



**ST.PHILOMENA'S COLLEGE (AUTONOMOUS),  
MYSURU**

***(AFFILIATED TO UNIVERSITY OF MYSORE)***

***REACCREDITED BY NAAC WITH A GRADE***

Three-year six semesters Choice Based Credit System (CBCS) with  
**Learning Outcome Based Curriculum framework (LOCF)**  
And Continuous Assessment & Grading Pattern (CAGP)  
Undergraduate Programme Under Autonomous Structure

**Programme- B.Sc.**

**The academic year 2018-19 onwards**

**DEPARTMENT OF BIOCHEMISTRY**

## VISION AND MISSION OF THE COLLEGE

### VISION:

The college is guided by the visionary zeal of providing value- based education to everyone irrespective of religion, caste, creed or sex by which the character is formed, intellect is explained and one can stand on his/her feet.

### MISSION:

To transform young men and women who come to learn not from books, but also from life and to share the experience of working and playing together, this inculcates life skills to become good citizens with integrity and discipline.

### Programme Educational Objective (PEO)

PEO1	Graduates will be able to master and display competency and leadership to become successful professionals, employees and entrepreneurs or pursue higher education and research.
PEO2.	Graduates will be able to demonstrate the commitment towards professional ethics, gender sensitivity, preservation of environment and sustainable development.
PEO3	Graduates will continue to learn and advance their careers through activities such as participation in professional organizations, attainment of professional certification and seeking higher education.

### Programme Outcomes (PO):BSc. Programme

PO1	<b>Disciplinary Knowledge:</b> The BSc. graduates will acquire the knowledge with facts and figures related to pure and applied sciences. Understand the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevancies in the day-to-day life.
PO2	<b>Cognitive and Communicative skills:</b> Students learn two languages along with three major subjects. At the end of the programme, the students would have developed advanced reading, writing, interpretive and composition skills in both languages. They would be able to communicate with others using appropriate media; confidently share one's views and express themselves.
PO3	<b>Research Related Skills:</b> The BSc. students will acquire the skills in handling scientific instruments, planning and performing in laboratory experiments.
PO4	<b>Ethics:</b> The BSc. students will be imbibed ethical, moral and social values in personal and social life leading to highly cultured and civilized personality.

PO5	<b>Problem Solving:</b> The BSc. graduates will develop the ability to analyze and solve Course-related problems and also the ability to evaluate situations and react responsibly to communicate, cooperate and lead a team among peers and others.
PO6	<b>Critical Thinking:</b> The qualities of a science student – observation, precision, analytical mind, logical thinking, clarity of thought and expression, systematic approach, qualitative and quantitative decision making are enhanced.
PO7	<b>Social Interaction:</b> The BSc. graduates shall appreciate the role of science in society; and its personal, social and global importance.
PO8	<b>Analytical Skills:</b> The graduates will master the skills of observations and drawing logical inferences from the scientific experiments. Analyzed the given scientific data critically and systematically and the ability to draw the objective conclusions.
PO9	<b>Environment and Sustainability:</b> Graduates will be able to understand the issues of environment and work towards sustainable development.
PO10	<b>Employability:</b> After completing the of the programme, graduates will have the competency to be employed or to be an entrepreneur.
PO11	<b>Leadership Quality:</b> In the graduation programme students are inculcated moral and ethical values, managerial skills, adoptability, problem solving, taking initiative, decision making, risk taking to make them confident leaders.

### Programme Specific Outcomes (PSO)

PSO	After the completion of BSc programme by studying Biotechnology, Biochemistry and Microbiology, (BtBMb) the student will be able to	Cognitive level
PSO1	demonstrate and apply their knowledge of cell biology, biochemistry, microbiology and molecular biology to solve the problems related to the field of <b>Biotechnology</b>	Apply
PSO2	To acquire in-depth theoretical and practical knowledge of Biochemistry and the ability to apply the acquired knowledge to provide cost efficient solutions in Biochemistry. And to bridge the gap between academia and industry	Understand & Apply
PSO3	Apply the scientific method and hypothesis testing in the design and execution of experiments related to isolation, identification, cultivation and control of microorganisms from/in food, human body, environmental sources.	Understand and apply

Mapping of Mission of the College with PEO			
Mission	PEO-1	PEO-2	PEO-3
Mision -1	✓	✓	✓

Mapping of PEOs with Programme Outcomes(PO)											
PEO No.	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11
PEO-1		✓	✓		✓					✓	✓
PEO-2	✓			✓					✓		
PEO-3						✓	✓	✓			

**ST. PHILOMENA'S COLLEGE (Autonomous), MYSURU- 570015**  
**Subject: BIOCHEMISTRY**  
**SYLLABUS FOR B.Sc., UNDER CBCS, LOCF SCHEME**  
**From The Academic Year 2018-2019 Onwards**

**PREAMBLE**

The syllabus is framed to give sound knowledge with an understanding of Biochemistry to undergraduate students of three Years of B.Sc degree course. The goal of the syllabus is to make the study of Biochemistry popular, interesting and encouraging to students for higher studies including research. The new updated syllabus includes/ incorporates recent concepts within different areas of each paper offered. The syllabus is designed based on a basic and applied approach with vigour and depth. The syllabus is prepared after discussion at length with several faculty members of the subject and experts from industries and research fields. The new CBCS syllabus includes an array of discipline specific electives (DSE) which are offered by the second year and final year B.Sc students. The students are given the choice to choose the elective of their interest. The syllabus of these electives is designed to impart additional Knowledge to students which will enable them to appreciate the vast application of Biochemistry, and various tools used.

Biochemistry being an experimental science, due importance is given to the development of laboratory and instrumentation. The major goals of practical work are to teach manual and observational skills, to improve the understanding of methods of scientific enquiry, to develop problem-solving skills and to nurture professional attitudes.

**CBCS SYLLABUS FOR BSc IN BIOCHEMISTRY**  
**FOR THE ACADEMIC YEAR 2018-19 ONWARDS**

### GENERAL SCHEME for TEACHING & EVALUATION

Semester	Title of the Paper	Course Code	TYPE	Teaching Hours per Week Theory/ Practical	Credits Theory/ Practical	Exam Duration in Hours Theory/ Practical	Max. Marks Theory/Practical		
							Theory/Practical	I A Theory/Practical	Total Marks
I	Paper-I: Principles of Biochemistry	MA210	DSC	03	03	03	50	20	100
	Practical Paper-I	MA212	DSC	03	1.5	03	20	10	
II	Paper-II: Biomolecules-I	MB210	DSC	03	03	03	50	20	100
	Practical Paper-II	MB212	DSC	03	1.5	03	20	10	
III	Paper-III: Biomolecules-II & Biochemical Techniques	MC210	DSC	03	03	03	50	20	100
	Practical Paper-III	MC212	DSC	03	1.5	03	20	10	
IV	Paper-IV: Enzymology & Metabolism-I	MD210	DSC	03	03	03	50	20	100
	Practical Paper-IV Colorimetric Estimations	MD212	DSC	03	1.5	03	20	10	
V	Paper-V: Metabolism II & Human Physiology	ME210	DSC	03	03	03	70	30	300
	Paper-VI : Molecular Biology & Genetic Engineering	ME212	DSC	03	03	03	70	30	
	Practical Paper-V Enzyme Assays	ME214	DSC	03	1.5	03	35	15	
	Practical Paper-VI Bio-Physical & Biochemical Experiments	ME216	DSC	03	1.5	03	35	15	
VI	Paper-VII: Nutrition	MF210	DSC	03	03	03	70	30	300

	<b>Paper-VIII: Clinical Biochemistry &amp; Immunology</b>	<b>MF212</b>	<b>DSC</b>	<b>03</b>	<b>03</b>	<b>03</b>	<b>70</b>	<b>30</b>	
	<b>Practical Paper-VII Nutrition</b>	<b>MF214</b>	<b>DSC</b>	<b>03</b>	<b>1.5</b>	<b>03</b>	<b>35</b>	<b>15</b>	
	<b>Practical Paper-VIII Clinical Biochemistry &amp; Immunology</b>	<b>MF216</b>	<b>DSC</b>	<b>03</b>	<b>1.5</b>	<b>03</b>	<b>35</b>	<b>15</b>	
			<b>DSE 1</b>	<b>02</b>	<b>02</b>	<b>03</b>	<b>30</b>	<b>20</b>	<b>100</b>
			<b>DSE 2</b>	<b>02</b>	<b>02</b>	<b>03</b>	<b>30</b>	<b>20</b>	
					<b>40</b>	<b>-</b>			<b>1100</b>

### Discipline Specific Electives Offered

Sl no	Title of the Paper	Course Code	TYPE	Semesters	Teaching Hours per Week Theory/ Practical	Credits Theory/ Practical	Exam Duration in Hours Theory/ Practical	Max. Marks Theory/Practical		
								Theory/Practical	I A Theory/Practical	Total Marks
<b>1</b>	Basic Chemistry	<b>MC21Y03</b>	<b>DSE</b>	<b>II to IV</b>	<b>2</b>	<b>2</b>	<b>02</b>	<b>30</b>	<b>20</b>	<b>50</b>
<b>2</b>	Basic Concepts of Genetics	<b>MC21Y04</b>			<b>2</b>	<b>2</b>	<b>02</b>	<b>30</b>	<b>20</b>	<b>50</b>
<b>3</b>	Lifestyle Disorders	<b>MC21Y01</b>			<b>2</b>	<b>2</b>	<b>02</b>	<b>30</b>	<b>20</b>	<b>50</b>
<b>4</b>	Plant Biochemistry and Medicinal Plants	<b>MC21Y05</b>			<b>2</b>	<b>2</b>	<b>02</b>	<b>30</b>	<b>20</b>	<b>50</b>
<b>1</b>	Molecular Basis of Non-Communicable Human diseases	<b>MF21Y06</b>	<b>DSE</b>	<b>V to VI</b>	<b>2</b>	<b>2</b>	<b>02</b>	<b>30</b>	<b>20</b>	<b>50</b>
<b>2</b>	Concepts of Pharmaceutical Biochemistry	<b>MF21Y07</b>			<b>2</b>	<b>2</b>	<b>02</b>	<b>30</b>	<b>20</b>	<b>50</b>
<b>3</b>	Molecular Endocrinology	<b>MF21Y08</b>			<b>2</b>	<b>2</b>	<b>02</b>	<b>30</b>	<b>20</b>	<b>50</b>
<b>4</b>	Introduction to Biostatistics	<b>MF21Y02</b>			<b>2</b>	<b>2</b>	<b>02</b>	<b>30</b>	<b>20</b>	<b>50</b>
<b>5</b>	Basic Bioinformatics	<b>MF21Y09</b>			<b>2</b>	<b>2</b>	<b>02</b>	<b>30</b>	<b>20</b>	<b>50</b>

### FIRST SEMESTER BIOCHEMISTRY PAPER-I

**Title: PRINCIPLES OF BIOCHEMISTRY.**  
**Class duration – 03 hours per week .48 Hours**  
**Marks: Theory - 50 + Internal Assessment - 20= 70**

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**COURSE OBJECTIVE**

- 1 Establish sound knowledge of various concepts in bio organic chemistry with relevance to various organic acids produced in the body and secondary metabolites produced by plants and their importance in human life.
- 2 Impart knowledge on the use of water as a universal solvent and various electrochemistry procedures used in physical chemistry labs.
- 3 Explain the functions of important inorganic compounds and the toxicity of heavy metals.

COURSE LEARNING OUTCOME		
CO	On completion of the course the student will be able to	Cognitive Level
CO-2	Summarize the importance of water and the principles involved in using conductivity meters, potentiometers and colorimeters.	Evaluate
CO-3	Comprehend the importance of inorganic compounds like sulphur selenium in maintaining normal health and also discuss the toxic effects of heavy metal poisoning.	Understand.

**Unit 1. BIO-ORGANIC CHEMISTRY**

- 1.1 **Concept of Biochemistry:** **1 hr**  
Definition and scope of biochemistry, Important discoveries in biochemistry, An outline of elements and major organic compounds in a living system.
- 1.2 **Hydroxy acids, dicarboxylic acids and ketoacids** **3hrs**
- 1.2.1 **Hydroxy acids:** Structure, properties & biological importance of Lactic acid (Action of heat, oxidation), Tartaric acid, Citric acid (Action of heat, salt formation) & Isocitric acid.
- 1.2.2 **Dicarboxylic acid:** Structure, properties & biological importance of Succinic acid, Maleic acid & fumaric acid.
- 1.2.3 **Ketoacids:** Structure, properties & biological importance of Pyruvic acid,  $\alpha$  - ketoglutaric acid & oxaloacetic acid.



1.3	<b>Heterocyclic compounds:</b> Occurrence, structural formula and biological importance of the following and their derivatives. Furan, Pyrrole, thiophene, thiazole and imidazole, pyridine, pyran, pyrimidine, purine, indole, quinoline and isoquinoline	4hrs
1.4	<b>Steroids:</b> 1.4.1 Basic ring system in steroids, structure & biological importance of cholesterol. 1.4.2 Structure & biological importance: Ergosterol, Estradiol, testosterone, progesterone, cortisol, cortisone, Biological importance of bile acids [mono, di & tricholic acids] and ecdysone.	4 hrs
1.5	<b>Phytochemicals</b> 1.5.1 <b>Terpenes</b> Isoprene rule, classification, structure, occurrence and importance of: a) Monoterpenes-limonene and importance of menthol and camphor. b) Sesquiterpenes- Juvenile hormone-I and importance of abscisic acid-II, c) Diterpenes-phytol d) Triterpenes- lanosterol e) Tetraterpenes-lycopene, f) Polyphenols- the importance of dolichol.	5hrs
1.5.2	<b>Flavanoids</b> Quercetin, capsaicin & curcumin: occurrence & biological importance.	2hrs
1.5.3	<b>Alkaloids</b> Definition, classification based on their composition with examples, structure & the physiological action of LSD, morphine, caffeine, nicotine, Biological importance of reserpine, piperine, quinine, cocaine, theobromine and atropine, Synthesis of Atropine and nicotine.	5hrs
<b>Unit 2. BIO-PHYSICAL CHEMISTRY</b>		
2.1	<b>Concentration units:</b> Mole, mole fraction, molarity, equivalent weight, normality, molality (problems to be worked out), dilution factors.	1 hrs
2.2	<b>Water:</b> Essentiality of water to life and Water as a biological fluid, Special properties of water, Hypo, hyper and isotonic solutions and effects of osmotic pressure on living cells.	2 hrs.
2.3	<b>Acids, bases and buffers:</b> Lewis concept of acids & bases, the Ionic product of water and pH scale, Henderson-Hasselbalch equation of weak acids, Buffers: Definition, Buffer capacity. Preparation of acidic and basic buffer solutions, Theory of acid-base indicators, Choice of indicators	3 hrs.
2.4	<b>Electrochemistry:</b> Electrodes (Hydrogen Electrode & calomel electrode), Quinhydrone electrode, Glass electrode. Conductometric titrations- Strong acid against the strong base, a weak acid (amino acid) against NaOH]. Determination of pKa values of weak acids (Hydrogen electrode & calomel electrode), quinhydrone electrode, and glass electrode. Determination of pKa values of a weak acid by potentiometric titration.	3 hrs.
2.5	<b>Photochemistry:</b> Laws of photochemistry, quantum efficiency, light absorption, Beer-Lambert's	3hrs

law-applications and limitation, Spectrophotometer, colourimeter-principle and applications, Fluorescence, phosphorescence, chemiluminescence, bioluminescence (Elementary treatment).

### Unit 3. BIO-INORGANIC CHEMISTRY

- 3.1 **Phosphorous, Sulphur and Selenium:** **2 hrs.**  
Importance of phosphorus & sulphur compounds in the biological system, the effect of sulphur compounds on environmental pollution, Role of selenium in a biological system.
- 3.2 **Biochemical Toxicology:** **3 hrs.**  
Source, entry into the biological system and toxic effects of lead, Mercury, Cadmium, Fluoride, Arsenic. Toxicity studies: LD<sub>50</sub> & ED<sub>50</sub>
- 3.3 **Porphyrins:** **3 hrs**  
Porphyrin nucleus – structure. Structure and the biological role of metal ions in important metalloporphyrins-Haemoglobin, Cytochromes, Chlorophyll, Vit-B<sub>12</sub>.
- 3.4 **Radiation chemistry:** **4 hrs.**  
Introduction, Natural and artificial radioactivity, Characteristics of radioactive elements, units of radioactivity, disintegration constant, half-life, detection of radioactivity by scintillation counter and advantages, Uses of radioisotopes in the biological system – <sup>3</sup>H, <sup>14</sup>C, <sup>131</sup>I, <sup>60</sup>Co and <sup>32</sup>P, Biological effects of radiations. Radiation hazards, Safety measurements in handling radioisotopes.

#### Books recommended:

S/no	Book	Author	Publication
1	Textbook of Inorganic chemistry	J.D Lee	B Black well Science Ltd
2	Textbook of Inorganic chemistry	Puri & Sharma	Shobhanlal Nagin Chand co
3	Textbook of physical chemistry	Puri & Sharma	Vishal Publishing Company
4	Textbook of physical chemistry	S. Glasstone	Read books
5	Textbook of Physical Biochemistry-	David Friefelder	Freeman and company W.H
6	Textbook of Organic Chemistry	Puri & Sharma	Shobhanlal Nagin Chand co

### PRACTICAL-I

#### Title: Principles of Biochemistry

**Practical Duration -03 Hours per week Examination-03 Hours**  
**MARKS=30**  
**Practical Proper-20. Internal Assessment - Record-05+ Class Test-05=10**

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### COURSE OBJECTIVE

- 1 To learn Basic skills in the biochemistry lab.
- 2 To learn the skills of calibration of laboratory glassware and preparation of normal and molar solutions of various strengths.
- 3 To prepare of standard solutions of known volumes and estimation of the amount of a given substance by titrimetric method.

**Note:** Analytical/electronic balance for weighing can be used.

COURSE LEARNING OUTCOME		
CO	On completion of the course the student will be able to	Cognitive Level
CO-1	Plan experiments, write protocols	Understand & Apply
CO-2	Calibrate the laboratory glassware and prepare solutions	Understand & Apply
CO-3	Estimate the amount of the unknown substance of the given solution by titrimetric method.	Understand & Apply

- 1 Calculation and preparation of molar solutions.
- 2 Calculation and preparation of normal solutions.
- 3 Calibration of volumetric glassware (Burette and Pipette).
- 4 Preparation of standard Oxalic acid solution. Standardization of NaOH solution and estimation of  $\text{H}_2\text{SO}_4$  in the given solution. (Phenolphthalein).
- 5 Preparation of standard Sodium carbonate solution, standardization of HCl (Methyl orange) and estimation of NaOH in the given solution (methyl orange or phenolphthalein).
- 6 Preparation of  $\text{ZnSO}_4$  solution. Standardization of EDTA solution and estimation of total hardness of water using Eriochrome black-T indicator.
- 7 Preparation of standard oxalic acid solution. Standardization of NaOH solution and

estimation of acidity in vinegar.

- 8 Preparation of standard potassium biphthalate solution, standardization of NaOH solution and estimation of free and total acidity in gastric juice.
- 9 Preparation of standard Potassium dichromate and estimation of ferrous/ferric mixture using diphenylamine indicator (Demonstration).
- 10 Preparation of standard Oxalic acid solution. Standardization of  $\text{KMnO}_4$  solution and estimation of calcium in milk.
- 11 Preparation of standard potassium biphthalate solution, standardization of sodium hydroxide solution and estimation of hydrochloric acid present in the given solution.
- 12 Preparation of standard potassium biphthalate solution, standardization of sodium hydroxide solution and estimation of alkalinity of antacids.

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## SECOND SEMESTER

**Biochemistry Paper-II**  
**Title: BIOMOLECULES –I**  
**Class duration – 03 hours per week. 48 Hours**  
**Marks: Theory - 50 + Internal Assessment - 20= 70**

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**COURSE OBJECTIVE**

- 1: Gain knowledge about various macromolecules present in biological system
- 2: Understand structure, linkage and functions of macromolecules

COURSE LEARNING OUTCOME		
CO	On completion of the course the student will be able to	Cognitive level
CO-1	Demonstrate knowledge and understanding of the molecular machinery of living cells and principles that govern the structures of carbohydrates and lipids.	Understand
CO-2	Structural elucidation and physiochemical properties of carbohydrates and lipids.	Understand
CO-3	Structure-Function relationship analysis	Apply

**Unit 1.CARBOHYDRATES**

- 1.1 **Carbohydrates:** **8hrs**  
Classification, biological importance of carbohydrates, Monosaccharides: Configuration relationship of D-aldoses, D-ketoses. Reactions of glucose and fructose-oxidation, reduction, reducing properties formation of glycosides, acylation, methylation, condensation – phenylhydrazine, addition – HCN. Interconversion of aldoses and ketoses by chemical method. Ascending and descending the series by chemical methods. Stereochemistry of monosaccharides, (+) and (-), D and L, epimers, anomers, enantiomers and diastereomers.
- 1.2 **Glucose:** **8hrs**  
Elucidation of open chain structure configuration and ring structure of glucose and mutarotation. Open and Haworth structures of galactose, mannose, ribose and fructose. Structure and biological importance of amino sugars, deoxy sugars, sugar acids, neuraminic and muramic acid.
- 1.3 **Disaccharides:** **8hrs**  
Establishment of structures of - sucrose and lactose. Structure of isomaltose, cellobiose, trehalose and maltose and importance of trehalose.
- 1.4 **Polysaccharides:**

Classification with examples. Partial structure, occurrence and importance of starch, glycogen, inulin, cellulose, chitin, and pectin. Glycosaminoglycans: Occurrence, importance and the structure of the repeating units of heparin, hyaluronic acid, and chondroitin sulphate. Bacterial cell wall polysaccharides- Teichoic acid and peptidoglycans. Blood group oligosaccharides. Chemical basis of the qualitative tests: Molisch, iodine, Benedicts, Fehling's, picric acid, Barfoed's, Bial's, Seliwanoff's, osazone tests.

## Unit 2. LIPIDS

- 2.1 **Lipids:** Definition, classification and biological role, 8 hrs  
 Fatty acids –Saturated [C4-C24] and unsaturated fatty acids: Nomenclature, structure & occurrence.  
 Physical properties and chemical reactions: esterification and rancidity.  
 Essential fatty acids ( $\omega$ -3 &  $\omega$ -6 fatty acids): structure, occurrence & biological importance.
- 2.2 **Tri-acylglycerols:** simple and mixed glycerides with examples, 8 hrs  
 Saponification, hydrolysis, Definition & significance of saponification value, iodine value, acid value and peroxide value.  
 Waxes: Composition, importance with examples  
 Phosphoglycerides: Structure of lecithin, cephalins, phosphatidyl inositol, plasmalogens, and cardiolipins. the biological role of phosphoglycerides.
- 2.3 **Sphingolipids:** Ceramides, structure and importance of sphingomyelin. 8 hrs  
**Glycosphingolipids:** Structure and importance of cerebrosides (galactocerebroside and glucocerebroside), gangliosides (GM<sub>1</sub>, GM<sub>2</sub>, GM<sub>3</sub>).  
**Eicosanoids:** Structure of PGE<sub>1</sub>, PGE<sub>2</sub>, PGF<sub>1 $\alpha$</sub>  and PGF<sub>2 $\alpha$</sub> . Biological roles of thromboxanes, leukotrienes and prostaglandins.  
**Plasma lipoproteins:** Types and functions, composition and structure of lipoprotein  
**Biological Membrane:** Amphipathic lipids, membrane bilayers, micelles, liposomes and its uses. Fluid Mosaic model – structure, composition & functions of the plasma membrane.

## Books recommended

Slno	Book	Author	Publication
1	Textbook of Biochemistry	West & Todd	Todd publications
2	Textbook of Biochemistry	A. Lehninger	Freeman, W.H and company
3	Chemistry of natural products	Chatwal	Himalaya Publishing House
4	Textbook of Biochemistry	O.P. Agarwal	Krishna Prakashan Media p Ltd

5	Textbook of Biochemistry	Jain	S Chand publishing
6	Handbook of Biochemistry	Satyanarayana	Elsevier India
7	Illustrated Biochemistry	Harper	Lange Medical Publication

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**PRACTICAL-II**  
**Bio-molecules-I**

**Practical Duration -03 Hours per week Examination-03 Hours**

**MARKS=30.**

**Practical Proper-20.**

**Internal Assessment - Record-05+ Class Test-05=10**

**COURSE OBJECTIVE**

- 1 Impart skills required for the qualitative analysis of carbohydrates.
- 2 Preparation of reagents used in qualitative analysis of carbohydrates.
- 3 Identification of given unknown sugar solution by systematic qualitative analysis
- 4 Teach the extraction of biomolecules from various natural sources and their identification

**COURSE LEARNING OUTCOME**

<b>CO</b>	<b>On completion of the course the student will be able to</b>	<b>Cognitive level</b>
CO-1	Demonstrate the skills of handling glasswares like test tubes and use of water bath and microscope in identifying the given unknown carbohydrate solution.	Understand & Apply
CO-2	Differentiate between various classes of sugars present in the given solution by the differences in the osazone formed.	Understand & Apply
CO-3	Estimate and extract the biomolecules from biological sources by performing step wise procedure involving techniques of grinding, mashing, filtration, precipitation and crystallization.	Apply

- 1 Qualitative analysis of monosaccharides (glucose, fructose).
- 2 Qualitative analysis of disaccharides & polysaccharides (lactose, maltose, sucrose & starch).
- 3 Acid hydrolysis of starch.
- 4 Determination of acid value of oil or fat.
- 5 Determination of saponification value of oil or fat.
- 6 Determination of iodine value of oil or fat.
- 7 Determination of peroxide value of oil or fat.
- 8 Extraction and confirmation of caffeine from tea leaves.
- 9 Extraction and estimation of lactose from milk.
- 10 Extraction of starch from potatoes.
- 11 Demonstration of extraction of Lycopene from Biological source.
- 12 Demonstration of extraction of oil from oilseeds.

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**THIRD SEMESTER-BIOCHEMISTRY**  
**Biochemistry Paper-III**  
**Title: BIOMOLECULES-II AND BIOCHEMICAL TECHNIQUES**  
**Class duration – 03 hours per week. 48 Hours**

**Marks: Theory - 50 + Internal Assessment - 20= 70**

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**COURSE OBJECTIVE**

- 1 Provide a comprehensive knowledge about the structure, function and properties of amino acids and nucleic acids.
- 2 Detail the various stages of protein structure and the chemical interactions which stabilize these structures with relevant examples.
- 3 Understand theoretical and practical knowledge about various techniques used in purification and characterization of characterization Biomolecules.

<b>COURSE LEARNING OUTCOME</b>		
<b>CO</b>	<b>On completion of the course the student will be able to</b>	<b>Cognitive level</b>
CO-1	Explain the importance of amino acids and their role in protein formation and function.	Understand
CO-2	Understand the levels of protein structure and various functions of proteins and nucleic acid.	Understand
CO-3	Use the current biochemical and molecular technique concept to plan and carry out experiment	Apply
CO-4	Understand construction, working principle and application of various techniques used in biochemistry with its limitations	Understand

**Unit 1.BIOMOLECULES- II**

**1.1 Amino acids & Peptides:**

**8 hrs.**

Structure and classification of amino acids based on polarity. D and L notation of amino acids Zwitterionic properties, pKa values of amino acids. Reactions of the amino groups with  $\text{HNO}_2$ ,  $\text{LiAlH}_4$ , phenylisothiocyanate, dansyl chloride, 1-Fluoro 2,4-dinitrobenzene. The reaction of the carboxyl group with hydrazine. Any one method (Gabriel's) of chemical synthesis of amino acids. Peptide bond-formation and characteristics. Structure and biological importance of glutathione. Biological importance of Valinomycin, leu-enkephalin and endorphins. Chemical synthesis of dipeptides by carbobenzoxy method.

- 1.2 **Proteins:** 8 hrs  
 Classification of proteins based on solubility, structure and functions with examples.  
 Colour reactions of proteins- Biuret, xanthoproteic, Millon's, Hopkins-Cole, Sakaguchi and lead acetate tests.  
 Structural organization of proteins: Primary Structure of proteins, steps involved in protein sequencing, amino acid composition, methods of determining N and C-terminal amino acids, sequencing by Edman's degradation method.  
 Secondary Structure -  $\alpha$ -Helix.  $\beta$ -sheets,  $\beta$ -bends. Tertiary structure: forces stabilizing the structure, structure of myoglobin. Quaternary structure: 3D structure of haemoglobin. Denaturation and renaturation of proteins, Anfinsen's experiment.
- 1.3 **Nucleic acids:** 8 hrs.  
 Isolation of DNA and RNA from plant and animal sources. Structure of purines and pyrimidines; nucleosides and nucleotides. Biological importance of nucleotides that are not found in nucleic acids.  
 DNA: Chargaff's rule, Watson and Crick model of DNA. Types of DNA -A, B and Z forms. Melting of DNA ( $T_m$ ).  
 RNA: Composition, types (mRNA, tRNA and rRNA), Secondary structures of tRNA - cloverleaf model, Chemical reactions of RNA and DNA with acid and alkali, colour reactions of DNA and RNA.
- Unit 2. BIO-CHEMICAL TECHNIQUES**
- 2.1 **Isolation of proteins:** methods of purification – dialysis, salting in & salting out, pH precipitation and solvent precipitation. Criteria of purity of proteins. 2 hrs.
- 2.2 **Chromatography:** Principles, procedures and applications of 12 hrs  
**Paper chromatography**-Ascending and descending paper chromatography, Circular paper chromatography, 2D chromatography.  
**Column chromatography**-Adsorption Chromatography, Gel-filtration Chromatography, Ion-exchange Chromatography, Affinity chromatography, HPLC GLC.  
 Thin-layer chromatography.
- 2.3 **Electrophoresis** 4 hrs.  
**Principles, procedures and applications of Electrophoresis** -Paper electrophoresis Gel electrophoresis (agarose, SDS – PAGE).
- 2.4 **Centrifugation:** 4 hrs.  
**Principle and procedure of Centrifugation**-Differential and density gradient centrifugation. Ultracentrifuge- construction and applications.
- 2.5 **Spectroscopy:** 2 hrs.  
 Principles & applications of Spectroscopy- UV-visible, IR, Fluorescence, NMR, CD spectra
- Books recommended**

<b>Slno</b>	<b>Book</b>	<b>Author</b>	<b>Publication</b>
<b>1</b>	Textbook of Biochemistry	West & Todd	Todd publications
<b>2</b>	Textbook of Biochemistry	A. Lehninger	Freeman, W.H and company
<b>3</b>	Textbook of Biochemistry	O.P. Agarwal	Krishna Prakashan Media p Ltd
<b>4</b>	Textbook of Biochemistry	Jain	S Chand publishing
<b>5</b>	Handbook of Biochemistry	Sathynarayana	Elsevier India
<b>6</b>	Illustrated biochemistry	Harper	Lange Medical Publication
<b>7</b>	A biochemical guide to principles and techniques of practical biochemistry	K.Wilson&K.Goulding	Cambridge University Press
<b>8</b>	Principles and techniques of practical biochemistry	Bryan L.Williams and Keith Wilson	Cambridge University Press
<b>9</b>	Textbook of Practical Biochemistry	Shawney	NarosaPublishing House

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### **COURSE OBJECTIVE**

- 1 Explain the procedures involved in the Identification of the given unknown protein and amino acids by using qualitative methods.
- 2 The isolation and detection of various Biomolecules by different chromatographic

<b>COURSE LEARNING OUTCOME</b>		
<b>CO</b>	<b>On completion of the course the student will be able to</b>	<b>Cognitive level</b>
CO-1	Analyse the presence of proteins and amino acids present in the given unknown solution by systematic qualitative analysis.	Apply
CO-2	Separate identify and calculate the presence of various biomolecules present in the mixture by using the skills of chromatography.	Apply
CO-3	Prepare mobile phase and reagents used for the identification of carbohydrates, proteins and amino acid.	Apply

### **PRACTICAL-III**

#### **Biomolecules –II & Biochemical Techniques**

**Practical Duration -02 Hours per week Examination-03 Hours**

**MARKS=30.**

**Practical Proper-20.**

**Internal Assessment - Record-05+ Class Test-05=10**

**PART – A**  
**PROTEINS**

- 1 Precipitation reactions of proteins (albumin).
- 2 Colour reactions of proteins (albumin, casein, gelatin).
- 3 Qualitative analysis of amino acids (arginine, tryptophan, tyrosine, cysteine & phenylalanine).
- 4 Extraction of casein from milk.
- 5 Determination of the activity of urease from horse gram.
- 6 Demonstration of the activity of phosphatase from potatoes.

**PART-B**  
**BIOCHEMICAL TECHNIQUES**

- 1 Identification of amino acid by circular paper chromatography.
- 2 Ascending paper chromatography of amino acids.
- 3 Separation of plant pigments by column chromatography using silica gel-G.
- 4 Demonstration on polyacrylamide gel electrophoresis [PAGE] of proteins.
- 5 Demonstration of separation of lipids by TLC.
- 6 Demonstration of two-dimensional chromatography of amino acids

**FOURTH SEMESTER- BIOCHEMISTRY**  
**Biochemistry Paper-IV**  
**Title: ENZYMOLOGY & METABOLISM-I**  
**Class duration – 03 hours per week. 48 Hours**

**Marks: Theory - 50 + Internal Assessment - 20 = 70**

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**COURSE OBJECTIVE**

- 1 Emphasize the importance of enzymes as biocatalyst with insights on their classification and concept of active site.
- 2 Conceptualize enzyme kinetics, mechanism of enzyme action, enzyme inhibition and their regulation.
- 3 Outline the diverse applications of enzymes in research and medicine as well as in industry.
- 4 Describe the fundamental concept of energetics of biochemical processes and introduce students to the basic tenets of Bioenergetics and detail out the molecular mechanisms of oxidative phosphorylation and photo-phosphorylation.
- 5 Provide an in-depth understanding of metabolism of carbohydrates and lipids and enzymes involved in it, with relevance to defects caused by absence of enzymes.
- 6 Recognize the basic mechanisms involved in the regulation of carbohydrates and lipid metabolism.

<b>COURSE LEARNING OUTCOME</b>		
<b>CO</b>	<b>On completion of the course the student will be able to</b>	<b>Cognitive level</b>
CO-1	Elaborate on the major classes of enzyme classification and their functions in cells.	Understand
CO-2	Summarize various concepts of mechanisms of enzyme action, kinetics of enzyme catalyzed reactions and clinical importance of enzyme inhibitors.	Understand
CO-3	Explain the role of enzymes in different fields.	Understand
CO-4	Relate the link between energy production using the concepts of chemi-osmotic theory and the mechanism of oxidative phosphorylation and ATP synthesis.	Apply
CO-5	Understand the concepts of metabolism, characteristics of metabolic pathways and energy production in carbohydrate and lipid metabolism and Justify diseases caused by defects in metabolism with emphasis on the metabolic control.	Understand and apply
CO-6	Differentiate various catabolic and anabolic pathways and also Understand the regulation of various pathways.	Analyze

## Unit1. ENZYMOLOGY

- 1.1 Enzymes:** **6hrs**  
 General characteristics, Definition with examples of the holoenzyme, apoenzyme, co-factors coenzymes, metalloenzymes, abzymes and RNA as an enzyme. Isolation and purification of enzymes.  
 Classification of enzymes based on IUB with examples, units of enzyme activity, Specific activity, enzyme specificity, Concept of the active site.  
**Theories of enzyme catalysis:** Lock and key model, Koshland's induced fit theory.  
**Mechanism of enzyme action:** General acid-base catalysis, covalent catalysis.
- 1.2 Enzyme kinetics:** **4 hrs**  
 Factors affecting the rate of enzyme-catalyzed reactions. Effect of substrate concentration, pH, temperature. Michaelis - Menten equation (derivation not required). Lineweaver- Burk (L-B) plot. Determination of  $K_m$  &  $V_{max}$  from L-B plot and their significance. Turn over number.
- 1.3 Enzyme inhibition:** **4 hrs**  
 Competitive, Non- competitive, uncompetitive inhibition with suitable examples, Graphical representation by L-B plot, Effect of inhibitor on  $K_m$  &  $V_{max}$  using LB plot, Irreversible inhibition- suicide inhibition.
- 1.4 Allosteric enzymes** – Characteristics with ATCase as an example. **4hrs**  
**Iso enzymes** – Properties – LDH as an example.  
**Multienzyme complex**- Pyruvate dehydrogenase complex,  
**Multi-functional enzymes** - Definition, characteristics with an example.  
 Applications of enzymes: Industrial & medical applications.
- Unit 2 METABOLISM – I**
- 2.1 Bioenergetics:** **2 hrs.**  
 Concept of free energy. Endergonic and exergonic reactions. Coupled reactions. High energy compounds – Structure of ATP and its free energy change during hydrolysis, Examples of other high energy compounds.
- 2.2 Biological oxidation:** **3 hrs**  
 Electron transport chain: electron transport complexes (Complex I, II, III and IV). Oxidative & substrate-level phosphorylation with examples, uncouplers and inhibitors of respiration: Rotenone, antimycin-A, cyanide and DNP, P/O ratio. Formation of ATP (Outlines of Mitchell's hypothesis) binding change mechanism (Boyer model). Photophosphorylation,
- 2.3 Metabolism:** Anabolism and catabolism compartmentalization of metabolic pathways. **1 hr.**
- 2.4 Metabolism of Carbohydrates:**
- 2.4.1** Reactions and energetics of glycolysis, Fermentation, Entry of -fructose, galactose, mannose and lactose into glycolytic pathway. Fates of pyruvate - conversion of pyruvate to lactate, alcohol and acetylCoA. Reactions and energetics of the TCA cycle. Cori cycle. **4 hrs**
- 2.4.2** Gluconeogenesis. Regulatory steps of glycolysis and TCA cycle, Futile cycle. Amphibolic and integrating roles of TCA cycle. Anaplerotic reactions. **4 hrs**

- 2.4.3 Pentose phosphate pathway and its significance. **4 hrs**  
Glycogen metabolism: Glycogenolysis, glycogenesis & regulation. Synthesis of starch and lactose. Regulation of blood glucose.
- 2.5 **Metabolism of Lipids:** **6 hrs**  
Outlines of  $\alpha$ ,  $\beta$  &  $\omega$  modes of oxidation. Beta oxidation of even number saturated fatty acid and carnitine shuttle. Energetics of  $\beta$ -oxidation. Biosynthesis of even number of saturated fatty acids. Metabolism of ketone bodies- formation, utilization and ketosis.
- 2.6 **Cholesterol Metabolism:** **6 hrs**  
Biosynthesis and degradation of cholesterol. Production of primary and secondary bile acids, bile salts and its importance. Regulation of cholesterol biosynthesis. Outline of the metabolism of lipoproteins: Chylomicrons, VLDL, LDL & HDL, Reverse transport of cholesterol.

### Books recommended

SLNO	BOOK	Author	Publisher
1	Principles of Biochemistry	Lehninger	Freeman, W.H and company
2	Textbook of Biochemistry	Voet and Voet.	John Wiley and Sons
3	Textbook of Biochemistry	Garrett and Grisham	Cengage Learning
4.	Essentials of Biochemistry	Sathyanarayan	Elsevier India
5.	Textbook of Biochemistry	Strayer.	W.H Freeman and Co Ltd
6.	Textbook of Biochemistry of Physiological chemistry	Harper	Lange Medical publications
7.	Textbook of Biochemistry	Suttie	Holt, Rinehart and Winston of Canada Ltd
8.	Outline of biochemistry	Conn & Stumpf.	John Wiley and Sons Inc
9.	3 <sup>rd</sup> edition Understanding enzymes.	Trevor Palmer	Ellis-Horwood Limited.
10.	Enzymes in 1964. Digitized	Dixon and Webb	Publisher Academic Press,



11.	Enzyme Technology Publisher	Chaplin & Bucke.	Cambridge University Press
12.	2 <sup>nd</sup> edition, Handbook of enzyme biotechnology.	Alan Welshman	

#### **PRACTICAL-IV**

### Colourimetric estimations

Practical Duration -03 Hours per week Examination-03 Hours

MARKS=30.

Practical Proper-20.

Internal Assessment - Record-05+ Class Test-05 = 10

### COURSE OBJECTIVE

- 1 Outline the and principle and procedure involved in using conductivitymeters for the colorimetric estimation of important molecules.
- 2 Prepare various reagents, stock and working standard solutions of specific concentrations required in the process of quantitative estimation of the unknown samples.

COURSE LEARNING OUTCOME		
CO	On completion of the course the student will be able to	Cognitive level
CO-1	Estimate the concentration of the unknown given by using conductivitymeter.	Apply
CO-2	Use pipettes accurately, identify lambda max and plot graphs.	Apply

### Colourimetric estimation of

- |    |                                                                       |  |
|----|-----------------------------------------------------------------------|--|
| 1  | Glucose by DNS method.                                                |  |
| 2  | Protein by Biuret method.                                             |  |
| 3  | Protein by Lowry's method.                                            |  |
| 4  | Keto acid by DNPH method.                                             |  |
| 5  | Urea by DAMO method.                                                  |  |
| 6  | Creatinine by Jaffe's method.                                         |  |
| 7  | Inorganic Phosphorous by Fiske and Subbrao/Ascorbic molybdate method. |  |
| 8  | Iron by Wong's method.                                                |  |
| 9  | Cholesterol by Zak's method.                                          |  |
| 10 | Glucose by Folin-Wu's method.                                         |  |
| 11 | Glucose by anthrone method.                                           |  |
| 12 | Aminoacid by ninhydrin method.                                        |  |
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**Title: METABOLISM–II AND HUMAN PHYSIOLOGY**  
**Class duration – 03 hours per week. 48 Hours**  
**MARKS-Theory - 70 + Internal Assessment -30= 100**

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**COURSE OBJECTIVE**

- 1 Detailed and comprehensive knowledge about the synthesis and degradation pathways of amino acids and nucleotides and their importance in the proper functioning of the cells.
- 2 Inter-relate the metabolism of these molecules with respect to health diseases in addition to providing overview of inhibitors of metabolism for treating the diseases of metabolic disorders.
- 3 Gain knowledge regarding biochemistry of various physiological processes specialized tissues and hormone action in animal system
- 4 Understand structure, operational mechanism and functions of the various organs and organ system in human body
- 5 Discuss on some of the more important organ related pathophysiological conditions

**COURSE LEARNING OUTCOME**

<b>CO</b>	<b>On completion of the course the student will be able to</b>	<b>Cognitive level</b>
CO-1	Comprehend the mechanism by which ammonia is incorporated in biomolecules and explain the conversion of amino acids into a variety of precursors	Apply
CO-2	Understand the breakdown and synthesis of amino acids and nucleotides in humans and recognize its relevance with respect to nutrition and human diseases.	Understand
CO-3	Acknowledge the role of inhibitors of nucleotide metabolism which are potentially being used as chemotherapeutic drugs.	Apply
CO-4	Describe the functioning of Excretory system with special relevance to urine formation and concentration and explain the working of nervous system in coordinating functions of the body.	Understand
CO-5	Distinguish between various structural and muscular components of the human body and how they help in coordinated movement.	Analyse
<del>CO-6</del>	<del>Analyse the role of various hormones and effects of their variation in various disease conditions.</del>	<del>Analyse</del>

## **Unit 1. METABOLISM –II**

### **1.1 Metabolism of Amino acids: 6 hrs.**

General mechanism of amino acid metabolism: Deamination-oxidative and non – oxidative deamination, Transamination, Decarboxylation (biologically important amines) Desulphuration. Catabolism of carbon skeleton of amino acids, glycogenic and ketogenic amino acids. Urea cycle and its significance.

Synthesis and catabolism of alanine, phenylalanine and cysteine.

### **1.2 Metabolism of peptides and porphyrins 8hrs.**

Biosynthesis of creatine, polyamines and glutathione

Heme –synthesis and degradation.

### **1.3 Metabolism of proteins:**

Protein turnover, Structural features influencing the protein degradation: PEST sequence, N-end rule. ATP dependent and ATP independent mechanism of protein degradation, Synthesis of glycoproteins: N-linked and O-linked glycoproteins.

### **1.4 Metabolism of Nucleic acids: 10hrs**

Pathways of degradation of nucleic acids in cells, Action of nucleases-DNase I and II, RNase and phosphodiesterases. Catabolism of purines and pyrimidines, uric acid formation and inhibition, Salvage pathways. De novo biosynthetic pathways of purine and pyrimidine nucleotides. Conversion of ribonucleotides to deoxyribonucleotides. Inhibitors of nucleotide biosynthesis-methotrexate, and 5-fluorouracil.

## **Unit 2. HUMAN PHYSIOLOGY**

### **2.1 Nervous system: 4 hrs.**

- Neurons -Types, the generalized structure of a multipolar neuron. Neuromuscular junction. Resting membrane potential, action potential transmission of a nerve impulse along an axon and across the synapse. Neurotransmitters-Excitatory and Inhibitory with examples. Inhibitors of neurotransmission and their importance.

### **2.2 Muscle: Types of muscles and their structure. Ultrastructure of skeletal muscle. 3 hrs.**

Contractile and regulatory proteins of skeletal muscle. Sliding filament model of skeletal muscle contraction.

- 2.3 **Bone:** Composition and structure of long bone (internal and external structure), **3 hrs.**  
growth (mechanism of growth) and remodelling of a long bone. Factors affecting growth.
- 2.4 **Renal system:** **2 hrs.**  
Structure of the nephron, formation of urine – Glomerular filtration, tubular reabsorption (sodium, urea, water and glucose) and Tubular secretions.
- 2.5 **Endocrine system:** **10 hrs.**  
Endocrine organs, classification of hormones. Hierarchy, interplay and dynamic balance and regulation of hormone secretions. Functions of the hormones of hypothalamus, pituitary (GH, ACTH, TSH, FSH, LH, oxytocin and ADH) adrenal (aldosterone, cortisol & cortisone), thyroid ( $T_3$  &  $T_4$ ) pancreas (insulin and glucagon) and gonads (testosterone, estradiol and progesterone). General mechanism of peptide and steroid hormone action. Concept of second messengers. Eg: CAMP, DAG and  $IP_3$ . Endocrine disorders-Diabetes Mellitus.
- 2.6 **Liver:** Structure of the liver lobule, Functions – metabolic & storage, role in the **2 hrs.**  
removal of following substances: ethanol, ammonia, bilirubin and drugs.

**Books recommended:**

SLNO	Book	Author	Publisher
1	Textbook of Biochemistry	West & Todd	Todd publications
2	Textbook of Biochemistry	A. Lehninger	Freeman, W.H and company
3	Textbook of Biochemistry	O.P. Agarwal	Krishna Prakashan Media p Ltd
4	Textbook of Biochemistry	Jain	S Chand publishing
5	Handbook of Biochemistry	Sathynarayana	Elsevier India
6	Illustrated biochemistry	Harper	Lange Medical publications

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**PRACTICAL -V**

**Enzyme Assays**

**Practical Duration -02Hours per week Examination-03 Hours**

**MARKS=50.**

**Practical Proper-35.**

**Internal Assessment - Record-05+ Class Test-10=15**

## COURSE OBJECTIVE

1. Gain an enhanced overall understanding of enzyme assays and in particular the influence of various physicochemical characteristics upon enzyme activity.
2. Gain an understanding of buffers and their importance in the context of pH control.
3. Apply and analyze the basics of the major analytical techniques including sample preparation, standardization and data analysis for each technique and develop interpersonal and teamwork skills

### Education tour V or VI Visit

1. Bangalore: IISE, JNCASR, NIMHANS, UAS-NCBS, Biocon.
2. Bombay: TIFR, cancer research institute, BARC, IIT
3. Hyderabad: CCMB, NIN, Reddy's lab, Indian Drug Research Lab
  - Internal crop research institute for semi and crops (ICRISAT) University of Poona

COURSE LEARNING OUTCOME		
CO	On completion of the course the student will be able to	Cognitive level
CO-1	Recognise, analyse, draw graph and calculate the enzyme kinetic studies	Apply

### I. Salivary amylase/Acid phosphatase/Invertase:

1. Determination of specific activity by DNS method.
2. Determination of optimum pH.
3. Determination of  $K_m$  and  $V_{max}$ .
4. Determination of optimum time.
5. Determination of optimum temperature.
6. Effect of activators/inhibitors on enzyme activity

### II. Report:

1. Visit to scientific/research institute – Tour report.
  - National Institute of virology
  - National chemical laboratory
  - National centre for the cell science
4. Goa: National Institute of Oceanography (NIO)
5. Cochin: Sree Chitra Tirunal Institute of medical science
6. Kasaragod: coconut research institute

7. Trivandrum: Rajiv Gandhi institute of biological science
8. Mangalore: fisheries college
  - Manipalcentre of higher education
  - Plant biotechnology lab- St. Aloysius college
  - Mangalore Chemical Fertilizers(MCF)
9. Hassan: coffee Estate,
10. Ooty: potato research station
11. Kannur: TATA tea process Centre, vaccine institute
12. Madras:IIT
  - Centre for Leather and Resin Institute
  - RSIC-Regional Sophisticated Instrumentation Centre
13. Other research institutes in other parts of the country may also be included in the visit.

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**FIFTH SEMESTER- BIOCHEMISTRY**  
**Biochemistry Paper-VI**  
**Title: MOLECULAR BIOLOGY & GENETIC ENGINEERING**  
**Class duration – 03 hours per week. 48 Hours**

**COURSE OBJECTIVE**

- 1.To understand the mechanism of Prokaryotic replication, transcription and regulation.
- 2.To summarize various features of Genetic code and translation mechanism.
- 3.To provide comprehensive understanding of DNA mutations and repair processes in a way that students can apply this knowledge in understanding the life processes and develop an interest to pursue high quality research.
- 4.To understand and the cellular mechanism of Gene expression and regulation.
- 5.To explain the process for isolation and engineering of DNA using restriction and modification enzymes and use of cloning and expression vectors. The methods for creation of genomic and cDNA libraries, their applications.
6. To understand the principles and applications of the techniques involved in various Gene transfer methods.

<b>COURSE LEARNING OUTCOME</b>		
<b>CO</b>	<b>On completion of the course the student will be able to</b>	<b>Cognitive level</b>
CO-1	Explain the mechanism of Prokaryotic replication, transcription and regulation.	Analyse
CO-2	Enumerate the features of Genetic code and translation mechanism.	Understand
CO-3	Differentiate and summarize various types of DNA mutation and repair mechanism and their implications on human health	Analyse
CO-4	Evaluate the cellular mechanism of Gene expression and regulation.	Evaluate
CO-5	Discuss the concepts of recombinant DNA technology or genetic engineering	Understand
CO-6	Explain the principles and applications of the techniques involved in various Gene transfer methods.	Understand

**Unit 1. MOLECULAR BIOLOGY**

- 1.1 Introduction: Nucleic acids as genetic information carriers, Experimental **3 hrs.** evidences ex: bacterial genetic transformation, Hershey Chase experiment.The



- central dogma of molecular biology and its modification.
- 1.2 **Replication of DNA:** 5 hrs.  
DNA replication in prokaryotes- conservative, semi-conservative and dispersive types. Mechanism of semi-conservative replication. DNA polymerases, other enzymes and protein factors involved in the replication. Meselson and Stahl experiment. Mechanism of replication in prokaryotes.
  - 1.3 **Prokaryotic RNA Synthesis:** 5 hrs.  
Role of RNA polymerase. Initiation, elongation and termination, reverse transcription-replication of HIV.
  - 1.4 **Genetic code:** 1 hr.  
General features, wobble hypothesis.
  - 1.5 **Prokaryotic Protein biosynthesis:** 5 hrs.  
Activation of Amino acids, aminoacyl-tRNA synthesis.  
Initiation, elongation and termination of protein synthesis. Inhibitors of protein synthesis. Post-translational modifications.
  - 1.6 **Mutations:** 4 hrs.  
Concept of mutation and mutagens – effect of HNO<sub>2</sub>, alkylating agents, intercalating agents and UV-radiation. Concept of missense, nonsense, point mutation and frameshift mutation.
  - 1.7 **Repair of DNA:** 3 hrs.  
DNA damage and their repair. Types of damages repair by direct reversal of damage, excision repair, recombination repair, SOS repair.
  - 1.8 **Concept of gene:** 4 hrs.  
Gene expression in prokaryotes - the concept of Lac operon and trp operon. Functional units in a typical eukaryotic gene-promoter, introns and exons.
- Unit 2. GENETIC ENGINEERING**
- 2.1 Historical development, aim and scope of genetic engineering. 1 hr.
  - 2.2 **Outline of techniques of genetic engineering.** 10 hrs.  
Isolation of DNA, cutting of DNA by restriction endonucleases –Types, staggered cut and blunt end. Separation of fragments by agarose gel electrophoresis.  
Vectors- plasmid (pBR322), bacteriophage, viruses, cosmids, phagemid and plant vectors. Insertion of foreign DNA into vectors- Use of linkers and adapters. Homopolymer tailing. Transfection of vectors into host cells. cDNA. Principle of polymerase chain reaction and applications.
  - 2.3 **Blotting techniques:** 4 hrs.  
Principle and procedure of Southern, northern and western blotting. Dot blot. DNA fingerprinting.

#### 2.4 Applications of Genetic engineering

3 hrs.

Transgenic plants, transgenic animals and gene therapy. Human genome project.

##### Books recommended:

SLNO	Book	Author	Publisher
1	Biochemistry of Nucleic acids	Adam et al	Springer Netherlands
2	Textbook of Molecular Biology	David Friefelder	Narosa
3	Text book Molecular Biology of gene	James and Watson	Pearson Education

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#### PRACTICAL-VI

##### Biophysical and Biochemical Experiments

Practical Duration -02Hours per week Examination-03 Hours

MARKS=50.

**COURSE OBJECTIVE**

- 1 To give hands on experience in handling equipments like conductivity meter, potentiometer and pH meter and use them in performing experiments
- 2 To Estimate and extract DNA and RNA from biological sources.

<b>COURSE LEARNING OUTCOME</b>		
<b>CO</b>	<b>On completion of the course the student will be able to</b>	<b>Cognitive level</b>
CO-1	Perform experiments using conductivity meters, potentiometer and pH meter with a knowledge of calibrating the equipments	Apply
CO-2	Determine the amount of DNA and RNA present in the samples using colorimetric methods	Apply

1. Conductometric titration of strong acid against a strong base.
2. Conductometric titration of amino acid against the strong base.
3. Preparation of acidic and basic buffers and determination of pH using pH meter.
4. Determination of pKa value of amino acid by using pH meter.
5. Determination of pKa value of acetic acid by using a potentiometer.
6. Determination of molar extinction coefficient.
7. Determination of UV spectra of proteins and nucleic acid.
8. Extraction of DNA from a natural source.
9. Estimation of DNA by diphenylamine method.
10. Demonstration of estimation of RNA by orcinol method.

**SIXTH SEMESTER- BIOCHEMISTRY**  
**Biochemistry Paper-VII**

**Title: NUTRITION**  
**Class duration – 03 hours per week. 48 Hours**  
**MARKS-Theory - 70 + Internal Assessment -30= 100**

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**COURSE OBJECTIVE**

- 1 To understand the proximate principles of nutrition with reference to RDA
- 2 To understand and analyse and quantification of nutritional content of the food items
- 3 To understand and apply nutritional significance of vitamins & Minerals
- 4 To understand and apply basic requirement of nutrition at different stages of life

<b>COURSE LEARNING OUTCOME</b>		
<b>CO</b>	<b>On completion of the course the student will be able to</b>	<b>Cognitive level</b>
CO-1	Compare the various parameters used in estimating the calorific value of food and the concept of BMR and reasons for its variation.	Remember
CO-2	Apply the knowledge in maintaining a balanced diet and use it for the betterment of their health.	Apply
CO-3	Summarize the importance of vitamins and minerals and their use maintaining normal body functions and differentiate between various adulterants present in food which can be easily identified by simple in-house methods.	Understand
CO-4	Analyze the importance of balanced diet and the normal functioning of various digestive secretions in aiding the digestion of food.	Analyse

**Unit1- NUTRITION**

**1.1 Introduction:**

**8 hrs**

Concept of Nutrition, the calorific value of foods and its determination (Bomb calorimeter), Different components of energy expenditure, measurement of energy expenditure by the direct and indirect calorimetric method.

Energy expenditure at rest and work, respiratory quotient, basal metabolic rate (BMR), determination of BMR by indirect calorimetric method, factors affecting BMR. The specific dynamic action of foods.

**Proximate analysis of food samples:** Moisture, fibre, ash, proteins,

- carbohydrates, fats and their importance.
- 1.2 **Carbohydrates:** 8hrs.  
Dietary sources of carbohydrates, dietary fibres (types, beneficial & adverse effects) and protein-sparing action.  
Glycemic index, importance with examples, lactose intolerance.
- 1.3 **Proteins:** Dietary sources of proteins, nutritional classification, Nutritive value of proteins-PER and biological value (BV). Essential amino acids.  
Nitrogen balance, Mutual Supplementation of proteins.  
Malnutrition-kwashiorkor and marasmus.
- 1.4 **Fats:**  
Dietary sources of fats, visible and invisible fat, trans fats, omega fatty acids and their biological importance, Role of DHA and EPA.  
Effects of fried foods.
- 1.5 **Vitamins:** 8 hrs.  
Dietary sources, requirements, deficiency symptoms and biological role of water-soluble vitamins-thiamine, riboflavin, niacin, pantothenic acid, pyridoxine, biotin, folic acid, vitamin-B<sub>12</sub> and vitamin-C.  
Fat-soluble vitamins-A, D, E and K, hypo and hypervitaminosis.
- 1.6 **Minerals:** 8 hrs.  
Dietary sources, physiological functions, deficiency disorders, absorption and excretion.  
Macronutrients-Ca, P, Na, Cl, Mg and K  
Micronutrients-Fe, Zn, Cu, I<sub>2</sub>, F, Se, Cr, Mn.
- 1.7 **Balanced diet:** 8 hrs.  
Composition of a balanced diet for infants, children, pregnancy and lactating women, old age.
- 1.8 **Water Metabolism:**  
Absorption, requirement, distribution of water in body fluid compartments.  
Factors influencing water metabolism, functions of water, deficiency and water intoxication in the human body.
- 1.9 **Antinutritional Factors:**  
Sources and harmful effects of anti vitamins (example:- avidin, dicoumarol), Natural toxicants (example:- Lathyrussativus) and adulterants (Butter yellow, lead chromate & malachite green)
- 1.10 **Digestion and absorption:** 8 hrs.  
GIT: secretion, composition and functions of saliva, gastric, bile, pancreatic and intestinal juices. Gastrointestinal hormones and its effects.  
Absorption and transport of carbohydrates, proteins and fats.
- 1.11 **Nutraceuticals:** Introduction, functional foods and pre and pro-biotics in health and disease prevention.

**Books recommended:**

SLNO	Book	Author	Publisher
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1	Textbook of nutrition	Swaminathan	The Bangalore printing And
2	Fundamentals of Foods, Nutrition and Diet Therapy	Sumati R. Mudambi& M.V. Rajagopal	New age international P Ltd

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### **PRACTICAL-VII**

#### **Nutrition**

**Practical Duration -02 Hours per week**

**Examination-03Hours**

**MARKS=50.**

**Practical Proper-35.**

**Internal Assessment - Record-05+ Class Test-10=15**

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### **COURSE OBJECTIVE**

1. To gain in depth knowledge in experiments involving the estimation and extraction of minerals, vitamins, sugars from various food sources.
2. To understand and perform the experiments used in analysis of food

### **COURSE LEARNING OUTCOME**

<b>CO</b>	<b>On completion of the course the student will be able to</b>	<b>Cognitive level</b>
CO-1	Estimate and report the amount of various minerals, vitamins and sugars present in various food samples by titrimetric and colorimetric methods	Apply
CO-2	Calculate the amount of major biomolecules present by proximate analysis of food.	Apply

- 1 Determination of moisture content of foods and detection of adulterants in food.
- 2 Extraction and estimation of calcium in ragi.
- 3 Proximate analysis of food samples- Moisture, fibre, protein fat and carbohydrate ( by difference)
- 4 Estimation of reducing sugars (From jams and jellies) by Fehling's method.
- 5 Extraction and estimation of vitamin – C in the biological sample.
- 6 Extraction and estimation of iron from mustard.
- 7 Determination of saponification value of oil.
- 8 Determination of iodine/acid/peroxide value of oil or fat.
- 9 Estimation of amino acid by Sorensen's formal titration.
- 10 Determination of pH of the given sample of fruit juice. (Eg: lemon, papaya, apple, sugar cane, bejoisjuiceetc).
- 11 Estimation of lactic acid in milk.

**SIXTH SEMESTER-BIOCHEMISTRY**  
**Biochemistry Paper-VIII**  
**Title:-CLINICAL BIOCHEMISTRY AND IMMUNOLOGY**  
**Class duration – 03 hours per week. 48hours**  
**MARKS-Theory - 70 + Internal Assessment -30= 100**

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**COURSE OBJECTIVE**

- 1 Remember the historical background for Clinical Biochemistry and understand the functions and importance of various body fluids.
- 2 Discuss the importance of various organs involved in acid base balance and also about the diagnostic significance of tests used in assessing renal and liver function.
- 3 Basic framework in immunology that will cover the major topics including innate and adaptive immunity, antibodies and antigens, the molecular events leading to the generation of antibody, humoral and cell mediated adaptive immune response, hypersensitivity, self-tolerance, autoimmunity and vaccines.
- 4 Understand and apply the types of immunity and lymphoid organs and lymphocytes
- 5 Understand and apply the various Immunological Techniques in daily life style

<b>COURSE LEARNING OUTCOME</b>		
<b>CO</b>	<b>On completion of the course the student will be able to</b>	<b>Cognitive level</b>
CO-1	Discuss the biochemistry and pathophysiology associated with tests performed in a clinical biochemistry laboratory and Compare and contrast the basic differences between carbohydrate, lipid and protein metabolism abnormalities.	Understand
CO-2	Describe and identify the main characteristics of diagnosis, screening, and prognosis of disease.	Remember
CO-3	An overview of the immune system including cells, organs and receptors. And Describe the basic mechanism, differences and functional interplay of innate and adaptive immunity. State the role of the immune system in the human body	Understand
CO-4	Understand Antigens & its Recognition, antigen processing and presentation and describe the structure & functions of different classes of Immunoglobulins.	Apply
CO-5	Define the cellular and molecular pathways of humoral and cell-mediated immune responses and Describe the mechanisms involved in different types of hypersensitivity and autoimmunity	Understand



## Unit 1. CLINICAL BIOCHEMISTRY

- 1.1 **Introduction:** **1 hr.**  
Clinical biochemistry: Definition, scope, collection & preservation of biological fluids.
- 1.2 **Urine:** **3 hrs.**  
**Normal composition of urine** – Volume, pH, colour and specific gravity. Chemical analysis and normal values of the constituents- urea, uric acid, creatinine, pigments and their clinical significance.  
**Abnormal constituents** - glucose, albumin, ketone bodies and bile pigments and their pathological significance.
- 1.3 **Body fluids:** **7 hrs.**  
Blood- volume, composition and functions. RBC, WBC and platelets: structure and functions. Total WBC count, differential count, erythrocyte count, platelet count. Hb%, blood grouping & ESR. C-reactive protein and subpopulation of blood cells. Mechanism of blood coagulation (outline) - intrinsic and extrinsic pathway. Blood-brain barrier. Cerebrospinal fluids and lymph – composition and functions.  
Normal constituents of blood and their variation in pathological conditions- urea, uric acid, creatinine, glucose, bilirubin, total protein, albumin/globulin ratio. Lipid profile: cholesterol, triglycerides, lipoproteins: chylomicrons, VLDL, LDL and HDL.
- 1.4 **Clinical enzymes:** **2 hrs.**  
Alkaline phosphatase, serum transaminases (SGPT & SGOT) and lactate dehydrogenase (LDH). Cardiac injury profile- CPK and LDH.
- 1.5 **Acid-base balance:** **4 hrs.**  
Maintenance of normal pH of the body fluids. Role of blood buffers. Biochemical events in the transport of CO<sub>2</sub> and O<sub>2</sub> in blood. Role of lungs and kidney in acid-base balance. Acidosis and alkalosis.

4 hrs.

**1.6 Liver disorders:**

Cirrhosis, hepatitis, fatty liver and jaundice (pre, post and hepatic). Estimation of conjugated and total bilirubin in serum (Diazo method). Detection of bilirubin and bile salts in urine (Fouchet's test and Hay's test).

**1.7 Inborn errors of Metabolism:**

3hrs.

Glycogen storage disease (Von-Gierke's disease), fructosuria, galactosemia, 7.2 phenylketonuria, alkaptonuria, albinism, Lesch-Nyhan syndrome, Niemann-Pick disease.

**Unit 2. IMMUNOLOGY**

**2.1 Overview of the Immune system:**

7 hrs.

Role of immunologically important organs and cells - bone marrow, thymus, spleen and lymphocytes. Innate and adaptive immunity. Passive and active immunity. Cellular and humoral immunity: formation and functions of T & B Lymphocytes. Helper T-cells and killer T-cells. Macrophages and dendritic cells.

**2.2 Antigens:**

2 hrs.

Definition, Types, chemical nature and antigenicity. Epitopes, paratopes, haptens and adjuvants.

**2.3 Antibodies:** Definition, Types and structure of a typical immunoglobulin (IgG – 4 hrs.

Light chain, heavy chain, hypervariable region, constant domains, Fab and Fc). Polyclonal and monoclonal antibodies. Production and applications of monoclonal antibodies.

**2.4 Antigen-antibody reaction *in-vitro*:**

Formation of an antigen-antibody complex. Agglutination and precipitation Principle, procedure and applications of immunodiffusion, RIA, ELISA.

4 hrs.

**2.5 Immunization:**

2 hrs.

Vaccines and their preparations, primary and secondary immune response.

**2.6 Hypersensitivity:**

2hrs.

Different types in brief, Immediate and delayed type of hypersensitivity.

**2.7 Immunological disorders:**

3 hrs.

Autoimmune disorder- systemic lupus erythematosus and rheumatoid arthritis Immunodeficiency diseases- AIDS.

**Books recommended:**

SLNO	Book	Author	Publisher
1	Textbook of clinical biochemistry	Ranasinghe	Jaypee Brothers, Medical Publishers Pvt Limited
2	Textbook of biochemistry	<u>Denise R. Ferrier,</u> <u>Richard A. Harvey</u>	Lippincott Williams and Wilkins
3	Textbook of biochemistry	<u>Thomas M. Devlin</u>	Wiley, John and Sons

	with clinical correlations		Incorporated
4	Clinical Chemistry in diagnosis and treatment	Philip.D.Mayne	CRC Press
5	Textbook of Immunology	Kuby	W.H Freeman and Company
6	Textbook of Immunology	Tortora	Pearson Education India

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### **PRACTICAL-VIII**

#### **Clinical Biochemistry and Immunology**

**Practical Duration -02Hours per week Examination-03 Hours**

**MARKS=50.**

**Practical Proper-35. Internal Assessment - Record-05+ Class Test-10=15**

#### **1 Qualitative analysis of urine:**

Organic: urea, uric acid, creatinine and amino acid. Inorganic constituents: chlorides, sulfates, phosphates and ammonia

### **COURSE OBJECTIVE**

- 1 Understand and apply the knowledge of theory and practice of clinical biochemistry techniques.
- 2 Understand the procedure for serum extraction from blood and to know the different components of blood
- 3 Perform quantitative and qualitative analysis of known standards as well as unknown samples develop problem-solving skills and to nurture professional attitudes

### **COURSE LEARNING OUTCOME**

<b>CO</b>	<b>On completion of the course the student will be able to</b>	<b>Cognitive level</b>
CO-1	Perform serum extraction from blood	Understand
CO-2	Understand the normal range of various blood components	<u>Understand</u>
CO-3	Know the normal and abnormal constituents of urine	Analyse
CO-4	Perform Immunodiffusion technique (ODD)	Analyse

Abnormal constituents -glucose, albumin, bile pigments, bile salts and ketone bodies.

#### **2 Quantitative estimations:**

- 3 Titrable acidity and ammonia in urine.
- 4 Creatinine in urine.
- 5 Urea in blood.
- 6 Blood glucose
- 7 SGPT/SGOT.
- 8 Alkaline phosphatase.
- 9 Hemoglobin.

- 10 Determination of antigen-antibody reaction by immunodiffusion technique.
- 11 Assay of antigen concentration by radial immunodiffusion technique.
- 12 Photographic demonstration of immunological important cells

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## **BIOCHEMISTRY DISCIPLINE SPECIFIC ELECTIVES (DSE)**

**BIOCHEMISTRY DSE(For 2<sup>nd</sup>, 3<sup>rd</sup>&4<sup>th</sup> Semesters)**

**Title:-BASIC CHEMISTRY**

**CLASS DURATION – 03 HOURS PER WEEK. 30 Hours**

**MARKS-Theory - 30 + Internal Assessment -20= 50**

**COURSE OBJECTIVE**

1. The course emphasizes on teaching the students the basic concepts of Chemistry.

**Unit 1. Chemical Bonding**

**8 hrs**

- 1.1 Definition, Types of chemical bonding Ionic bond, covalent bond, Co-ordinate bond, Metallic bond, Vander wall's bond, Hydrogen bond.  
1.2 Theories of bonding –Valence bond Theory, Molecular orbital theory.

**Unit 2. Study of Organic Compounds**

**7 hrs**

**COURSE LEARNING OUTCOME**

CO	On completion of the course the student will be able to	Cognitive level
CO-1	Appreciate the different types of organic reactions, procedures employed in the determination of important elements,	Understand
CO-2	Basics of stereochemistry.	<u>Understand</u>
CO-3	better understanding of metabolic pathways.	Analyse

- 2.1 Empirical, structural & Molecular formula  
2.2 Nomenclature & classification of organic compounds,  
2.3 Determination & estimation of C, H, N & Halogens

**Unit 3. Mechanism of Organic Reactions**

**7 hrs**

- 3.1 Types of reagents – Electrophiles, Nucleophiles  
3.2 Electron Mobility : Inductive effect, Resonance, Hyper conjugation (With one example each)  
3.3 Reactive intermediates – carbocation, carbanion, free radicals, carbenes, Arynes & nitrenes.  
3.4 Types of Reactions: Substitution, Addition, Elimination, Rearrangement, Redox Reaction.

**Unit 4. Stereochemistry**

**8 hrs**

- 4.1 Isomerism, Types of isomerism, representation of organic molecules  
4.2 Optical isomerism. Plane polarized light, optical activity. Working of Polarimeter, angle of rotation, specific rotation  $[\alpha]_D$ . Cause of optical activity symmetry, elements and chirality.  
4.3 Enantiomers, diastereomers and geometrical isomerism with suitable examples.

4.4 R S nomenclature, Methods of Racemisation Resolutions of Racemic mixture

**Reference Books:-**

1. Textbook of Inorganic chemistry - Puri & Sharma.
2. Concise inorganic chemistry - J.D.Lee
3. Textbook of inorganic chemistry - Guradeep Raj & Chatwal
4. Advanced organic chemistry - Bhal & Bhal
5. Advanced organic chemistry - P.L.Soni

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**BIOCHEMISTRY DSE (For 2nd, 3rd & 4th Semesters)**

**Title:-BASIC CONCEPTS OF GENETICS**

**CLASS DURATION – 03 HOURS PER WEEK. 30 Hours**

**MARKS-Theory - 30 + Internal Assessment -20= 50**

## COURSE OBJECTIVE

1.The course emphasizes on teaching the students the basic concepts of genetics.

### Unit 1 Introduction

**6 hrs**

1.1 Introduction: A brief overview of the modern history of genetics;

COURSE LEARNING OUTCOME		
CO	On completion of the course the student will be able to	Cognitive level
CO-1	understand the concept of genetics and molecular basis of mutations	Understand
CO-2	Understand the conditions caused due to abnormality in chromosome number.	Understand

1.2 Mendel's experiments, segregation, dominance, independent assortment; Epistasis; Multiple alleles; one gene-one enzyme hypothesis.

### Unit-2 Linkage and Inheritance

**8 hrs**

2.1 Linkage And Recombination Of Genes In A Chromosome.

2.2 X-Linked Inheritance. Polygenic Inheritance, Mitochondrial Inheritance,

### Unit-3 Chromosome Numbering

**2 hrs**

3.1 Ploidy, Karyotyping, Sex Chromosome And Dosage Compensation.Mobile Genetic Elements.

### Unit-4 Mutations

**8hrs**

4.1 Mutations; Nature Of Mutations, Spontaneous And Induced Mutation, Conditional, Lethal (Temperature Sensitive) Mutation. Chemical Mutagens, Radiation-Induced Mutation, Reverse Mutations And Suppressor Mutations - Intergenic And Intragenic Suppression,

4.2 Reversion As A Means Of Detecting Mutagens - Ames Test.

4.3 **Chromosomal Basis Of Human Diseases:** Extra Or Missing Chromosome,Abnormality In Chromosome Structure; Deletion, Duplication, Inversion, Translocation.

### Unit-5 Population genetics:

**6hrs**

5.1 Gene pool, allele frequency, genotype frequency, and Hardy-Weinberg equation;

- 5.2 Variation, Mutation, Mechanisms of speciation, factors producing changes in populations.

**Suggested Reading:**

1. A textbook of Genetics essentials by Benjamin. Pierce
2. Biotechnology –2 (Cell Biology, Genetics, Microbiology), Rajeshwari S. Setty and V. Sreekrishna. New Age International Publishers, 2002.
3. Basic Genetics. G. S. Miglani. Narosa Publishing House. New Delhi, 2000.
4. Principles of Genetics. VIII edition, J. Gardner. John Wiley and Sons, New York. 2003.
5. Gene VII. Lewin, B. Oxford Univ. Press. Oxford. 2003

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**BIOCHEMISTRY DSE(For 2<sup>nd</sup>, 3<sup>rd</sup>&4<sup>th</sup> Semesters)**  
**Title: LIFESTYLE DISORDERS**  
**CLASS DURATION – 03 HOURS PER WEEK. 30 Hours**

**MARKS-Theory - 30 + Internal Assessment -20= 50**

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## COURSE OBJECTIVE

1. This course is designed to impart knowledge about the importance of a healthy lifestyle for a better healthy living.

### Unit-1 Introduction to lifestyle disorders

5 hrs

- 1.1 Introduction: Definition of health, lifestyle disorders
- 1.2 Types and contributory factors of lifestyle disorders

COURSE LEARNING OUTCOME		
CO	On completion of the course the student will be able to	Cognitive level
CO-1	understand the need to maintain a healthy lifestyle and the complications associated with the unhealthy /poor lifestyle	Understand
CO-2	Able to know the Important practices which enable them to have a lifestyle which can prevent the occurrence of various disorders	Understand

- 1.3 Impact of lifestyle factors on physical & mental health of the people.

### Unit-2Lifestyle disorders

7hrs

- 2.1 Eating, physical, mental and occupational lifestyle disorders;
- 2.2 Causes -food, physical & mental habits and its consequences
- 2.3 Symptoms and Prevention of lifestyle disorders in children, adult and old age diseases.

### Unit-3 Lifestyle disorders in India

9hrs

- 3.1 Cardiovascular disease –hypertension, heart attack and stroke
- 3.2 Asthma, chronic liver disease, chronic obstructive pulmonary diseases (COPD), nephritis diabetes and osteoporosis;
- 3.3 Cancer, Alzheimer's disease and Obesity.

### Unit-4Growth monitoring and promotion:

9 hrs

- 4.1 Growth & factors affecting growth and development;
- 4.2 Importance of Nutrition for ensuring adequate development, management of diet-related to lifestyle disorders.
- 4.3 Strategies and approaches in lifestyle disorders: Prevention of the disease using diet and lifestyle changes;
- 4.4 Lifestyle choices and personalwellness.

### Textbooks and References

- 1. Guide to Prevention of Lifestyle Diseases by M. Kumar and R. Kumar,2003, DEER & DEEP publications, New Delhi.
- 2. Dietetics bySrilakshmi, 2014, 7th Edition, Publisher: New Age International Private Limited.

3. Principles of Nutrition & Dietetics by Swaminathan M, ISBN-13: 5551234022792,2001

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**BIOCHEMISTRY DSE (For 2<sup>nd</sup>, 3<sup>rd</sup> & 4<sup>th</sup> Semesters)**  
**PLANT BIOCHEMISTRY AND MEDICINAL PLANTS**  
**CLASS DURATION – 03 HOURS PER WEEK. Hours-30**  
**MARKS-Theory - 30 + Internal Assessment -20= 50**

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#### **COURSE OBJECTIVE**

1. To acquire a good working knowledge of the chemistry of important biological processes in plants.

2. To understand the biochemistry of phytochemicals and metabolites and their use as alternate medicines

### Unit- 1 Introduction

6 hrs

- 1.1 Plant cell – structure and functions of subcellular organelles, plant cell wall
- 1.2 Mechanism of water absorption, Ascent of sap.
- 1.3 Transpiration - types, stomatal opening, Mechanism and factors affecting transpiration.

### Unit-2Photosynthesis and Carbon assimilation:

8 hrs

- 2.1 Structure of PSI and PSII complexes, Light reaction, Cyclic and non cyclic photophosphorylation

COURSE LEARNING OUTCOME		
CO	On completion of the course the student will be able to	Cognitive level
CO-1	understand the Biochemical processes in plants and applied knowledge for the development of herbal drugs.	Understand

- 2.2 Calvin cycle and regulation
- 2.3 C<sub>4</sub> cycle and Crassulacean acid metabolism (CAM), Photorespiration.

### Unit-3Nitrogen Metabolism:

6 hrs

- 3.1 Importance Of Nitrogen In Biological Systems, Nitrogen Cycle.
- 3.2 Nitrogen Fixation; Symbiotic And Non-Symbiotic, Nitrogenase Complex, Energetics And Regulation. Formation Of Root Nodules In Legumes.
- 3.3 Assimilation Of Nitrate And Ammonium Ion.

### Unit-4Plant Hormones

5 hrs

- 4.1 Introduction to plant hormones and their effect on plant growth and development- Auxins, Gibberellins, cytokinins, Ethylene, Absciscic acid.
- 4.2 Biochemistry of seed dormancy, Seed germination, Fruit ripening and Senescence.

### Unit-5Plants in alternative medicines

5 hrs

- 5.1 Medicinal value of different parts of plants.
- 5.2 Basic methods to identify the secondary metabolites
- 5.3 Role of secondary metabolites in Ayurvedha and Sidha treatment.
- 5.4 Medicinal value of Amla, Stevia, Aswagandha and Turmeric.

### Suggested Readings

1. Plant physiology, Verma, 7th Revised edition, Emkay Publications 2001.
2. Plant Physiology, S. N. Pandey and B.K. Sinha, Vikas Publishing House Pvt. Ltd, 3rd edition, 1999.
3. Plant Biochemistry and Molecular Biology, Peter Jhe, Richard C. Leegood,
4. Introduction to plant physiology, William. G. Hopkins, Norman. P.A. Hunger, 3rd edition
5. A Handbook of Medicinal Plants –Prajapathi, Purohit, Sharma, Kumar
6. Medicinal Plants –a compendium of 500 species.
7. Medicinal Plants –Chopra, Khana, Prasad, Malik, Bhutiani

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**BIOCHEMISTRY DSE(For 5th and 6th Semesters)**

**Title: BIOCHEMISTRY OF NON COMMUNICABLE DISORDERS**

**CLASS DURATION – 03 HOURS PER WEEK. Hours-30**

**MARKS-Theory - 30 + Internal Assessment -20= 50**

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**COURSE OBJECTIVE:**

1. To acquire molecular basis for non-communicable diseases which are a major concern of the modern world.

2. To increase the awareness about having a healthy lifestyle.

**Unit-1 Metabolic and Lifestyle disorders**

**10 hrs**

- 1.1 Obesity and eating disorders like Anorexia nervosa and Bulimia.
- 1.2 Diabetes mellitus A metabolic syndrome and the relationship with hypertension, obesity, hypothyroidism and stress.
- 1.3 Cardiovascular disorders and Atherosclerosis- understanding the factors that contribute to the syndrome, stages of disorder and the management of the condition.
- 1.4 Irritable bowel syndrome- biochemistry behind the disorder and the influence of diet, stress and environment on the condition.

**Unit-2 Cancer**

**6 hrs**

COURSE LEARNING OUTCOME		
CO	On completion of the course the student will be able to	Cognitive level
CO-1	Gain the knowledge regarding non-communicable diseases and the molecular basis for their appearance.	Understand
CO-2	Enrich and help the students in understanding the importance of a healthy lifestyle.	Understand

- 2.1 Cancer: characteristics of a transformed cell, causes and stages of Cancer, molecular basis for neoplastic growth and metastasis, Proto-oncogenes and tumour suppressor genes; Cancer-causing mutations
- 2.2 Tumour viruses; Biochemical analysis of cancer; Molecular approaches to cancer treatment.

**Unit-3 Other Complex disorders**

**6 hrs**

- 3.1 Disorders of mood: Schizophrenia, dementia and anxiety disorders.
- 3.2 Polycystic ovarian syndrome, Parkinson's disease, ALS.

**Unit-4 Protein Folding disorders:**

**8 hrs**

Introduction to protein folding and proteasome removal of misfolded proteins; etiology and molecular basis for Alzheimer's, Prion diseases, Huntington's Chorea, sickle cell anaemia, Thalassemia.

**SUGGESTED READINGS**

- 1 Textbook of Biochemistry with Clinical Correlations (2011) Devlin, T.M. John

- Wiley & Sons, Inc. (New York),
- 2 Introduction to Human Physiology (2012) 8th edition; Lauralee Sherwood. Brooks/Cole, Cengage Learning.
  - 3 The World of the cell, 7th edition (2009). Lewis J. Kleinsmith, Jeff Hardin, Gr Wayne M. Becker.
  - 4 Genetics (2012) 6th ed., Snustad, D.P. and Simmons, M.J., John Wiley & Sons
  - 5 The Cell: A Molecular Approach (2009) 5th ed., Cooper, G.M. and Hausman, R.E., ASM Press & Sunderland (Washington DC), Sinauer Associates, MA,

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**BIOCHEMISTRY DSE(For 5<sup>th</sup> and 6<sup>th</sup> Semesters)**  
**Title:-CONCEPTS OF PHARMACEUTICAL BIOCHEMISTRY**  
**CLASS DURATION – 03 HOURS PER WEEK. Hours-30**  
**MARKS-Theory - 30 + Internal Assessment -20= 50**

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**COURSE OBJECTIVE:**

1. To emphasize on teaching the students to identify some general drugs used in medicine, their mode of action, clinical application, side effects and toxicity.

COURSE LEARNING OUTCOME		
CO	On completion of the course the student will be able to	Cognitive level
CO-1	Identify a range of drugs used in medicine and discuss their mechanisms of action.	Apply
CO-2	Report the clinical applications, side effects and toxicities of drugs used in medicine	Understand & Apply
CO-3	Explain the mechanisms of action and pathology of ethanol and drugs of abuse	Understand

### Unit 1 General Pharmacology

- 1.1 Importance of Biochemistry and pharmacy: Metabolites and anti-metabolites; **6 hrs**  
 1.2 Drugs -Classification of drugs, routes of drug administration, absorption and distribution of drugs, factors influencing drug absorption.

### Unit 2 Pharmacokinetics

- 2.1 Drugs: Receptor interaction, the involvement of binding forces in drug-receptor interaction, drug action not mediated by receptors; **6hrs**  
 2.2 Drug metabolism, the role of cytochrome P450.

### Unit 3 Adverse responses

- 3.1 Adverse responses and side effects of drugs: Allergy, drug intolerance, drug addiction, drug abuses and their biological effects. **8hrs**  
 3.2 Drugs and pharmaceuticals from marine organisms: Marine lipids, marine flavourants and flavonoids.  
 3.3 Natural products: Alkaloids - cocaine, nicotine, quinine, atropine; Terpenoids - terpenoids, menthol, d-limonene; Flavonoids - anthoxynene

### Unit 4 Drug action

#### Mechanism of action of

1. CNS stimulants- (strychnine, amphetamine).
2. Beta-blockers
3. Opioids- Morphine
4. NSAID – Aspirin, Paracetamol and ibuprofen
5. Anti-Hypertensive drugs
6. Diuretics and antidiuretics
7. Allopurinol
8. Anti-diabetic drugs- Oral drugs ( Metformin and gliclazide) and hormonal ( Insulin and glucagon)
9. Oral contraceptives
10. Alcohol

### Suggested Readings

1. Essentials of Medical Pharmacology, 7th edition (2010), K.D. Tripathi, Jaypee

- Brothers,
2. Pharmacology, 7th edition (2011), H.P. Rang, M.M. Dale, J.M. Ritter and P.K. Moore, Churchill Livingstone.
  3. Handbook of Experimental Pharmacology, 4th edition (2012), S.K. Kulkarni, VallabhPrakashan, 2012.
  4. Textbook of pharmacology and pharmacotherapeutics by R.S. Satoskar, S.D. BandarkarAinapure.
  5. The Pharmacology volume I and II –Goodman and Gillman
  6. Basic Pharmacology –Foxter Cox
  7. Oxford textbook of Clinical Pharmacology and Drug Therapy,D.GGrahmeSmithandJ.K.Aronson
  8. Pharmacology and Pharmacotherapeutics – R.S.Satoskar,S.D.Bhandhakarand.

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**BIOCHEMISTRY DSE (For 5<sup>th</sup> and 6<sup>th</sup> Semesters)**  
**Title: MOLECULAR ENDOCRINOLOGY**  
**CLASS DURATION – 03 HOURS PER WEEK. Hours-30**  
**MARKS-Theory - 30 + Internal Assessment -20= 50**

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### **COURSE OBJECTIVE:**

1. To emphasize on teaching the students to define and discuss the physiological actions of hormones relating them whenever possible to human disorders.
2. To explain the consequences of under and overproduction of hormones and to learn techniques in endocrinology.

**6 hrs**

### **Unit-1 Introduction**

<b>COURSE LEARNING OUTCOME</b>		
<b>CO</b>	<b>On completion of the course the student will be able to</b>	<b>Cognitive level</b>
CO-1	Understand the mechanism of action of various hormones and conditions caused due to the variation in their secretion.	Understand

- 1.1 Definition and scope of molecular endocrinology- steroid hormones- structure,
- 1.2 Biosynthesis and transport - dynamics of steroid hormone production and metabolism
- 1.3 Mechanisms of action of sex steroid hormones.

### **Unit- 2Peptide Hormones**

**6hrs**

- 2.1 Peptide hormones- genetic control of peptide hormone formation- gonadotropins – cell surface receptors - mechanisms of action of peptide hormones.

### **Unit-3Endocrinopathies**

**10 hrs**

- 3.1 Molecular basis of - Disorders of pituitary hormone axis- thyrotoxicosis- hypothyroidism- Hashimoto's thyroiditis- metabolic bone diseases- Cushing syndrome- Addison's diseases,
- 3.2 Androgen deficiency syndromes- testicular neoplasm- Klinefelter's syndrome and Turner's syndrome.

### **Unit-4Laboratory techniques in molecular endocrinology**

- 4.1 Principles of radioimmunoassay and enzyme-linked immunoassays- basic principles and measurement of steroid hormone receptors- analytic validation- quality assurance.

**8hrs**

### **Text Books:**

- 1 Henry M. Kronenberg, ShlomoMelmed, Kenneth S. Polonsky, P. Reed Larsen. Williams Textbook of Endocrinology, 11th ed. Saunders Elsevier 2008
- 2 Molecular Endocrinology, III ed, Bolander, F. F. Academic Press, 2004.
- 3 Knobil & Neill's Physiology of Reproduction III Edition, J.D. Neill (Ed in chief), Elsevier Academic Press, 2006.

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**BIOCHEMISTRY DSE(For 5th and 6th Semesters)**  
**Title:-INTRODUCTION TO BIOSTATISTICS**  
**CLASS DURATION – 03 HOURS PER WEEK. Hours-30**  
**MARKS-Theory - 30 + Internal Assessment -20= 50**

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### **COURSE OBJECTIVE:**

1. To emphasize on introducing the students to the concepts of applied statistics – Biostatistics.
2. To understand the methodology and theory of statistics as applied to the problems in the life and health sciences.

#### **Unit 1 Introduction**

**10hrs**

- 1.1 Nature and scope of statistical methods and their limitations:
- 1.2 Collection of sample –Classification, Types and methods of data collection-
- 1.3 Tabulation of data and representation of data, Diagrammatic representation (histogram, frequency, polygon and Ogives.

#### **Unit 2 Measurements**

**8hrs**

Measures of central tendency: Mean, Median, Mode, Harmonic mean, geometric mean -merits and demerits.

#### **Unit 3 Statistical Measurements**

**6hrs**

- 3.1 Measurements of dispersion: Range, Variance, Standard deviation, Quartile deviation, Lorenz curve, Coefficient of variation. Skewness: classification of skewness, Karl Pearson's coefficient of skewness; Kurtosis.
- 3.2 Correlation: Types and method of correlation, coefficient of correlation, scatter diagram, Regression, Regression analysis. Test of significance (student t-test), F-test, Chi-square, ANOVA (one way)

#### **COURSE LEARNING OUTCOME**

1. Statistical Methods, Sultan chand & sons S.P. Gupta, V.K. Kapor, New Delhi 2002
2. Introduction to Biostatistics P.S.S. Sundaram.

### **TEXTBOOKS:**

#### **BIOCHEMISTRY DSE(For 5th and 6th Semesters)**

**Title: BASIC BIOINFORMATICS**

**CLASS DURATION – 02 HOURS PER WEEK. Hours-30**

**MARKS-Theory - 30 + Internal Assessment -20= 50**

### **COURSE OBJECTIVE:**

CO	On completion of the course the student will be able to	Cognitive level
CO-1	Understand the importance of Bioinformatics and will appreciate the use of the structural data in understanding the behaviour of biomolecules	Apply & Understand
CO-2	Know how the information can be used to design a specific drug, to predict the structure of a molecule.	Apply

1. To impart knowledge on the information stored in the structure of biologically important molecules. It also introduces them to the concepts of drug designing and basics of proteomics and its application in the current scenario.

### RECOMMENDED BOOKS

- 1 Bioinformatics Sequence and Genome Analysis –David .W.Mount.
- 2 Complete practical Guide to bioinformatics for life science
- 3 Bioinformatics computing –Bryan Bergeron
- 4 Bioinformatics –Zeonacroix
- 5 Bioinformatics methods and applications –S.C.Rastogi,Mendiratta,P. Rastogi
- 6 A new handbook of bioinformatics –Punithmehrotra,Kumudserin, Swapna .K.Srivatsava

<b>Unit-1 Introduction</b>		<b>6 hrs</b>
	Introduction to Bioinformatics,History ,Current Status of Bioinformatics,tasks of Bioinformatics,Problems and Scope of Bioinformatics	
<b>Unit 2</b>	Biological Database, properties of Biological, Nature of biological Database- Diversity and variability, data source in life science,Data integration, Ontology, Bioinformatics Tools.	<b>6hrs</b>
<b>Unit 3</b>	Biological queries, searching and Mining, Browsing,the semantics of queries, Query processing,Biological resource,Query planning, Query optimization, Tools for a website,Data retrieval tool.	<b>6hrs</b>
<b>Unit4Proteomics and drug discovery</b>		<b>6hrs</b>
4.1	Introduction to origin of proteomics, Types of proteomics, Applications and future perspectives of proteomics.	
4.2	Introduction to Drug Discovery and Drug designing. Importance parameters in drug discovery, Areas influencing drug discovery, Drug design Approaches.	
<b>Structure Predictions and data banks</b>		<b>6hrs</b>
<b>Unit5</b>		
	DNA and RNA structure prediction, Limitations of prediction, DNA and cDNA sequencing, Genbank DNA sequencing entry, EMBL, SWISSPROT,FASTA, Sequence alignment and significance of sequence alignment	

**BIOCHEMISTRY**  
**DISCIPLINE SPECIFIC CORE**

**Blue Print of Question Paper I Semester**

<b>Time: 3 Hours</b>		<b>Max Marks: 60</b>
<b>PART-A</b>		
<b>Answer the following:</b>		<b>5x2=10</b>
	<b>1</b>	
	<b>2</b>	
	<b>3</b>	

	4	
	5	
<b>PART-B</b>		
<b>Answer any SIX questions:</b>		<b>6x5= 30</b>
	6	
	7	
	8	
	9	
	10	
	11	
	12	
	13	
<b>PART-C</b>		
<b>Answer any TWO questions:</b>		<b>2x5=10</b>
	14	
	15	
	16	
	17	
<b>PART-D</b>		
<b>Answer any TWO questions:</b>		<b>2x5=10</b>
	18	
	19	
	20	
	21	

**BIOCHEMISTRY**  
**DISCIPLINE SPECIFIC CORE**  
**Blue Print of Question Papers II & III Semester**

<b>St. Philomena's College (Autonomous), Mysore</b>	
<b>Time: 3 Hours</b>	<b>Max Marks: 60</b>
<b>PART-A</b>	

<b>Answer the following:</b>		<b>5x2=10</b>
	<b>1</b>	
	<b>2</b>	
	<b>3</b>	
	<b>4</b>	
	<b>5</b>	
<b>Answer any FIVE questions:</b>		<b>5x5=25</b>
	<b>6</b>	
	<b>7</b>	
	<b>8</b>	
	<b>9</b>	
	<b>10</b>	
	<b>11</b>	
	<b>12</b>	
<b>Answer any FIVE questions:</b>		<b>5x5=25</b>
	<b>13</b>	
	<b>14</b>	
	<b>15</b>	
	<b>16</b>	
	<b>17</b>	
	<b>18</b>	
	<b>19</b>	

**BIOCHEMISTRY**  
**DISCIPLINE SPECIFIC CORE**  
**Blue Print of Question Paper IV Semester**

<b>St. Philomena's College (Autonomous), Mysore</b>	
<b>Time: 3 Hours</b>	<b>Max Marks: 60</b>

<b>PART-A</b>		
<b>Answer the following:</b>		<b>5x2=10</b>
	<b>1</b>	
	<b>2</b>	
	<b>3</b>	
	<b>4</b>	
	<b>5</b>	
<b>Answer any FOUR questions:</b>		<b>4x5=20</b>
	<b>6</b>	
	<b>7</b>	
	<b>8</b>	
	<b>9</b>	
	<b>10</b>	
	<b>11</b>	
<b>Answer any SIX questions:</b>		<b>6x5=30</b>
	<b>12</b>	
	<b>13</b>	
	<b>14</b>	
	<b>15</b>	
	<b>16</b>	
	<b>17</b>	
	<b>18</b>	
	<b>19</b>	

## BIOCHEMISTRY

### Blue Print of Question Papers V & VI Semesters

(Equal weightage to be given as per allotted hours for PART- A & B of the syllabus)

<b>St. Philomena's College (Autonomous), Mysore</b>	
<b>Time: 3 Hours</b>	<b>Max Marks: 70</b>



<b>PART-A</b>		
<b>Answer the following:</b>		<b>10x1=10</b>
	<b>1</b>	
	<b>2</b>	
	<b>3</b>	
	<b>4</b>	
	<b>5</b>	
	<b>6</b>	
	<b>7</b>	
	<b>8</b>	
	<b>9</b>	
	<b>10</b>	
<b>PART-B</b>		
<b>Answer any SIX questions:</b>		<b>6x5= 30</b>
	<b>11</b>	
	<b>12</b>	
	<b>13</b>	
	<b>14</b>	
	<b>15</b>	
	<b>16</b>	
	<b>17</b>	
	<b>18</b>	
<b>PART-C</b>		
<b>Answer any SIX questions:</b>		<b>6x5=30</b>
	<b>19</b>	
	<b>20</b>	
	<b>21</b>	
	<b>22</b>	
	<b>23</b>	
	<b>24</b>	
	<b>25</b>	
	<b>26</b>	

## BIOCHEMISTRY

### Blue Print of Question of DSE Papers

<b>St. Philomena's College (Autonomous), Mysore</b>	
<b>Time: 02 Hours</b>	<b>Max Marks: 30</b>

<b>PART-A</b>		
<b>Answer the following of the following:</b>		<b>6x1=6</b>
	<b>1</b>	
	<b>2</b>	
	<b>3</b>	
	<b>4</b>	
	<b>5</b>	
	<b>6</b>	
<b>PART-B</b>		
<b>Answer any FOUR questions:</b>		<b>4x6=24</b>
<b>7</b>		
<b>8</b>		
<b>9</b>		
<b>10</b>		
<b>11</b>		
<b>12</b>		

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