

# **DEPARTMENT OF BIO-CHEMISTRY**

**U. G. PROGRAMME**

## **SYLLABUS**

**(B. Sc. Biochemistry I to VI Semester)**

**2017-18**



**GOVERNMENT CITY COLLEGE**

**(AUTONOMOUS)**

**REACCREDITED WITH “A” GRADE BY NAAC**

**(Affiliated to Osmania University, Hyderabad)**

**Hyderabad – 500 002**

**Government City College (Autonomous), Hyderabad**

**DEPARTMENT OF BIOCHEMISTRY**

**B. Sc. COURSE STRUCTURE**

<b>Semester</b>	<b>Theory/Practical</b>	<b>Title</b>	<b>Contact hours per Week</b>	<b>Maximum Marks</b>	<b>Credits</b>
<b>I</b>	Theory I	Chemistry of biomolecules	4	100	4
	Practical I	Qualitative analysis of biomolecules	2	25	1
<b>II</b>	Theory II	Chemistry of nucleic acids & biochemical techniques	4	100	4
	Practical II	Quantitative analysis of biomolecules	2	25	1
<b>III</b>	Theory III	Enzymology, bioenergetics & biological oxidation	4	100	4
	Practical III	Biochemical preparations	2	25	1
<b>IV</b>	Theory IV	Intermediary metabolism	4	100	4
	Practical IV	Separation techniques	2	25	1
<b>V</b>	Core V	Molecular biology	3	100	3
	Advanced Elective I	Nutrition physiology & endocrinology	3	100	2
	Advanced Elective II	Biochemical genetics	3	100	2
	Practical V	Nutrition biochemistry & enzymology	3	50	1
	Practical VI	Clinical biochemistry	3	50	1
<b>VI</b>	Core VI	Clinical biochemistry & immunology	3	100	3
	Applied Elective I	Genetic engineering & microbiology	3	100	2
	Applied Elective II	Food technology	3	100	2
	Practical VII	Nucleic acid & lipids	3	50	1
	Practical VIII	Microbiology	3	50	1
	Project work	Self study & skill based		Grade	1

## SYLLABUS FOR B.Sc. BIOCHEMISTRY COURSE

SEMESTER –I

Paper - I

**Chemistry of Biomolecules**

**04 hrs/week & 4 Credits**

### **Unit 1: Introduction**

- 1.1 Scope of biochemistry
- 1.2 Water as biological solvent
- 1.3 Weak acids and bases
- 1.4 pH, buffers, Biological Buffers, Henderson- Hasselbalch equation.  
(Simple numerical problems)
- 1.5 Stereo chemistry with reference to carbohydrates & amino acids.

### **Unit 2: Carbohydrates and Lipids**

- 2.1 Classification of carbohydrates
- 2.2 Monosaccharide straight chain and ring structures
- 2.3 Reactions of monosaccharides, mutarotation, aminosugars & glycosides
- 2.4 Disaccharides, oligosaccharides & polysaccharides
- 2.5 Storage and structural polysaccharides, glycosaminoglycans and bacterial cell wall polysaccharides.

### **Unit 3: Lipids**

- 3.1 Classification of lipids, essential fatty acids. Reactions & properties of lipids
- 3.2 General properties and structures of neutral fats, waxes, phospholipids  
sphingolipids, cholesterol, glycolipids.
- 3.3 Prostaglandins and lipoproteins.
- 3.4 Bio membranes, behaviour of amphipathic lipids in water, formation of micelles, bilayers, vesicles, membrane composition and fluid mosaic model.

### **Unit 4: Amino acids & proteins**

- 4.1 Classification, structure, stereochemistry and chemical reactions of amino acids.
- 4.2 Titration curve of glycine & pK values.
- 4.3 Essential, nonessential amino acids and non-protein amino acids.
- 4.4 Peptide bond- Nature and conformation, naturally occurring peptides –  
Glutathione, enkephalin.

- 4.5 Outlines of protein classification, structural organization of proteins: primary, secondary, tertiary and quaternary structures (ex. hemoglobin & myoglobin).
- 4.6 General properties of proteins, denaturation and renaturation of proteins.
- 4.7 Determination of amino acid composition of proteins.

## **Practical I**

### **Qualitative Analysis of biomolecules**

Time: 2 hrs

Max Marks: 25

1. Laboratory general safety procedures.
2. Preparation of standard solutions
3. Determination of pKa values of amino acids by titration
4. Preparation of buffers
5. Qualitative identification of Carbohydrates, Amino acids & Lipids.

## SYLLABUS FOR B.Sc. BIOCHEMISTRY COURSE

### SEMESTER –II

#### Paper - II

### **Chemistry of Nucleic Acids & Biochemical Techniques**

04 hrs/week & 4 Credits

#### **Unit 1: Composition of Nucleic acids**

- 1.1 Nature (functions) of nucleic acids.
- 1.2 Structure of purines and pyrimidines.
- 1.3 Nucleosides, nucleotides, DNA & RNA.
- 1.4 Stability and formation of phosphodiester linkages, effect of acids, alkali and nucleases.
- 1.5 Photochemical and Spectral characteristics of Nucleic acid.

#### **Unit 2: Structure of nucleic acids**

- 2.1 Watson & Crick DNA double helix structure.
- 2.2 Introduction to circular DNA, supercoiling, helix to random coil transition, denaturation of nucleic acids.
- 2.3 Hyper chromic effect,  $T_m$  values and their significance.
- 2.4 Reassociation kinetics,  $cot$  curves and their significance.
- 2.5 Different types of RNA and their biological functions.

#### **Unit3: Spectrophotometric and Centrifugation Techniques**

- 3.1 Colorimetry and spectrophotometry.
- 3.2 Beer-Lamberts law and its limitations.
- 3.3 UV, visible spectra, molar extinction coefficient.
- 3.4 Principle of fluorimetry
- 3.5 Principle and applications of Centrifugation technique in biology

#### **Unit 4: Chromatographic Techniques.**

- 4.1 Principle in chromatographic technique.
- 4.2 Application of chromatographic technique in paper chromatography (one & two dimensional), TLC, gel filtration (molecular sieve), ion exchange chromatography and affinity chromatography.

4.3 Principle of electrophoresis, Electrophoresis: paper, polyacrylamide and agar gels, SDS-PAGE.

## **Practical II**

### **QUANTITATIVE ANALYSIS OF BIOMOLECULES**

Time: 2 hours

Max Marks: 25

1. Amino acid Estimation by Ninhydrin method
2. Protein Estimation by Folin`s Method
3. Total Sugar Estimation by Anthrone Method
4. Total Reducing Sugar Estimation by Dinitrosalicylate
5. Estimation of Keto sugar by Roe`s resorcinol Method

**SYLLABUS FOR B.Sc. BIOCHEMISTRY COURSE**

**SEMESTER –III**

**Paper - III**

**Enzymology, Bioenergetics & biological oxidation**

**04 hrs/week & 4 credits**

**Unit 1: Introduction to Enzymes**

- 1.1 Introduction to biocatalysts, differences between chemical and biological catalysis
- 1.2 Classification and nomenclature of Enzymes and Enzymes units; Active site.
- 1.3 Interaction between enzyme and substrate- Lock and Key Theory, Induced fit models (allosteric enzymes)
- 1.4 Factors affecting the catalysis. Substrate concentration, pH, temperature, activators, inhibitors (reversible and irreversible)
- 1.4 Apo enzyme, coenzyme and cofactors

**Unit 2: Enzyme Action**

- 2.1 Introduction to the principles of activation energy, transition energy
- 2.2 Specificity
- 2.3 Outlines of mechanism of enzyme action.
- 2.4 Allosteric enzymes
- 2.5 Michaelis constant and its significance (derivation not required). Methods for determination of  $K_m$ ,  $V_{max}$ .
- 2.6 Outlines of enzyme purification.
- 2.7 Regulation of enzyme activity- allosterism and cooperativity
- 2.8 ATCase as an allosteric enzyme, covalent modulation
- 2.9 Zymogens, Isozymes and ribozyme

**Unit 3: Bioenergetics**

- 3.1 Energy transformations in the living systems. Free energy concept. Enthalpy, Entropy.
- 3.2 Exergonic and endergonic reactions.
- 3.3 High-energy compounds. Phosphate group transfer. Redox reactions.
- 3.4 Redox potential. Standard Redox potential of some biochemically

Important half reactions

**Unit 4: Biological Oxidation**

4.1 Definition of biological oxidation and enzymes involved- oxidases, dehydrogenases and oxygenases

4.2 Ultra structure of mitochondria & chloroplast

4.3 Electron transport chain and carriers involved, oxidative phosphorylation  
Mitchell's chemiosmotic theory

4.4 Inhibitors of respiratory chain and oxidative phosphorylation

**Practical III**

**Biochemical preparations**

Time 2 hrs

Max Marks 25

1. Preparation of Osazones and their identification.
2. Isolation of albumin from egg.
3. Isolation of casein from milk.
4. Isolation of cysteine from hair.
5. Titration curve of glycine and determination of pK and pI values.
6. Absorption maxima of a colored solution and finding the extinction coefficient of aromatic amino acids by knowing the concentration of the given solution.



**SYLLABUS FOR B.Sc. BIOCHEMISTRY COURSE**

**SEMSTER –IV**

**Paper - IV**

**Intermediary Metabolism**

**04 hrs/week & 4 credits**

**Unit 1: Carbohydrate metabolism**

- 1.1 Glycolysis pathway, energy yields. Pasteur Effect,
- 1.2 Catabolism of polysaccharides: starch, glycogen and cellulose.
- 1.3 Glycogenolysis, glycogenesis.
- 1.4 Citric acid cycle, regulation, energy yield & anaplerotic reactions..
- 1.5 Pentose phosphate pathway, Gluconeogenesis.
- 1.6 Photosynthesis: light and dark reactions. Calvin cycle. C4 pathway
- 1.7 Metabolic disorders in carbohydrates ( Lactose intolerance, Galactosemia, Wernicke-Korsakoff Syndrome)

**Unit 2: Amino acid metabolism**

- 2.1 Nitrogen cycle, Biological nitrogen fixation, assimilation of ammonia.
- 2.2 General reactions of amino acid (Transamination, Decarboxylation, Deamination, Methylation).
- 2.3 Metabolism of valine, phenylalanine, tyrosine methionine serine glycine and threonine.
- 2.4 Urea cycle regulation and biological significance
- 2.5 Inborn errors of amino acid metabolism (Phenylketonuria, Alkaptonuria and Albinism).

**Unit 3: Metabolism of Nucleotide**

- 3.1 Biosynthesis and regulation of purines and pyrimidines.
- 3.2 De novo and salvage pathways.
- 3.3 Catabolism of purines and pyrimidines.
- 3.4 Biosynthesis of deoxyribonucleotides: ribonucleotide reductase and thymidylate synthase and their significance.
- 3.4 Disorders of nucleotide metabolism (Gout, Lesch-Nyhan syndrome)

## **Unit 4: Lipid metabolism**

- 4.1 Biosynthesis and degradation of fatty acids
- 4.3 Biosynthesis and degradation of triglycerides
- 4.3 Fatty acid elongation
- 4.4 Disorders in lipid metabolism ( Tay-Sachs disease and Gaucher's disease)

### **Practical IV**

#### **Separation techniques**

Time 3 hrs

Max Marks: 25

1. Demonstration of Dialysis
2. Separation of lipids by TLC
3. Paper electrophoresis
4. Paper Chromatography of amino acids.
5. Separation of plant pigments by circular chromatography.

**SYLLABUS FOR B.Sc. BIOCHEMISTRY COURSE**

**SEMESTER –V**

**Paper-V**

**Nutrition, Physiology & Endocrinology**

**03 hrs/week & 3 Credits**

**Unit I: Nutrition**

Balanced diet, calorific values of foods and determination by bomb calorimeter. BMR and factors affecting it. Specific dynamic action of food. Energy requirements and recommended dietary allowance (RDA) for children, adults, pregnant & lactating women. Sources of complete and incomplete proteins. Biological value of proteins. Essential and non-essential amino acids and essential fatty acids. Protein-calorie malnutrition, Kwashiorkor and marasmus. Vitamins: Structure and functional aspects of water and fat soluble vitamins occurrence in natural foods, deficiency disorders, recommended doses, supplementation. Introduction to nutraceutical and functional foods. Major and micro inorganic nutrients: Fe, Ca, Mg, & I, Cu, Mo, Zn, Se, F. obesity and starvation.

**Unit II: Physiology**

Digestion and absorption of carbohydrates, proteins and lipids, blood composition, coagulation, Hemoglobin and transport of gases in blood. Heart-structure of heart, cardiac cycle, cardiac factors controlling blood pressure. Muscles-kinds of muscles, muscle structure (smooth, skeletal, myofibril) and mechanism of contraction, organization of contractile proteins.

Nervous system –structure of neuron, resting potential, action potential, propagation of nerve impulse, synapse, synaptic transmission & excitatory inhibitory neuro transmitters, physiology of vision, visual pigments & visual cycle.

**Unit III: Endocrinology**

Organization of Endocrine System. Classification of hormones. Outlines of chemistry, physiological role and disorders of hormones of hypothalamus, pituitary, thyroid, adrenal, pancreas, parathyroid, placenta and gonads. Introduction of gastro intestinal hormone. Neurotransmitters.

Mechanism of hormone action: Signal transduction pathways for adrenaline glucocorticoids & insulin.

# **SYLLABUS FOR B.Sc. BIOCHEMISTRY COURSE**

**Semester –V**

**Advanced Elective I**

**Molecular Biology**

**03 hrs/week & 2 Credits**

## **Unit I: DNA Replication**

Organization of genome in prokaryotes and eukaryotes. Transformation –Griffith's experiment. DNA as genetic material-Hershey chase experiment. Nature and structure of gene. DNA Replication: Models of DNA replication, Meselson-Stahl's experimental proof for semi-conservative model. DNA polymerases I, II & III of E.coli, helicase, topoisomerases, primase, ligase. Bidirectional replication model, Okazaki fragments, leading and lagging strands of DNA synthesis. Inhibitors of DNA replication.

## **Unit II: Transcription and Genetic code**

Transcription. RNA synthesis, initiation, elongation and termination of RNA synthesis. RNA polymerases of prokaryotic and eukaryotic organisms. Promoters Genetic code, deciphering of genetic code, Nerenberg's and Khorana's experiments, wobble hypothesis, degeneracy of genetic code. Post transcriptional modifications, Inhibitors of transcription.

## **Unit III: Protein synthesis and regulation of gene expression**

Introduction of protein synthesis: Protein synthesis: Activation of amino acids (t-RNA structure, amino acid t- RNA synthetases) Ribosome structure. Initiation, elongation and termination of protein synthesis. Post translational modifications and inhibitors of protein synthesis. Regulation of gene expression: Operon concept: lac operon induction and catabolite repression. Trp operon and attenuation.

# **SYLLABUS FOR B.Sc. BIOCHEMISTRY COURSE**

**Semester –V**

**Advanced Elective II**

**Biochemical Genetics**

**03 hrs/week & 2 Credits**

## **Unit – I: Mendelian Genetics**

Mendel's Laws, Importance of meiosis in heredity. Gene interactions - Epistasis, Expressivity, Penetrance. Sex linked, sex limited, and sex influenced genes; Polygenic inheritance and polyploidy. Mutations (spontaneous / induced, somatic / germinal, forward / reverse, transition / transversions). Mutations (Silent, missense, nonsense, and frame shift mutations, conditional, leaky). Mutagens – physical, chemical. Transposon mutagenesis, site-directed mutagenesis.

## **Unit – II: Linkage and Mapping**

Discovery of linkage, Morgan's experiments, Cytological proof of crossing over, 2- and 3- point crosses, Recombination, Interference, Tetrad analysis, Fundamentals of population genetics (HW Law), Pedigrees of AR, AD, XR, and XD inherited traits, Mobile genetic elements – Zea Ac, Ds and Spm elements. *Drosophila copia*, Yeast Ty elements

## **Unit – III: Bacterial Genetics**

Discovery of conjugation, Mapping bacterial genes by conjugation. Discovery of transformation, Mapping bacterial genes by transformation. Discovery of transduction, Mapping bacterial genes by transduction. Discovery of transposition, Structure of transposons, replicative and conservative transposition, use as mutagens. Mapping phage genes – Fine structure of rII locus: Complementation analysis, Fine structure of rII locus: Deletion mapping.

## **Practical V**

### **Nutritional Biochemistry & Enzymology**

Time: 3 hours

Marks: 50

1. Estimation of Calcium by titrimetry
2. Estimation of calcium and sodium by flame photometry.
3. Estimation of Vitamin C by 2,6Dichloro phenol indophenol method.
4. Estimation of Iron – thiocyanate method
5. Estimation of iron from apple juice.
6. Extraction and assay of amylases.
7. Extraction and assay of urease.
8. Extraction and assay of catalase.

## **Practical VI**

### **Clinical Biochemistry**

Time: 3 hours

Marks: 50

1. R.B.C and W.B.C count
2. Preparation of serum and plasma.
3. Estimation of Hemoglobin in blood.
4. Qualitative analysis of blood, Blood grouping and Rh.
5. Determination of serum alkaline phosphatases activity
6. Determination of SGOT SGPT.
7. Estimation of Blood glucose.
8. Estimation of blood urea.
9. Estimation of cholesterol.
10. Qualitative analysis of urine.
11. Estimation of urinary creatinine.

## SYLLABUS FOR B.Sc. BIOCHEMISTRY COURSE

### SEMESTER –VI

#### Paper VI

### Clinical Bio Chemistry & Immunology

03 hrs/week & 3 Credits

#### **Unit I: Clinical Biochemistry-I**

Plasma Proteins in health and disease. Disorders of Blood Coagulation (Hemophilia). Types of Anemias, Hemoglobinopathies-Sickle cell anemia and thalassemias. Structure and function of Liver. Liver diseases Jaundice, Hepatitis, Cirrhosis. Liver functions tests-Conjugated and total Bilirubin in serum and albumin-Globulin ratio, Hippuric acid and Bromo sulphthalein test. Serum enzymes in liver diseases- SGPT, GGT and Alkaline phosphatase. Erythrocytes Sedimentation rate (ESR). Differential counts of blood cells.

#### **Unit II: Clinical Biochemistry-II**

Kidney- Structure of Nephron ,Urine formation, Normal and abnormal constituents of urine ,Biological buffers, Role of Kidney in maintaining Acid-Base balance in the body, Renal function tests – Creatinine and Urea clearance tests ,Phenol red test. Disorders of Carbohydrate metabolism- Hypoglycemia, Hyperglycemia, Glycosuria, renal threshold value, Diabetes mellitus-classification, Glucose tolerance test (GTT), Diabetic ketoacidosis. Disorders of Lipid metabolism-Plasma lipoproteins, Lipoproteinemias, Fatty Liver, Hyper Cholesterolemia, Atherosclerosis. Bio Chemical tests for the diagnosis of heart diseases-HDL/LDL Cholesterol, SGOT, LDH, CK,C-reactive protein, Cardiac troponins, Composition of CSF

#### **UNIT-III Immunology**

Organization of immune system. Organs & cells of immune system. Innate and acquired immunity, cell mediated and humoral immunity. Origin and role of T and B cells. Classification of immunoglobulins, structure of IgG, epitopes or antigenic determinants, haptens, Adjuvants. Theories of antibody formation: Clonal selection theory. Monoclonal antibodies. Determination of antigen-antibody reactions, agglutination, immune –precipitation, immune-diffusion. blood group antigens.



Immunodiagnostic techniques RIA & ELISA. Vaccines and their classification, Traditional- Live and attenuated toxoids. Modern vaccines-Recombinant and Peptide vaccines. Outlines of hyper sensitivity reactions. Fundamentals of graft rejection and MHC proteins.

## SYLLABUS FOR B.Sc. BIOCHEMISTRY COURSE

### SEMESTER –VI

#### Applied elective I

#### Microbiology & Genetic Engineering

03 hrs/week & 2 Credits

##### **Unit I: Bacteriology**

Introduction to brief history of microbiology: Basics concepts of Microscopy. Classification of microorganisms, prokaryotic and eukaryotic microorganisms. Isolation and cultivation of bacteria, selective media and enriched media. Bacterial growth curve and kinetics of growth. Batch, continuous and synchronous cultures. Gram's staining: Differential Staining Gram +ve and –ve bacteria, Motility and Sporulation.

##### **Unit II: Virology**

Plant and Animal viruses , Structure and composition of viruses. One-step growth and determination of plaque forming units. Isolation and cultivation of bacterial plaques: lytic and lysogenic life cycle of lamda phage.  $\Phi$  X174, Tobacco mosaic virus (TMV), Rous sarcoma virus (retrovirus), HIV and Prions.

##### **Unit III: Genetic Engineering**

Outlines of genetic engineering: Isolation of DNA fragments (genes) DNA Sequencing-Maxam Gilbert and Sangers Methods. Tools of r-DNA technology: Restriction endonucleases, Ligases, Phosphatases, Reverse transcriptase, Poyucleotide Kinases ,terminal transferase, Nucleases and RNAaseH. Restriction mapping, c DNA synthesis, Cloning vectors -pBR322, pUC18,Ti Plasmid , Cosmids, lamda phages, shuttles vectors ,expression vectors, Host –E Coli ,S acchromyces, cereviciae. Agrobacterium tumifaciens : Structure and functions.

Outlines of cloning strategies, genomic libraries, isolation and sequencing of cloned genes-colony hybridization, nucleic acid hybridization, hybrid released translation (HRT) and hybrid arrested & released translation (HART) using reporter genes,  $\beta$ -galactosidases, green fluorescent proteins (GFP). Introduction of recombinant DNA molecules into the host cells: Transformation, Preparation of Competent cells. Conjugation, Identification of clones with desired genes. Polymerase chain reactions-

Principle and applications. Outlines of blotting techniques-southern, northern and western. Application of gene cloning-production of Bt cotton and edible vaccines. Introduction to Bio informatics-Definition of proteomics and genomics. GENE bank, NCBI, DDBJ, Swissprot, PDB. Sequence alignment –BLAST and FASTA.

## **SYLLABUS FOR B.Sc. BIOCHEMISTRY COURSE**

**SEMESTER –VI**

**Applied elective II**

**Food Technology**

**03 hrs/week & 2 Credits**

### **Unit I Nutritive value of foods & Food preservation:**

Nutritive value of different types of foods-Cereals, Pulses, Dairy products, poultry, meat, fish and beverages. Calorific Value of Food stuffs. Classical methods of Preservation, Refrigerated storage or low temperature preservation, freezing preservation, preservation by chemical preservatives, preservation by canning, drying & dehydration, preservation by radiation and preservation by semi-moist food.

### **Unit II Packaging of foods:**

Purpose of packaging, Aseptic Packaging, Aseptic packaging material, package forms, Packaging materials like Plastics, Aluminium foils. Polymeric packaging material and their Safe use in food contact application.

### **Unit III Food quality assurance, Food Contamination & Food safety:**

The principles of quality assurance for food industry, Food safety issues and Food regulatory authorities. Safety evaluation of Food additives, Food contamination & infections due to spoilage of food. Food contamination by different bacterial, viral, fungal and protozoal organisms. Precautions to reduce food contamination.

Food hygiene, Hazards associated with foods, Hazard analysis critical control point (HACCP)

**Practical VII**  
**Nucleic acid & Lipids**

Time: 3 hours

Marks: 50

1. Estimation of RNA – Orcinol method.
2. Estimation of DNA – Diphenylamine method.
3. Determination of purity of nucleic acids by UV-Spectrophotometric method
4. Electrophoresis of nucleic acids & visualization by methylene blue staining.
5. Sequence alignment of insulin /BSA with other proteins using BLAST & FASTA.
6. Basic concepts of Bio-informatics, BLAST, FASTA, Genomics, Proteomics.
7. Restriction mapping – $\lambda$ -DNA with any two restriction enzymes.
8. Saponification of oils and fats.
9. Determination of Iodine Number.
10. Isolation of total lipids by gravimetric method.
11. Estimation of acid value of oil.

**Practical VIII**

**Microbiology**

Time: 3 hours

Marks: 50

1. Preparation of culture media and sterilization methods.
2. Isolation of pure cultures.
3. Streak plate method
4. Serial dilution method.
5. Bacterial growth curve.
6. Gram staining
7. Motility of bacteria by paper disc method.
8. Isolation of plasmids

### **Recommended Books for UG Course (Biochemistry)**

1. Lehninger's Principles of Biochemistry – Nelson. D.L. and Cox. M.M., Freeman
2. Biochemistry – Berg. J.M., Tymoczko. J.L. and Stryer. L., Freeman & Co.
3. Biochemistry – Voet. D. and Voet. J.G., John Wiley & Sons.
4. Textbook of Biochemistry – West. E.S., Todd.W.R., Mason. H.S. and Bruggen. J.T.V., Oxford & IBH Publishers.
5. Principles of Biochemistry: General Aspects –Smith. E.L., Hill. R.L., Lehman. I.R., Lefkowitz. R.J., Handler. P. and White.A. McGraw-Hill.
6. Outlines of Biochemistry – Conn.EE., Stumpf. P.K., Bruening. G and Doi. R.H., John Wiley & Sons.
7. Harper's Illustrated Biochemistry – Murray. R.K., Granne. D.K., Mayes P.A. & Rodwell. V.W., McGraw-Hill.
8. Biochemistry – Lippincott's Illustrates Reviews – Champ. P.C and Harvey, R.A. Lippincott.
9. Fundamentals of Biochemistry – Jain. J.L., Jain.S, Jain.N, S.Chand & Co.
10. Biochemistry – Satyanarayana. U and Chakrapani. U, Books & Allied Pvt Ltd.
11. Biochemistry – Rama Rao. A and Ratna Kumari. D, Kalyani Publishers.
12. Biochemistry – The Molecular Basis of Life – McKee. T and McKee, J.R., McGraw-Hill.
13. Biophysical Chemistry Principles & techniques –Upadhyay & Upadhyay Nath

**Question paper model**  
**Semester I-IV**  
**GOVERNMENT CITY COLLEGE**  
**(AUTONOMOUS)**  
**Re accredited with "A"**

**SUBJECT-BIOCHEMISTRY**  
**SEMESTER – / MODULE-**  
**Name of the module-**

**Time – 3 hours**

**Max Marks: 80**

**Section –A**

- I. Short Answer Questions: (5x4M=20M)  
**(Answer any five questions)**
- 1.
  - 2.
  - 3.
  - 4.
  - 5.
  - 6.
  - 7.
  - 8.
- (Two questions should be given from each unit)

**Section –B**

- II. Essay Questions (4x15M=60M)  
**(Answer all the questions)**
9. (A) or (B)
  10. (A) or (B)
  11. (A) or (B)
  12. (A) or (B)

(Two questions should be given from each unit with internal choice)

**Question paper model**  
**Semester V & VI**  
**GOVERNMENT CITY COLLEGE**  
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**SUBJECT-BIOCHEMISTRY**  
**SEMESTER – / MODULE-**  
**Name of the module-**

**Time – 2½hours**

**Max Marks: 75**

**Section –A**

III. Very Short Answer Questions: (5x2=10)  
**(Answer all questions)**

- 1.
- 2.
- 3.
- 4.
- 5.

(At least one question should be given from each unit)

II. Short answer Questions: (7x5=35)  
**(Answer any seven)**

- 6.
- 7.
- 8.
- 9.
- 10.
- 11.
- 12.
- 13.
- 14.

(Three questions should be given from each unit)





Government City College, Hyderabad. (Autonomous)  
 Department of Bio Chemistry  
 Affiliated to Osmania University  
 PANEL OF EXAMINERS

S.No	Name of the Examiner	Address
1	Rama	Lecturer, Dept. Of Bio-Chemistry, Ideal College, Dilsuknagar, Hyderabad.
2	SumanaYadgiri	Asst Prof, Dept of Bio- Chemistry, IPDC College for women, Nampally, Hyderabad.
3	A. Chandra shekhar	Asst Prof, Dept of Biochemistry, SR & BGNR Govt Degree College, Khammam
4	Padmashri	Lecturer, Dept of Bio-Chemistry, HRD College, Narayanaguda, Hyderabad
5	K S Naga Jyothi	Asst Prof, Dept of Bio-Chemistry, University College for Women, Koti Hyderabad, Mobile: 967083339
6	K. Swapna	Lecturer Dept of Bio-Chemistry, Pasha Nobel, degree College, Dilsukhnagar Hyderabad
7	Nanda Devi	HOD, Dept of Bio chemistry Reddy college for women,Hyderabad
8	Dr S. Ravi kiran	HOD, Dept of Bio chemistry, Aurora Degree & PG College, Chikkadpally, Hyderabad
9	G.Bindu	Lecturer Dept of Bio-Chemistry, Aurora Degree & PG College, Chikkadpally, Hyderabad
10	Dr M. Thirumala	Asst Prof, Dept of Bio chemistry, Mahatma Gandhi University, Nalgonda
11	M. Padmaja	Asst Prof, Dept of Biochemistry, GDC (Bhadrachalam), Khammam.
12	R. Shyamala Chandra	Asst Prof, Dept of Biochemistry, GDC (W), Karimnagar
13	S. Suma	Lecturer, Chaitanya Degree College (Autonomous), Hanamkonda, Warangal.
14	K.V.N. Rajeswari	Lecturer, Chaitanya Degree College (Autonomous), Hanamkonda, Warangal.
15	B. Srikanth	Lecturer, Chaitanya Degree College (Autonomous), Hanamkonda, Warangal.

**Board of Studies (2017-18):**

Composition as per UGC –XII Plan guidelines Annexure – V:

<b>S.No</b>	<b>Name</b>		<b>Signature</b>
01.	Prof. Ch.Venkata Ramana Devi	Hon'ble Chairperson BOS ,Osmania University.	
02.		Hon'ble member Nominated by Academic Council	
03.		Hon'ble member Nominated by Academic Council	
04.	CH. Vidya	Chairperson,GCC,Hyd	