respiratory control- Mechanism, and theories of oxidative phosphorylation.
- 2.8 Respiratory chain inhibitors and uncouplers of oxidative phosphorylation.
- 2.9 Bioluminescence.

UNIT-III

3. Carbohydrate metabolism

- 3.1 Glucose as fuel, glucose transporters.

- 3.2 Glycolysis, and its regulation. Substrate cycling.
- 3.3 TCA cycle – function and regulation,
- 3.4 Glyoxylate cycle, Gluconeogenesis, and its regulation
- 3.5 HMP shunt and its significance,
- 3.6 Glycogen metabolism and its regulation with special reference to phosphorylase and glycogen synthase
- 3.7 Inborn errors of carbohydrate metabolism.

UNIT-IV

4. Lipid metabolism

- 4.1 Oxidation of fatty acids
- 4.2 Biosynthesis of fatty acids and regulation;
- 4.3 Metabolism of arachidonic acid
- 4.4 Biosynthesis of triglycerides.

UNIT-V

5. Metabolism of lipids

- 5.1 Brief outlines of Metabolism of phospholipids, sphingolipids.
- 5.2 Biosynthesis of cholesterol and its regulation in brief
- 5.3 Role of liver and adipose tissue in lipid metabolism.
- 5.4 In born errors of lipid metabolism

RECOMMENDED BOOKS

1. Principles of Biochemistry, White. A, Handler, P and Smith.
2. Biochemistry, Lehninger A.L.
3. Biochemistry, David E. Metzler.
4. Biochemistry, Lubert Stryer.
5. Text of Biochemistry, West and Todd.

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IV Semester

Course No-3: BIOENERGETICS AND METABOLISM OF CARBOHYDRATES AND LIPIDS

Credits: 1

Hours/Week: 3

Course Objectives: By the end of this course the learner can:

1. Learn protocol for isolation of casein and lactalbumin from milk
2. Acquire knowledge on estimation of glucose
3. Estimate urea and creatinine in serum
4. Learn protocol estimation of cholesterol
5. Perform protocol for estimation of glucose

Course Outcomes: On completion of this course students will be able to:

1. Isolate casein and lactalbumin from milk
2. Estimate reducing sugars in food samples and urine
3. Analyse glucose in urine using titrimetric method
4. Estimate serum for urea and creatine
5. Analyse serum cholesterol

PRACTICAL SYLLABUS

1. Isolation of casein from milk
2. Preparation of lactalbumin from milk
3. Estimation of reducing sugar by DNS (dinitrosalicylic acid) method
4. Titration of glucose by Benedict's method
5. Estimation of urea by Diacetylmonoxime method
6. Estimation of creatinine in serum
7. Estimation of cholesterol by ZAK's method

RECOMMENDED BOOKS

1. Principles of Biochemistry, White. A, Handler, P and Smith.
2. Biochemistry, Lehninger A.L.
3. Biochemistry, David E. Metzler.
4. Biochemistry, LubertStryer.
5. Text of Biochemistry, West and Todd.

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IV Semester

Course No-4: CLINICAL BIOCHEMISTRY

Credits: 3

Hours/Week: 3

Course Objectives: By the end of this course the learner can:

1. Learn basic equipment in a Clinical Biochemistry laboratory
2. Acquire knowledge on Haemoglobin related disorders
3. Understand fundamental of Renal and Gastric functioning
4. Learn basic tests used to analyse pancreas and liver
5. Imbibe knowledge on clinically importance enzymes

Course Outcomes: On completion of this course students will be able to:

1. Illustrate and establish a Clinical Biochemistry laboratory that is automated
2. Narrate the reasons behind the hemoglobinopathies and anaemias
3. Explain reasons for renal and gastric failure and analyse the test
4. Illustrate functions of liver and its related disorders
5. Explain role of enzymes in clinical diagnostics

UNIT-I Introduction to Clinical Biochemistry Laboratory

Clinical Biochemistry Laboratory and Investigation of Homeostasis. The use of biochemical tests- Specimen collection and types, Automation and Computerization Water and electrolyte homeostasis - renin angiotensin – aldosterone system Pathological variations of water and electrolytes- diagnosis and Interpretations Self Study: Acid base balance and imbalance - Mechanism of regulations, Anion gap, Acidosis and Alkalosis.

UNIT-II Abnormal Hemoglobin and Inherited Disorders

Inborn errors of Metabolism: Patterns of inheritance - alkaptonuria, phenyl ketonuria, albinism, glycogen storage diseases and inherited disorders associated with urea cycle. Abnormal hemoglobin and' hemoglobinopathies- Sickle cell anemia and thalassemias, porphyrias and porphyrinurias.
Self-study: Plasma proteins in health and diseases

UNIT-III Investigation of Renal and Gastric functions

Renal functions tests: Preliminary investigations, tests based on GFR, RPF and tubular function. Diseases related to kidney - nephritis, nephrosis, uremia, renal failure, renal calculi, renal hypertension, renal tubular acidosis, diabetes insipidus.. Dialysis - hemodialysis and peritoneal dialysis.

Gastric function tests: Examination of resting content, Fractional gastric analysis, stimulation tests, Tubeless gastric analysis. Malabsorption syndrome, acidity, ulcers - gastric, duodenal and peptic, colon cancer, pancreatitis, gastric and pancreatic 'function tests. Self study: Gout, Leschnyhan syndrome and oroticaciduria.

UNIT-IV Liver Function Tests and Lipid Disorder Liver function tests:

Tests based on abnormalities of bile pigment metabolism, detoxification and excretory functions. Diagnosis of different types of jaundice.

Pancreatic function tests.

Diseases relating to liver - jaundice, cirrhosis, hepatitis, cholestasis, cholelithiasis, hepatic coma, hepatic carcinoma, inherited diseases of bilirubin metabolism **Lipid:** Lipoproteinemias and atherosclerosis coronary heart diseases and hypertension.

Self study: Biochemical changes in cancer - detection of tumor markers

UNIT- V Blood Glucose Regulation and Enzymes of Diagnostic Importance

Carbohydrates: Blood glucose level - regulation and its clinical significance, Diabetes mellitus, Glycosuria and GTT.

Enzymes and Isoenzymes of clinical importance - general principles of assay - Clinical significance of enzymes and isoenzymes (LDH, CK, phosphatase, 5' nucleosidase, amylase, lipase, acetyl cholinesterase, transaminase and gamma glutamyl transferase)

Self study: meningitis, encephalities, epilepsy, Parkinson's, Alzheimer's, cerebral palsy.

RECOMMENDED BOOKS

1. Gowenlock, A.H. and Donald, J(2002). Varley's practical clinical Biochemistry, sixth edition, CBS publications and Distributors, New Delhi.
2. Sembulingam, K and Sembulingam, P(2010). Essentials of Medical Physiology, fifth edition. Jaypae Brothers (p) ltd, New Delhi.
3. Burtis and Ashwood (2007) Tietz Fundamentals of Clinical chemistry, 6th edition, WB Saunders Company, Oxford Science Publications USA.
4. Chatterjee and Shindae(2012). Text book of medical biochemistry, 8th edition.
5. Devlin, T.M(2010). Text Book of Biochemistry with clinical correlations, 7th edition. NewYork.
6. Gans, G and Murphy, J.M. (2008). Clinical Biochemistry, fourth edition, Churchill Livingstone, Elsevier

St. JOSEPH'S COLLEGE FOR WOMEN (AUTONOMOUS), VISAKHAPATNAM

w.e.f. AY 2023-24

IV Semester

Course No-4: CLINICAL BIOCHEMISTRY

Credits: 2

Hours/Week: 3

Course Objectives: By the end of this course the learner can:

1. Learn analysis of blood glucose, iron and Hb.
2. Acquire knowledge serum and urine analysis for some minerals
3. Imbibe knowledge on lipid profiling
4. Learn protocols for liver function tests
5. Perform protocols for kidney function tests

Course Outcomes: On completion of this course students will be able to:

1. Analyse serum for Glucose, Iron, Hb and GTT.
2. Estimate biologically important compounds and ions like creatinine and chloride in serum and urine
3. Analyse the serum for lipids like cholesterol, HDL and LDL.
4. Examine bilirubin, albumin, globulin and some enzymes for estimating liver function
5. Analyse urea, creatinine and uric acid to evaluate kidney functioning.

PRACTICAL SYLLABUS

1. Blood analysis: Iron and Hemoglobin, Glucose, GTT.
2. Serum and Urine analysis: Creatine, chloride, phosphorus, calcium.
3. Lipid profiles (Serum) – Total cholesterol, triglycerides, HDL, LDL
4. Liver function tests – Total Bilirubin, total protein, albumin, globulin, albumin/globulin ratio, AST, ALT, ALP
5. Kidney function tests Urea, creatinine, uric acid.

RECOMMENDED BOOKS

1. Gowenlock, A.H. and Donald, J(2002). Varley's practical clinical Biochemistry, sixth edition, CBS publications and Distributors, New Delhi.
2. Sembulingam, K and Sembulingam, P(2010). Essentials of Medical Physiology, fifth edition. Jaypae Brothers (p) ltd, New Delhi.
3. Burtis and Ashwood (2007) Tietz Fundamentals of Clinical chemistry, 6th edition, WB Saunders Company, Oxford Science Publications USA.
4. Chatterjee and Shindae(2012). Text book of medical biochemistry, 8th edition.
5. Devlin, T.M(2010). Text Book of Biochemistry with clinical correlations, 7th edition. NewYork.
6. Gans, G and Murphy, J.M. (2008). Clinical Biochemistry, fourth edition, Churchill Livingstone, Elsevier

St. JOSEPH'S COLLEGE FOR WOMEN (AUTONOMOUS), VISAKHAPATNAM

w.e.f. AY 2025-26

V Semester

NUTRITIONAL BIOCHEMISTRY

Code- BCH Mi1 5801 (3)

Credits: 3

Hours/Week: 3

Course Objectives: By the end of this course the learner can:

1. Narrate the nutrients of animal and plant food and learn about calorific value
2. Explain about role of diet and nutrition in body mass balance and special nutrition requirements
3. Describe the biological impact of Antinutrients, toxins, food allergens.
4. Illustrate the role of vitamins and minerals
5. Explain the diet management in some disease states

Course Outcomes: On completion of this course students will be able to:

1. To compile various Nutrition and balanced diet, various dietary requirements of nutrients.
2. To acquire knowledge about protein calorie malnutrition
3. To learn the biological impact of antinutrients, toxins and food allergens
4. To revise the facts about Fat- and Water-soluble vitamins and their importance
5. To learn about dietary management in diseases

UNIT- I

1. Composition of Foods and BMR

- 1.1 Animal and vegetative foods – chemical composition.
- 1.2 Nutrients – Essential Nutrients and their classification.
- 1.3 Digestibility, absorption and biochemical functions of macro nutrients.
- 1.4 Carbohydrates – dietary requirements.
- 1.5 Proteins – Nitrogen balance studies,
- 1.6 Determination of Biological values of proteins,
- 1.7 Specific Dynamic Action
- 1.8 Improvement of protein quality by supplementation and fortification.
- 1.9 Lipids – Dietary needs of lipids, essential fatty acids.
- 1.10 Calorific values of foods
- 1.11 Basal metabolic rate and its determination, factors influencing BMR.

UNIT-II

2. Clinical nutrition and nutritional requirements

- 2.1 Clinical nutrition – role of diet and nutrition in prevention of atherosclerosis and obesity
- 2.2 Role of leptin in regulation of body mass.
- 2.3 Starvation – Protein sparing treatment during fasting
- 2.4 Protein calorie malnutrition – Kwashiorkar and Marasmus
- 2.5 Nutritional requirements for pregnant and lactating women and aged people.

UNIT-III

3. Antinutrients, Toxins and Food allergens

- 3.1 Biological effects of non-nutrients, dietary fibre, physiological actions.
- 3.2 Antinutrients – Protease inhibitors, hemagglutinins, hepatotoxin, goitrogens, cyanogenic glucosides, methyl xanthines, oxalates.
- 3.3 Toxins from mushrooms.
- 3.4 Biological effects of food contaminants – Hexachlorobenzene, arsenic, DDT, cadmium, mercury, lead, aflatoxins,
- 3.5 Food additives - saccharin and sodium nitrite.
- 3.6 Food allergy – types of food allergens and management of food allergy.
- 3.7 Food processing and loss of nutrients during processing and cooking.

UNIT-IV

4. Vitamins and minerals

- 4.1 Vitamins – Fat soluble vitamins (A,D,E,K) - Sources, biological functions and RDA
- 4.2 Water soluble vitamins (B complex and C) - Sources, biological functions and RDA
- 4.3 Disorders of vitamins A, D, E, K, C and B
- 4.4 Minerals- iron, calcium, iodine, selenium - Sources, biological functions and RDA.
- 4.5 Deficiency disorders of minerals
- 4.6 Nutritional requirements in infancy, childhood, pregnancy and lactation and old age.

UNIT- V

5. Dietary Management in diseases

- 5.1 Obesity – Causes, Anthropometric measurements and Diet management.
- 5.2 Dietary management in – Infection, Fever, Constipation, Diabetes mellitus, Peptic Ulcer, PCOS, Hypertension, Cardiovascular diseases, Pancreatitis, Cirrhosis and Cancer.

RECOMMENDED BOOKS

1. Smith EL (1983) Principles of biochemistry: mammalian biochemistry: McGraw- Hill Companies.
2. Chatterjee CC (1951) Human physiology: Medical Allied Agency.
3. Murray R, Granner D, Mayes P, Rodwell V (2003) Harper's illustrated biochemistry (LANGE basic science): McGraw-Hill Medical.
4. Guyton Aurcher C, Hall John E (2006) Text book of Medical Physiology. Elsevier India Pvt. Ltd. New Delhi.
5. Dixon M, Webb E (1979) Enzyme inhibition and activation. Enzymes 3: 126-136.
6. Rao C (1973) University General Chemistry: An Introduction to Chemical Science: MacMillan India.
7. Price NC, Frey PA (2001) Fundamentals of enzymology. Biochemistry and Molecular Biology Education 29: 34-35.
8. Palmer T, Bonner PL (2007) Enzymes: biochemistry, biotechnology, clinical chemistry: Elsevier

St. JOSEPH'S COLLEGE FOR WOMEN (AUTONOMOUS), VISAKHAPATNAM

w.e.f. AY 2025-26

V Semester

NUTRITIONAL BIOCHEMISTRY PRACTICALS

Code- BCH Mi1 5851 (1)

Credits: 1

Hours/Week: 2

Course Objectives: By the end of this course the learner can:

1. Determine Vitamin C concentration in food samples
2. Analyse the ash content of food samples
3. Demonstrate analysis of quality of milk
4. Determine moisture content of food samples
5. Perform protocols for quality testing of oils

Course Outcomes: On completion of this course students will be able to:

1. Analyse the role of various vitamins and minerals
2. Determine composition of milk
3. Determine ash content in food
4. Analyse quality of oil
5. Determine moisture content of foods

PRACTICAL SYLLABUS

1. Determination of reduced Ascorbic acid by DCPIP method
2. Determination of total Ascorbic acid by DNPH method
3. Determination of calcium in the food
4. Isolation of casein from milk and determination of its protein by any method
5. Determination of cholesterol of edible oil
6. Determination of ash content
7. Determination of moisture content of foods/food grains/ powders
8. Determination of fructose from honey/fruit pulp
9. Determination of pyridoxine of fruits/leaves
10. Isolation of lactose from skimmed milk and the estimation of lactose
11. Determination of iodine value of edible oil by titrimetry
12. Determination of acid value by titrimetry

RECOMMENDED BOOKS

1. Murray R, Granner D, Mayes P, Rodwell V (2003) Harper's illustrated biochemistry (LANGE basic science): McGraw-Hill Medical.
2. Guyton Aurcher C, Hall John E (2006) Text book of Medical Physiology. Elsevier India Pvt. Ltd. New Delhi.
5. Dixon M, Webb E (1979) Enzyme inhibition and activation. Enzymes 3: 126-136.
6. Rao C (1973) University General Chemistry: An Introduction to Chemical Science: MacMillan India.
7. Price NC, Frey PA (2001) Fundamentals of enzymology. Biochemistry andMolecular Biology Education 29: 34-35.
8. Palmer T, Bonner PL (2007) Enzymes: biochemistry, biotechnology, clinical chemistry: Elsevier

St. JOSEPH'S COLLEGE FOR WOMEN (AUTONOMOUS), VISAKHAPATNAM
w.e.f. AY 2025-26
V Semester
ENZYMOLGY

Code- BCH Mi2 5801 (3)

Credits: 3

Hours/Week: 3

Course Objectives: By the end of this course the learner can:

1. Identify the class of enzymes, name them and narrate its working
2. Explain the kinetics of enzyme activity and study factors that contribute to it
3. Measure enzyme activity and study impact of inhibitors
4. Illustrate the method of regulation of enzyme activity
5. Use enzymes at industrial scale

Course Outcomes: On completion of this course students will be able to:

1. Classify enzymes and narrate their interaction with substrate
2. Determine V_{max} and K_m value of enzymes
3. Explain about enzyme inhibitions and measure enzyme activity
4. Understand enzyme regulation
5. Narrate enzyme immobilization and their uses.

UNIT-I

Introduction to Enzymes and Nomenclature

- 1.1 Introduction to enzymes: Holoenzyme, apoenzyme, prosthetic group.
- 1.2 Interaction between enzyme and substrate- lock and key model, induced fit model., enzyme specificity and types.
- 1.3 IUB system of classification and nomenclature of enzymes (Class and subclass with one example)
- 1.4 Ribozymes, Abzymes

UNIT-II

2. Enzyme kinetics

- 2.1 Enzyme kinetics: Importance, order of reaction
- 2.2 Study of the factors affecting the velocity of enzyme catalysed reaction- enzyme concentration, temperature, pH, substrate concentration, inhibitors
- 2.3 Derivation of Michaelis -Menten equation and K_m value determination and its significance.
- 2.4 Definition of V_{max} value of enzyme and its significance.
- 2.5 Lineweaver- Burk plot (Only for single substrate enzyme catalyzed reaction).

UNIT-III

3. Measurement of Enzyme activity, units and inhibitors

- 3.1 Methods of measurements and expression of enzyme activity.
- 3.2 Unit of enzyme activity - definition and importance.
- 3.3 Enzyme inhibition: Reversible and irreversible – examples. Reversible- competitive, noncompetitive and uncompetitive inhibition
- 3.4 Explanation of double reciprocal plot with examples.

UNIT-IV

4 Regulation of Enzymes

4.1 Enzyme regulation – covalently modulated enzymes with examples of adenylation and phosphorylation and allosteric regulation- example Aspartate transcarbamoylase.

4.2 Isoenzymes- Lactate dehydrogenase and creatine phosphokinase.

4.3 Zymogens

UNIT-V

5. Enzyme immobilization and applications

5.1 Immobilization of enzymes, methods of immobilization.

5.2 Industrial uses of enzymes: Detergent enzymes, thermostable alpha amylase, papain, chymotrypsin

RECOMMENDED BOOKS

1. Enzymes: M. Dixon and E. C. Webb. Longman Publication
2. Enzymology: Nicholas and Price
3. Biochemistry: D.Voet and J. G. Voet, John Wiley & sons Inc. New York, Chichester Brisbane, Toronto, Singapore ISBN 0-471-58651-X
4. Biochemistry: L. Stryer. and Hall, J.E., Library of congress cataloguing-in publication Data, Bery, Jeremy mark ISBN -0-7167-4684-0.
5. Enzymes: Trevor Palmer Affiliated East- West Press Pvt. Ltd, New Delhi ISBN 817671-04

St. JOSEPH'S COLLEGE FOR WOMEN (AUTONOMOUS), VISAKHAPATNAM

w.e.f. AY 2025-26

V Semester

ENZYMOLGY PRACTICALS

Code- BCH Mi2 5851 (1)

Credits: 1

Hours/Week: 2

Course Objectives: By the end of this course the learner can:

1. Acquire the knowledge determining alpha amylase activity
2. Identify the effect of pH on enzyme activity
3. Study the determination of optimum values for physical factors
4. Explain monosubstrate and bisubstrate reaction kinetics.
5. Explore the applications of enzymes in clinical and various industrial sectors.

Course Outcomes: On completion of this course students will be able to:

1. Assay enzymes given
2. Determine the optimum pH and temperature for enzymes
3. Analyse the effect of substrate concentration on enzymes
4. Explain and demonstrate enzyme kinetics
5. Perform and evaluate mono-substrate and bi-substrate kinetics

PRACTICAL SYLLABUS

1. Assay of α - amylase activity in saliva
2. Determination of optimum pH of a plant/animal or microbial enzyme.
3. Studying the effect of different temperatures during enzyme activity measurements.
4. Studying the effect of different pH during enzyme activity measurements.
5. Substrate saturation and determination of K_m value from Michaelis Menten curve.

RECOMMENDED BOOKS

1. Biochemistry: L. Stryer. and Hall, J.E., Library of congress cataloguing-in publication Data, Bery, Jeremy mark ISBN -0-7167-4684-0.
2. Enzymes: Trevor Palmer Affiliated East- West Press Pvt. Ltd, New Delhi ISBN 817671-04