

## B.Sc. Degree in Biochemistry

### Scheme of Examination

| Title of the paper                                                                                                                                  | Contact hours/<br>week | Exam.<br>hour | IA | Marks | Total Marks | Credits |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------|----|-------|-------------|---------|
| <b>First Semester</b>                                                                                                                               |                        |               |    |       |             |         |
| Biochemistry-I: BCT 101<br><b>Chemical Foundations of Biochemistry</b>                                                                              | 4                      | 3             | 20 | 80    | 100         | 3       |
| Biochemistry Practical-I: BCP 102<br><b>Experimental Biophysical Chemistry</b>                                                                      | 4                      | 3             | 10 | 40    | 50          | 2       |
| <b>Second Semester</b>                                                                                                                              |                        |               |    |       |             |         |
| Biochemistry-II: BCT 201<br><b>Bioorganic Chemistry</b>                                                                                             | 4                      | 3             | 20 | 80    | 100         | 3       |
| Biochemistry Practical-II: BCP 202<br><b>Experimental Bioorganic Chemistry</b>                                                                      | 4                      | 3             | 10 | 40    | 50          | 2       |
| <b>Third Semester</b>                                                                                                                               |                        |               |    |       |             |         |
| Biochemistry-III: BCT 301<br><b>Biomolecules</b>                                                                                                    | 4                      | 3             | 20 | 80    | 100         | 3       |
| Biochemistry Practical-III: BCP 302<br><b>Experimental Qualitative analysis of Biomolecules</b>                                                     | 4                      | 3             | 10 | 40    | 50          | 2       |
| Elective Paper- III: BCE 303<br><b>Cell Biology</b>                                                                                                 | 2                      | 2             | 10 | 40    | 50          | 2       |
| <b>Fourth Semester</b>                                                                                                                              |                        |               |    |       |             |         |
| Biochemistry-IV: BCT 401<br><b>Analytical Biochemistry</b>                                                                                          | 4                      | 3             | 20 | 80    | 100         | 3       |
| Biochemistry Practical-IV: BCP 402<br><b>Experimental Analytical Biochemistry</b>                                                                   | 4                      | 3             | 10 | 40    | 50          | 2       |
| Elective Paper –IV: BCE 403<br><b>Food- Environmental Biochemistry &amp; Hematology</b>                                                             | 2                      | 2             | 10 | 40    | 50          | 2       |
| Skill Enhancement(Project Work/Internship): BCPW-604<br><b>Project Work/Internship*</b><br>(Student can opt this paper either in IV,V, VI Semester) | 2                      | -             | 10 | 40    | 50          | 2       |
| <b>Fifth Semester</b>                                                                                                                               |                        |               |    |       |             |         |
| Biochemistry-V: BCT 501<br><b>Human Physiology and Clinical Biochemistry</b>                                                                        | 3                      | 3             | 20 | 80    | 100         | 3       |
| Biochemistry-V: BCT 502<br><b>Molecular Biology</b>                                                                                                 | 3                      | 3             | 20 | 80    | 100         | 3       |
| Biochemistry Practical-V: BCP 503<br><b>Experimental Human Physiology</b>                                                                           | 4                      | 3             | 10 | 40    | 50          | 2       |

|                                                                                                               |   |   |    |    |     |   |
|---------------------------------------------------------------------------------------------------------------|---|---|----|----|-----|---|
| <b>Clinical Biochemistry and Molecular Biology</b>                                                            |   |   |    |    |     |   |
| <b>Sixth Semester</b>                                                                                         |   |   |    |    |     |   |
| Biochemistry-VI: BCT 601<br><b>Enzymology and Metabolism</b>                                                  | 3 | 3 | 20 | 80 | 100 | 3 |
| Biochemistry -VI: BCT 602<br><b>Nutrition and Immunology</b>                                                  | 3 | 3 | 10 | 80 | 100 | 3 |
| Biochemistry Practical-VII:<br>BCP 603<br><b>Experimental Enzymology Metabolism, Nutrition and Immunology</b> | 4 | 3 | 10 | 40 | 50  | 2 |

**\*Note: Students can complete the Project work/Internship (BCPW-604) in either IV, V or VI Semester**

**Theory question paper pattern:**

Each theory question paper has three Sections;

1. 25% of the marks seeking short answers; Students have to answer all the questions of 2 marks each.
2. 37.5% of marks seeking medium-size answers: Student has to answer 6 out of 8 questions of 5 marks each.
3. 37.5% of question seeking comprehensive answers: Student has to answer 3 out of 4 questions of 10 marks each. These questions may include sub questions (5+5).

Internal Assessment: Tests: 10 Marks (two internal tests to be conducted and average is considered for assessment).

## SEMESTER III

|                      |                    |                       |         |
|----------------------|--------------------|-----------------------|---------|
| Program Name         | B.Sc. Biochemistry | Semester              | III     |
| Course Title         | Biomolecules       |                       |         |
| Course Code          | BCT 301            | No of Credits         | 3       |
| Contact Hours        | 56 Hours           | Duration of SEA/ Exam | 3 Hours |
| Formative Assessment | 20                 | Summative Assessment  | 80      |

### Course Outcomes:

1. Understand the classification, structure, and biological roles of carbohydrates, proteins, lipids, and nucleic acids.
2. Learn the chemical reactions and physical properties of biomolecules.
3. Comprehend the structural organization of proteins and nucleic acids.
4. Analyze the role of biomolecules in cellular function and metabolism.

### UNIT-I

**14 Hours**

**Carbohydrates:** Definition, classification, biological importance.

**Monosaccharides:** Configuration relationship of D-aldoses, D-ketoses. General properties of aldoses and ketoses. Oxidation, reduction, reducing property, formation of glycosides, acylation, methylation, condensation-phenyl hydrazine, addition-HCN. Inter-conversion of aldoses and ketoses by chemical method. Ascending and descending the series by chemical methods. Structure and biological importance of amino sugars, deoxy sugars, sugar acids neuraminic and muramic acid.

**Disaccharides:** Structures and biological importance of sucrose, lactose, maltose, trehalose and isomaltose.

**Polysaccharides:** Partial structure, occurrence and importance of starch, glycogen, inulin, cellulose, chitin, and pectin.

**Glycosaminoglycans:** Occurrence, importance and structure of heparin, hyaluronic acid. Bacterial cell wall polysaccharide, peptidoglycans.

### UNIT-II

**14 Hours**

**Amino acids:** Structure and general classification of amino acids based on composition, Essential and non-essential amino acids. Biological importance, Structure & Shape. Structure and stereochemistry. Reactions of the amino groups

with  $\text{HNO}_2$ ,  $\text{LiAlH}_4$ , ninhydrin, phenyl isothiocyanate, dansyl chloride, fluoro dinitro benzene. Zwitterions.  $\text{pK}_a$  values. Reaction of carboxyl group-Hydrazine. D&L notation.

**Peptides:** Peptide bond, structure and biological importance of glutathione, valinomycin. Synthetic peptides-poly glutamic acid.

**Proteins: General** Classification of proteins, classification based on solubility, structure and functions with examples.

**Structure of Proteins:** Primary, Secondary ( $\alpha$  Helix,  $\beta$ -sheet,  $\beta$ -bend), Tertiary (myoglobin) and Quaternary (hemoglobin) Structure with Suitable examples. Methods of determining Protein Structure by end group Analysis: N and C-terminal amino acids, amino acid composition. Sequencing by Edman's degradation method. Denaturation and Renaturation of proteins. Anfinsen's experiment.

### UNIT-III

**14 Hours**

**Lipids:** Classification and biological role. Fatty acids- Nomenclature of saturated and unsaturated fatty acids. Physiological properties of fatty acids, omega 3 and omega 6 fatty acids. Sources of fats, invisible fat, essential fatty acids and their biological importance. Saponification, saponification value, iodine value, acid value and significance. Acylglycerols: Mono, di and tri acyl glycerols.

**Phospholipids:** Structure of lecithin, cephalins, phosphatidylinositol, plasmalogens, and cardiolipin. Biological role of phospholipids.

**Sphingolipids:** Structure and importance of sphingomyelin.

**Eicosanoids:** Structure and biological roles of arachidonic acid, prostaglandins, thromboxane, leukotrienes.

### UNIT-IV

**14 Hours**

**Nucleic acids:** Composition of DNA and RNA, nucleosides and nucleotides. Functions of nucleotides, source of energy, component of coenzyme and second messengers. Chargaff's rule. Watson and Crick model of DNA. Nucleic acid chemistry- UV absorption, Effect of alkali and acid on DNA, Chemical reactions of RNA and DNA. Melting temperature of DNA ( $T_m$ ). Types of RNA (mRNA, tRNA and rRNA), Secondary structures of tRNA – clover leaf model.

### Suggested Readings:

1. A.L., Lehninger, Principles Of Biochemistry (1982), Worth Publishers, Inc. New York.
2. E.E. Conn and P.K. Stumpf. Outlines of Biochemistry (1976) Wiley Eastern, New Delhi.
3. Biochemistry by L. Stryer 1995) W.H. Freeman Press, San Francisco, USA.
4. Biochemistry, by Voet, D. and Voet, J.G. (2004). 3<sup>rd</sup> Edition, John Wiley & Sons,

Inc. USA.

5. Biochemistry by U. Sathyanarayana Books and Allied (P) Ltd. Kolkata, ISBN0-87893-214-3, (2014).
6. Textbook of Biochemistry by J.L Jain(2016)
7. Medical Biochemistry by Ramakrishnan (2012)
8. Text Book of Biochemistry by D.M. Vasudevan (2018)
9. Text Book of Biochemistry by A.C. Deb, 9<sup>th</sup> revised edition (2017)

### Course Articulation Matrix Mapping

| COs  | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|------|------|------|------|------|------|------|------|------|------|-------|-------|-------|
| CO 1 | ✓    |      | ✓    | ✓    |      |      |      |      |      |       |       |       |
| CO 2 |      | ✓    |      |      | ✓    |      |      |      |      | ✓     |       |       |
| CO 3 | ✓    | ✓    |      |      |      |      | ✓    |      |      |       |       |       |
| CO 4 | ✓    |      |      |      | ✓    | ✓    |      |      |      | ✓     |       |       |

### PRACTICAL- III

|                      |                                                   |                       |               |         |
|----------------------|---------------------------------------------------|-----------------------|---------------|---------|
| Program Name         | B.Sc. Biochemistry                                |                       | Semester      | III     |
| Course Title         | Experimental Qualitative analysis of Biomolecules |                       |               |         |
| Course Code          | BCP 302                                           |                       | No of Credits | 2       |
| Contact Hours        | 04 Hours/ Week                                    | Duration of SEA/ Exam |               | 3 Hours |
| Formative Assessment | 10                                                | Summative Assessment  |               | 40      |

### Course Outcomes:

1. Perform qualitative tests to identify carbohydrates, proteins, amino acids, nucleic acids, and lipids.
2. Gain skills in interpreting biochemical color reactions.
3. Learn analytical procedures to test for food adulterants and estimate biochemical constituents.
4. Develop competence in handling and processing various biological samples.

### Experiments:

1. Qualitative analysis of carbohydrates– Molisch, Benedict's/ Fehling's, picric acid, Barfoed's, Bial's, Seliwanoff's, osazone tests. Color reactions of Glucose, fructose, lactose, maltose and sucrose.
2. Qualitative analysis of proteins: Albumin and casein

3. Qualitative analysis of proteins: Color reactions of proteins– Biuret, xanthoproteic, Millon's.
4. Qualitative analysis of amino acids– color reactions of amino acids like tryptophan, tyrosine, cysteine, methionine, arginine, proline and histidine.
5. Estimation of amino acid by formal titration.
6. Qualitative analysis of lipids–solubility, acroleintest, Salkowskitest, Lieberman- Burchard test.
7. Qualitative tests for nucleic acid.

### Suggested Readings:

1. Analytical techniques in Biochemistry and Molecular Biology; Katoch, Rajan. Springer, 2011
2. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology 8<sup>th</sup> Edn Andreas Hoffman and Samuel Clockie, Ed., Cambridge University Press, 2018.
3. Biochemistry and Molecular Biology; 5<sup>th</sup> Edn. Papachristodoulou, A. Snape, W.H. Elliott, and D.C. Elliott, Oxford University Press, 2014

### Course Articulation Matrix Mapping

| COs  | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|------|------|------|------|------|------|------|------|------|------|-------|-------|-------|
| CO 1 | ✓    | ✓    | ✓    | ✓    |      | ✓    |      |      |      |       |       |       |
| CO 2 |      |      | ✓    | ✓    |      |      |      |      |      | ✓     |       |       |
| CO 3 | ✓    | ✓    | ✓    |      | ✓    |      |      |      |      |       |       |       |
| CO 4 | ✓    | ✓    | ✓    | ✓    |      |      |      | ✓    |      | ✓     |       |       |

## SEMESTER IV

|                      |                         |                       |         |
|----------------------|-------------------------|-----------------------|---------|
| Program Name         | B.Sc. Biochemistry      | Semester              | IV      |
| Course Title         | Analytical Biochemistry |                       |         |
| Course Code          | BCT 401                 | No of Credits         | 3       |
| Contact Hours        | 56 Hours                | Duration of SEA/ Exam | 3 Hours |
| Formative Assessment | 20                      | Summative Assessment  | 80      |

### Course outcomes:

1. Understand principles of sample preparation and biochemical separation techniques.
2. Learn the operational principles of chromatographic, electrophoretic, and spectroscopic methods.
3. Gain insight into clinical and forensic biochemical analysis.
4. Explore the role of radioisotopes in biological investigations.

### UNIT I:

**14 Hours**

Introduction and cell disruption methods, extraction of macromolecules from tissues; liquid-liquid, liquid-solid and precipitation methods. Indian knowledge system in the preparation of herbal formulations and macromolecules- herbal decoction, Arishta, Lehya, churna, bhasma, herbal oil, herbal creams. Historical perspectives of Ayurvedic medicines.

**Centrifugation-** Introduction, principles of centrifugation, Sedimentation, angular velocity, centrifugal field, relative centrifugal field. Types of centrifugations- Preparative and analytical. Differential, density gradient and ultra-centrifugation. Basic instrumentation; types of rotors and their design. Laboratory centrifuge; operational instruction and applications. Analytical Centrifuges- Optics, Sedimentation coefficient.

### UNIT II:

**14 Hours**

**Chromatography:** General principles of chromatography, Classification based on matrices-thin layer chromatography, Paper chromatography - ascending, descending and circular, 2-D chromatography, Rf value. Classification of chromatography based on separation: Principles, methodologies and applications of adsorption, partition,

ion-exchange, gel-filtration and affinity-chromatography. Advanced chromatography- GC, HPLC

### UNIT III:

**14 Hours**

**Electrophoresis:** General principle of electrophoresis and types of electrophoresis- paper, agarose, polyacrylamide electrophoresis. Chemistry of polymerization of acrylamide gels, methodology and applications of native PAGE and SDS- PAGE, Identification of proteins post electrophoresis- dyes. Applications of electrophoresis and isoelectric focusing.

**Radio isotopic methods:** Radioactivity–Types of radioactive decay, properties of  $\alpha$ ,  $\beta$ ,  $\gamma$  radiations. Decay law- decay constant, half-life period and average life of a radioactive element. Detection of radioactivity – GM counter and scintillation counters (principle and procedure) Applications of radioisotopes –  $^3\text{H}$ ,  $^{14}\text{C}$ ,  $^{131}\text{I}$ ,  $^{60}\text{Co}$  and  $^{32}\text{P}$ . Biological effects of radiations. Safety measure in handling radio isotopes.

### UNIT IV:

**14 Hours**

**Spectroscopic methods:** Wave particle duality of light, electromagnetic spectrum, transition in spectroscopy. Beer-Lambert law and its limitations, determination of molar absorption coefficient of molecules. Working principle and application of a colorimeter, principle, design and application of UV-visible spectrophotometer, flame photometer and fluorimeter. Principle and application of IR, Raman and NMR spectroscopy.

### Suggested Readings:

1. Analytical techniques in Biochemistry and Molecular Biology; Katoch, Rajan. Springer 2011.
2. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology 8<sup>th</sup>Edn. Andreas Hoffman and Samuel Clockie, Ed., Cambridge University Press, 2018.
3. Biochemistry and Molecular Biology; 5<sup>th</sup> Edn. D. Papachristodoulou, A.Snape, W.H. Elliott, and D.C. Elliott, Oxford University Press 2014.

PEDAGOGY: MOOC/ DESKWORK/ BOOK CHAPTER/ PROBLEM SOLVING/  
ASSIGNMENT

### Course Articulation Matrix Mapping

| COs  | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|------|------|------|------|------|------|------|------|------|------|-------|-------|-------|
| CO 1 | ✓    |      |      |      |      |      |      |      | ✓    |       |       |       |
| CO 2 |      |      | ✓    | ✓    |      |      |      |      |      | ✓     |       |       |
| CO 3 | ✓    |      | ✓    | ✓    |      | ✓    |      |      |      |       |       |       |

|      |   |   |  |  |   |  |  |  |  |   |  |  |
|------|---|---|--|--|---|--|--|--|--|---|--|--|
| CO 4 | ✓ | ✓ |  |  | ✓ |  |  |  |  | ✓ |  |  |
|------|---|---|--|--|---|--|--|--|--|---|--|--|

## PRACTICALS IV

|                      |                                      |                       |               |         |
|----------------------|--------------------------------------|-----------------------|---------------|---------|
| Program Name         | B.Sc. Biochemistry                   |                       | Semester      | IV      |
| Course Title         | Experimental Analytical Biochemistry |                       |               |         |
| Course Code          | BCP 402                              |                       | No of Credits | 2       |
| Contact Hours        | 04 Hours/ Week                       | Duration of SEA/ Exam |               | 3 Hours |
| Formative Assessment | 10                                   | Summative Assessment  |               | 40      |

### Course outcomes:

1. Acquire hands-on training in basic analytical techniques like centrifugation and chromatography.
2. Develop proficiency in electrophoretic and spectrophotometric techniques.
3. Understand sample handling and preparation for biochemical analysis.
4. Apply instrumentation knowledge in research-based biochemical investigations.

### Experiments:

1. Preparation of human lymphocytes using clinical centrifuge
2. Determination of packed cell volume/hematocrit
3. Separation of amino acids by ascending, descending and circular paper chromatography.
4. Separation of plant pigments by thin layer chromatography.
5. Separation of plant pigments by adsorption chromatography
6. Colorimetric estimation of glucose by DNS method
7. Estimation of Protein by Biuret method
8. Estimation of DNA by diphenylamine method
9. Estimation of RNA by orcinol method
10. Electrophoretic separation of plasma proteins

### Suggested Readings:

1. Plummer DT. *An Introduction to Practical Biochemistry*. 3rd ed. New Delhi: Tata McGraw-Hill; 2001.
2. Jayaraman J. *Laboratory Manual in Biochemistry*. New Delhi: New Age International Publishers; 1981.
3. Sadasivam S, Manickam A. *Biochemical Methods*. 3rd ed. New Delhi: New Age International Publishers; 2008.

4. Wilson K, Walker J. *Principles and Techniques of Biochemistry and Molecular Biology*. 7th ed. Cambridge: Cambridge University Press; 2010.
5. Sawhney SK, Randhir Singh. *Introductory Practical Biochemistry*. 2nd ed. New Delhi: Narosa Publishing House; 2000.

### Course Articulation Matrix Mapping

| COs  | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|------|------|------|------|------|------|------|------|------|------|-------|-------|-------|
| CO 1 | ✓    | ✓    | ✓    | ✓    |      |      |      |      | ✓    |       |       |       |
| CO 2 | ✓    |      | ✓    | ✓    |      |      |      |      |      |       |       |       |
| CO 3 | ✓    | ✓    | ✓    | ✓    | ✓    |      |      | ✓    |      |       |       |       |
| CO 4 | ✓    | ✓    | ✓    | ✓    | ✓    |      |      |      |      |       |       |       |

PEDAGOGY: MOOC/ DESKWORK/ BOOK CHAPTER/ PROBLEM SOLVING/ ASSIGNMENT

### SEMESTER V

|                      |                                            |                       |         |
|----------------------|--------------------------------------------|-----------------------|---------|
| Program Name         | B.Sc. Biochemistry                         | Semester              | V       |
| Course Title         | Human Physiology and Clinical Biochemistry |                       |         |
| Course Code          | BCT 501                                    | No of Credits         | 3       |
| Contact Hours        | 40 Hours                                   | Duration of SEA/ Exam | 3 Hours |
| Formative Assessment | 20                                         | Summative Assessment  | 80      |

### Course Outcomes:

1. Understand physiological systems and biochemical basis of digestion, respiration, and excretion.
2. Study the biochemical role of blood constituents and neurological functions.
3. Explore the acid-base balance and its physiological regulation.
4. Analyze biochemical markers in clinical diagnostics and disease conditions.

### UNIT I:

**10 Hours**

**Digestive System and GIT:** GIT and accessory organs, Digestion, absorption & transport of carbohydrates, lipids and proteins.

**Blood-** Blood volume, composition and functions. RBC, WBC and platelets- structure, Blood coagulation mechanisms and blood clotting factors .

and functions.

## UNIT II:

10 Hours

**Nervous System:** Types of neurons, Generalized structure of multipolar neuron. Resting membrane potential, Action potential. Transmission of nerve impulse along an axon and across synapse. Neurotransmitters.

**Muscle:** Types of muscles and their structure. Ultrastructure of skeletal muscle. Contractile and regulatory proteins of skeletal muscle. Sliding filament model of skeletal muscle contraction.

## UNIT III:

10 Hours

**Respiratory System:** Functions of lungs, mechanism of respiration (pulmonary ventilation), gas exchange mechanism, Biochemical events in transport of CO<sub>2</sub> and O<sub>2</sub> in blood. **Excretory System:** Structure of nephron. Formation of urine- Glomerular filtration, tubular reabsorption and tubular secretions.

**Acid-Base balance:** Blood buffers- Bicarbonate, phosphate and protein buffer system. Role of lungs and kidney in acid- base balance.

## UNIT IV:

10 Hours

**Biochemical Analysis of Blood and Urine:** Normal composition of urine- volume, specific gravity. Constituents- urea, uric acid, creatinine, pigments and their clinical significance in brief. Kidney disorder.

Normal constituents of blood. Urea, Uric acid, Creatinine, Glucose, Bilirubin, Total protein, Albumin/ globulin ratio- Variation in pathological conditions. Lipid Profile- Cholesterol, Triglycerides, lipoproteins, HDL and LDL

### Suggested Readings:

1. Fundamentals of Biochemistry-JL Jain, S. Jain and N.Jain (2000), S. Chand.
2. Lehninger's biochemistry- Nelson and Cox (2005) CBS Publishers.
3. Biochemistry- U. Sathyanarayana and U.Chakrapani (2006).
4. Textbook of Physiology- A.K. Jain (2005). APC.

### Course Articulation Matrix Mapping

| COs  | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|------|------|------|------|------|------|------|------|------|------|-------|-------|-------|
| CO 1 | ✓    |      | ✓    |      |      |      |      | ✓    |      |       |       |       |

|      |   |   |   |   |   |  |  |   |  |  |  |  |
|------|---|---|---|---|---|--|--|---|--|--|--|--|
| CO 2 | ✓ | ✓ |   | ✓ |   |  |  |   |  |  |  |  |
| CO 3 | ✓ | ✓ | ✓ |   | ✓ |  |  |   |  |  |  |  |
| CO 4 | ✓ |   | ✓ | ✓ | ✓ |  |  | ✓ |  |  |  |  |

## SEMESTER V

|                      |                    |                       |               |         |
|----------------------|--------------------|-----------------------|---------------|---------|
| Program Name         | B.Sc. Biochemistry |                       | Semester      | V       |
| Course Title         | Molecular Biology  |                       |               |         |
| Course Code          | BCT 502            |                       | No of Credits | 3       |
| Contact Hours        | 40 Hours           | Duration of SEA/ Exam |               | 3 Hours |
| Formative Assessment | 20                 | Summative Assessment  |               | 80      |

### Course Outcomes:

1. Learn molecular mechanisms of DNA replication, transcription, and translation.
2. Understand gene structure, regulation, and mutations.
3. Explore techniques of genetic engineering and recombinant DNA technology.
4. Analyze applications of molecular biology in medicine and biotechnology.

### UNIT I:

**10 Hours**

**Historical perspective:** Central dogma of molecular biology and its modification. DNA as genetic material- Griffith and Hershey Chase experiment.

**Replication of DNA:** Semiconservative mechanism, Meselson and Stahl experiment. Enzymes and regulatory proteins involved in replication, Mechanism of replication in prokaryotes. Fidelity of replication.

### UNIT II:

**10 Hours**

**Transcription:** Prokaryotic RNA synthesis, Role of RNA polymerase. Initiation, elongation and termination. Reverse transcription. Eukaryotic transcription, post-transcriptional process- mRNA splicing, cap addition and poly A tail addition.

Genetic Code: Triplet codon, universal features of genetic code, Wobble hypothesis.

**UNIT III:****10Hours**

**Protein biosynthesis:** Activation of amino acids, aminoacyl tRNA synthesis, Initiation, elongation and termination of protein synthesis in prokaryotes and Eukaryotes. Protein translation inhibitors (any three examples) Post translational modifications, Protein sorting and targeting.

**Concept of gene:** Functional units in prokaryotic and eukaryotic gene- promoter, introns and exons. Gene expression in prokaryotes, concept of operon, Lac-Operon, Tryptophan Operon.

**UNIT IV:****10 Hours**

Mutation and DNA repair: Concept of mutation and mutagens- effect of HNO<sub>2</sub>, Alkylating agents, Inter-chelating agents and UV- radiation. Concept of Point mutation and frameshift mutation. DNA repair.

Genetic Engineering: Basic principles of recombinant DNA technology.

**Suggested Readings:****Course Articulation Matrix Mapping**

| COs  | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|------|------|------|------|------|------|------|------|------|------|-------|-------|-------|
| CO 1 | ✓    | ✓    |      |      |      |      |      |      |      |       |       |       |
| CO 2 | ✓    | ✓    | ✓    | ✓    |      |      |      |      |      |       |       |       |
| CO 3 | ✓    | ✓    |      | ✓    |      |      |      |      |      |       |       |       |
| CO 4 | ✓    | ✓    | ✓    | ✓    |      |      |      | ✓    |      |       |       |       |

## PRACTICAL-V

|                      |                                                                            |                       |         |
|----------------------|----------------------------------------------------------------------------|-----------------------|---------|
| Program Name         | B.Sc. Biochemistry                                                         | Semester              | V       |
| Course Title         | Experimental Human Physiology, Clinical Biochemistry and Molecular Biology |                       |         |
| Course Code          | BCP 503                                                                    | No of Credits         | 2       |
| Contact Hours        | 04 Hours/ Week                                                             | Duration of SEA/ Exam | 3 Hours |
| Formative Assessment | 10                                                                         | Summative Assessment  | 40      |

### Course Outcomes:

1. Identify normal and abnormal constituents in urine through qualitative analysis.
2. Estimate important clinical biomarkers like glucose, urea, creatinine, and iron.
3. Perform isolation of DNA, and apply electrophoretic technique analyze nucleic acids.
4. Gain practical exposure to molecular biology protocols and tools.

### Experiments:

1. Qualitative analysis of organic and inorganic constituents of urine.
2. Qualitative analysis of abnormal constituents of urine.
3. Determination of titrable acidity of urine.
4. Estimation of creatinine.
5. Estimation of Urea by DAM method
6. Estimation of Uric acid.
7. Estimation of inorganic phosphate by Fiske-Subba Rao method.
8. Isolation of DNA from banana/endosperm of coconut/ bacteria / any other source
9. Purity check by UV spectrophotometer ( DNA and RNA ratio )
10. Isolation of plasmid from E. coli
11. Agarose gel electrophoresis of nucleic acids

### Suggested Readings:

6. Plummer DT. *An Introduction to Practical Biochemistry*. 3rd ed. New Delhi: Tata McGraw-Hill; 2001.
7. Jayaraman J. *Laboratory Manual in Biochemistry*. New Delhi: New Age International Publishers; 1981.
8. Sadasivam S, Manickam A. *Biochemical Methods*. 3rd ed. New Delhi: New Age International Publishers; 2008.
9. Wilson K, Walker J. *Principles and Techniques of Biochemistry and Molecular Biology*. 7th ed. Cambridge: Cambridge University Press; 2010.
10. Sawhney SK, Randhir Singh. *Introductory Practical Biochemistry*. 2nd ed. New Delhi: Narosa Publishing House; 2000.

### Course Articulation Matrix Mapping

| COs  | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|------|------|------|------|------|------|------|------|------|------|-------|-------|-------|
| CO 1 | ✓    |      |      |      |      |      |      | ✓    |      |       |       |       |
| CO 2 | ✓    | ✓    | ✓    | ✓    |      |      |      | ✓    |      |       |       |       |
| CO 3 | ✓    |      | ✓    | ✓    |      |      |      |      |      |       |       |       |
| CO 4 | ✓    |      |      |      |      |      |      | ✓    |      |       |       |       |

### VI SEMESTER

|                      |                           |                       |               |         |
|----------------------|---------------------------|-----------------------|---------------|---------|
| Program Name         | B.Sc. Biochemistry        |                       | Semester      | VI      |
| Course Title         | Enzymology and Metabolism |                       |               |         |
| Course Code          | BCT 601                   |                       | No of Credits | 3       |
| Contact Hours        | 40 Hours                  | Duration of SEA/ Exam |               | 3 Hours |
| Formative Assessment | 20                        | Summative Assessment  |               | 80      |

### Course Outcomes:

1. Understand enzyme structure, function, kinetics, and regulation.
2. Study catabolic and anabolic pathways of carbohydrates, lipids, amino acids, and nucleotides.
3. Analyze mechanisms of biological oxidation and energy transduction.
4. Explore metabolic disorders and clinical applications of enzymes

### UNIT I:

**10 Hours**

**Enzymes:** Introductory aspects, General characteristics, co-factors, coenzyme and metal ions. Classification of enzymes based on IUB with examples. Unit of enzymes, activity-specific activity. Enzyme specificity. Concept of active site.

Theories of enzyme catalysis-Lock and key model, Koshland's induced fit theory. Regulation of enzymes. Enzyme Kinetics: Michaeli's-Menten equation derivation. Determination of  $V_{max}$  and  $K_m$  from L-B plot and its significance. Factors affecting rate of enzyme catalyzed reaction. Effect of substrate, enzyme, product concentration, pH, temperature.

## **UNIT II: 10 Hours**

**Enzyme Inhibition:** Competitive, noncompetitive and uncompetitive inhibition. Graphical representation by L-B plot. Allosteric enzymes: Definition, ATCase as an allosteric enzyme Isoenzymes- LDH, Multienzyme -complex- pyruvate dehydrogenase complex. Ribozyme. Clinical and Biotechnological application of enzymes.

## **UNIT III: 10 Hours**

**Metabolism of Carbohydrates:** Glycolysis- aerobic and anaerobic and energetics of Glycolysis, regulation of glycolysis. TCA cycle and its regulation. ETC and its complexes- I, II, III, IV. Uncouplers and inhibitors of respiration (Rotenone, Actinomycin D, Cyanide and 2,4-DNP). Oxidative phosphorylation, P/O ratio. Formation of ATP-Outline of Mitchell's hypothesis. Gluconeogenesis and its importance. Outlines of HMP shunt pathway and its significance. Glycogen metabolism.

## **UNIT IV: 10 Hours**

**Metabolism of Lipids:** Oxidation of fatty acids- alpha, beta and omega types. Beta-oxidation of even number saturated fatty acids. Energetics of beta oxidation. Biosynthesis of fatty acids.

**Metabolism of Amino acids:** General metabolic reactions of amino acid degradation and synthesis-transamination and its mechanism of action. Deamination and decarboxylation. Ketogenic and Glucogenic amino acids.

**Metabolism of Nucleic acids:** Schematic pathway of synthesis and degradation of purines and pyrimidines.

## Suggested Readings:

1. Fundamentals of Biochemistry-JL Jain, S. Jain and N. Jain (2000), S. Chand.
2. Lehninger's Biochemistry- Nelson and Cox (2005) CBS Publishers.
3. Biochemistry- U. Sathyanarayana and U. Chakrapani (2006).
4. Enzymes: Biotechnology, Biochemistry and Clinical Chemistry- Trevor Palmer (2006).

## Course Articulation Matrix Mapping

| COs  | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|------|------|------|------|------|------|------|------|------|------|-------|-------|-------|
| CO 1 | ✓    |      | ✓    |      |      |      |      | ✓    |      |       |       |       |
| CO 2 | ✓    |      | ✓    |      |      |      |      |      |      |       |       |       |
| CO 3 | ✓    |      | ✓    |      |      |      |      |      |      |       |       |       |
| CO 4 | ✓    | ✓    | ✓    | ✓    |      |      |      |      |      |       |       |       |

## VI SEMESTER-PAPER II

|                      |                          |                       |               |         |
|----------------------|--------------------------|-----------------------|---------------|---------|
| Program Name         | B.Sc. Biochemistry       |                       | Semester      | VI      |
| Course Title         | Nutrition and Immunology |                       |               |         |
| Course Code          | BCT 602                  |                       | No of Credits | 3       |
| Contact Hours        | 40 Hours                 | Duration of SEA/ Exam |               | 3 Hours |
| Formative Assessment | 20                       | Summative Assessment  |               | 80      |

## Course Outcomes:

1. Understand nutritional requirements and roles of macronutrients and micronutrients.
2. Study human digestion, absorption, and metabolism.

3. Learn the basics of immune system components and immune responses.
4. Examine mechanisms of innate and adaptive immunity and immunological disorders.

## **UNIT I:**

**10 Hours**

**Concept of nutrition.** Calorific value of foods and its determination (bomb calorimeter). Different components of energy expenditure, respiratory quotient, basal metabolic rate, determination of BMR, factors affecting BMR, specific dynamic action of foods. **Carbohydrates:** Dietary sources, dietary fibers and protein sparing action. **Proteins:** Dietary sources, nutritional classification, nutritional value of protein- PER, NPU and biological value of proteins. Essential amino acids. Nitrogen balance. Fat: Dietary sources of fats, invisible fats, essential fatty acids (omega 3 and omega 6 fatty acids) and their biological importance. Minerals: Macro and micro nutrients.

## **UNIT II:**

**10 Hours**

**Abnormal nutritional States:** Malnutrition- Kwashiorkor and Marasmus. Obesity, Glycemic index of common food items. **Water metabolism:** Distribution of water in body fluids. Factors influencing water metabolism. **Antinutritional factors:** Sources and harmful effects of anti-vitamins (eg: Avidin), Natural toxicants (Lathyrus toxins), and adulterants (eg: Butter yellow, Malachite green).

## **UNIT III:**

**10 Hours**

**Cells and Organs of the immune system:** Anatomy and functions of lymphoid tissues, Cellular components of the immune system – Cells of innate immunity and cells of adaptive immunity, Primary and secondary lymphoid organs. **Antigen:** Concept of antigenic determinants and immunogens, factors that influence immunogenicity, Haptens. **Antibody:** Molecular Structure - general features, light and heavy chains, Hyper-variable and constant regions, Different isotypes and subtypes of immunoglobulins, Allotypes and idiotypes.

## **UNIT IV:**

**10 Hours**

**Innate and adaptive immunity:** Different lines of innate defense mechanisms, phagocytosis and complement activation. Mechanism of humoral immune response- B cell receptors (BCR), B-Cell maturation, activation, differentiation, generation of plasma cells and memory B cells. Mechanism of cell mediated immune response- T cell-receptors, T-cell maturation, activation, proliferation, and differentiation.

### Course Articulation Matrix Mapping

| COs  | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|------|------|------|------|------|------|------|------|------|------|-------|-------|-------|
| CO 1 | ✓    | ✓    |      |      |      |      |      | ✓    |      |       |       |       |
| CO 2 | ✓    | ✓    | ✓    |      |      |      |      |      |      |       |       |       |
| CO 3 | ✓    | ✓    | ✓    | ✓    |      |      |      |      |      |       |       |       |
| CO 4 | ✓    | ✓    | ✓    | ✓    |      | ✓    |      | ✓    |      |       |       |       |

### PRACTICAL VI

|                      |                                                                      |                       |         |
|----------------------|----------------------------------------------------------------------|-----------------------|---------|
| Program Name         | B.Sc. Biochemistry                                                   | Semester              | VI      |
| Course Title         | <b>Experimental Enzymology ,Metabolism, Nutrition and Immunology</b> |                       |         |
| Course Code          | BCP 603                                                              | No of Credits         | 2       |
| Contact Hours        | <b>04 Hours/ Week</b>                                                | Duration of SEA/ Exam | 3 Hours |
| Formative Assessment | 10                                                                   | Summative Assessment  | 40      |

### Course Outcomes:

1. Learn enzyme assay techniques and determine activity parameters like  $K_m$  and  $V_{max}$ .
2. Explore enzyme kinetics and effect of various factors on enzyme function.
3. Perform blood grouping , leucocytes cell counting and agglutination reactions.
4. Analyze food adulterants and test physicochemical parameters of food.

## Experiments:

1. Determination of activity of salivary amylase by DNS method.
2. Determination of specific activity of salivary amylase
3. Determination of optimum pH for salivary amylase.
4. Determination of optimum temperature of amylase.
5. Determination of  $K_m$  and  $V_{max}$  of salivary amylase
6. Blood grouping
7. Total leucocyte count
8. Differential leucocyte count
9. Detection of common adulterants present in the food sample – spices and condiments, food grains, sugars, preserves, fats and oils
10. Determination of acid value of oil/fat.
11. Determination of Iodine value of oil/fat.

## Suggested Readings:

1. Plummer DT. *An Introduction to Practical Biochemistry*. 3rd ed. New Delhi: Tata McGraw-Hill; 2001.
2. Jayaraman J. *Laboratory Manual in Biochemistry*. New Delhi: New Age International Publishers; 1981.
3. Sadasivam S, Manickam A. *Biochemical Methods*. 3rd ed. New Delhi: New Age International Publishers; 2008.
4. Wilson K, Walker J. *Principles and Techniques of Biochemistry and Molecular Biology*. 7th ed. Cambridge: Cambridge University Press; 2010.
5. Sawhney SK, Randhir Singh. *Introductory Practical Biochemistry*. 2nd ed. New Delhi: Narosa Publishing House; 2000.

## Course Articulation Matrix Mapping

| COs  | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|------|------|------|------|------|------|------|------|------|------|-------|-------|-------|
| CO 1 | ✓    |      | ✓    |      |      |      |      |      |      |       |       |       |
| CO 2 | ✓    |      | ✓    |      |      |      |      |      |      |       |       |       |
| CO 3 | ✓    |      | ✓    |      |      |      |      |      |      |       |       |       |
| CO 4 | ✓    | ✓    | ✓    | ✓    |      |      |      | ✓    |      |       |       |       |

**B.Sc. PRACTICAL QUESTION PAPER MODEL  
BIOCHEMISTRY**

**Practical Examination Scheme for III to VI Semester**

**Duration: 3 Hrs**

- Experimentation (Major & Minor/Spotters) - 30 Marks
- Viva-Voce - 10 Marks

**Total 40 Marks**

**Internal Assessment for Practical Paper III-VI Semesters**

- Attendance - 05 Marks
- Record/Journal - 05 Marks

**Total 10 Marks**

**Continuous Assessment Programme/ Internal Assessment/ Formative  
Assessment for Major program/ Subject: Biochemistry**

| Sl. No.     | Continuous Assessment Programme/ Internal Assessment                                                     | Maximum Marks |
|-------------|----------------------------------------------------------------------------------------------------------|---------------|
| 01          | Two Session Tests with proper record for assessment (5+5=10)                                             | 10            |
| 02          | Assessment of Skill Development activities/Seminars/Group Discussion/Assignment etc., with proper record | 05            |
| 03          | • Attendance with proper record                                                                          | 05            |
| TOTAL MARKS |                                                                                                          | 20            |

• **Attendance Marks-breakup**

|         |          |
|---------|----------|
| <75%_   | 00Marks  |
| 75.80%_ | 01 Mark  |
| 80-85%- | 02 Marks |
| 85-90%- | 03 Marks |
| 90-95%- | 04 Marks |
| >95%-   | 05 Marks |

**THEORY EXAMINATION QUESTION PAPER PATTERN FOR MAJOR COURSE/**  
**SUBJECT: BIOCHEMISTRY**  
**(Semesters III to VI)**

- \_\_\_\_ Semester B.Sc. -Degree Examination; 2025-26  
(Semester Scheme: New Syllabus: 2025-26)

**SUBJECT: BIOCHEMISTRY**

**Paper-\_\_\_\_: \_\_\_\_\_**

**Paper Code: \_\_\_\_\_**

**Time: 3 Hours**

**Max. Marks: 80**

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**Instructions to candidates:**

- 1) All sections are compulsory
- 2) Draw neat and labeled diagrams wherever necessary.

**SECTION-A**

1. Answer **all** the following questions: **(2x10=20)**

- a)
- b)
- c)
- d)
- e)
- f)
- g)
- h)
- i)
- j)

**SECTION-B**

Answer any **SIX** of the following: **(5x6=30)**

2. From Unit-I
3. From Unit-I
4. From Unit-II
5. From Unit-II
6. From Unit-III
7. From Unit-III
8. From Unit-IV
9. From Unit-IV

**SECTION-C**

Answer **Any Three** of the following:  
**(10x3=30)**

10. From Unit-I
11. From Unit-II
12. From Unit-III
13. From Unit-IV

|                      |                                                            |                       |                 |                |
|----------------------|------------------------------------------------------------|-----------------------|-----------------|----------------|
| Program Name         | <b>B.Sc. Biochemistry</b>                                  |                       | <b>Semester</b> | <b>IV/V/VI</b> |
| Course Title         | <b>SKILL ENHANCEMENT PROGRAMME-PROJECT WORK/INTERNSHIP</b> |                       |                 |                |
| Course Code          | BCPW 604                                                   |                       | No of Credits   | 2              |
| Contact Hours        | <b>02Hours/ Week</b>                                       | Duration of SEA/ Exam |                 | -              |
| Formative Assessment | 10                                                         | Summative Assessment  |                 | 40             |

### **Course Outcomes:**

1. Understand the fundamental concepts, types, and importance of scientific research, with an emphasis on biochemistry and life sciences.
2. Distinguish between various research designs and methodologies, and apply appropriate qualitative or quantitative approaches for experimental planning.
3. Conduct an effective literature review using scientific databases and manage references using modern citation tools.
4. Demonstrate awareness of research ethics, scientific misconduct, and the use of artificial intelligence in enhancing research quality and academic writing.

### **Proposed Topics for Project Work/Internship:**

1. Study of Food adulteration in oil, ghee, tea powder, honey, pepper etc.
2. Preparation of wine from different edible fruits
3. Edible Mushroom cultivation
4. Analysis of sugar content of fruits and market products
5. Analysis of cholesterol content in different animal products.
6. Evaluation of antioxidant properties plant extracts.
7. Evaluation of in vitro anti-inflammatory properties plant extracts.
8. Evaluation of cytotoxicity of plant extracts.

9. Separation of plant extract by silica gel chromatography
10. Separation of amino acids in plant extracts by TLC.
11. Separation of amino acids in plant extracts by paper chromatography.
12. Evaluation of antimicrobial activity of medicinal plants
13. Determination of iodine value of different oil samples
14. Determination of saponification number of different oil samples
15. Evaluation of chlorophyll content in different plant/algal samples
16. Evaluation of phenol content in different plant samples
17. Evaluation of flavonoid content in different plant samples
18. Evaluation of larvicidal potential of different medicinal plants
19. Preparation of different metal nanoparticles using medicinal plant extract/s
20. Isolation and estimation of proteins from different biological samples.
21. Isolation and estimation of reducing sugars from different plant samples.

Note: In addition to the above mentioned, any other topics relevant to the Biochemistry may be chosen.

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### **Guidelines for Project Work/Internship**

1. Project allotment should be done at the beginning of semester and topic should be finalized in consultation with the guide by the student.
2. Each project work will be carried out as individual (preferably) or in a batch of 2/3/4 students. There shall not be more than 4 students in each group.
3. Dissertation work has to be submitted in the format prescribed.
4. Title page, Page I - Certificate, Page II - Declaration, Page III - Acknowledgements, Page, IV – contents followed by the body of the dissertation.
5. Contents should include the following subheadings:
  1. Introduction with Review of Literature
  2. Materials and Methods
  3. Result and Discussion.
  4. Summary
  5. References
6. Dissertation should contain a minimum of 20 pages excluding photographs (A4 sheets with 1inch margin on all sides, Times New Roman font, font size -12 and line spacing - 1.5).
7. A student who is going to other institutions/industry/laboratory/fields for any assistance has to take permission letter by the HOD/Principal of the college.
8. Dissertation has to be submitted individually even if the work is done in group, i.e. one student has to submit his/her dissertation exclusively. No joint author submission. The dissertation to be certified by project guide and HOD. Certified dissertation shall be submitted during practical examination which shall be evaluated by both internal and external examiners.

## Course Outcomes:

1. Perform biochemical tests to detect food adulterants and quantify biomolecules in biological and commercial samples.
2. Apply biotechnological methods to produce wine, cultivate mushrooms, and synthesize nanoparticles using plant extracts.
3. Evaluate the therapeutic and toxicological properties of plant extracts through various in vitro bioassays.
4. Use chromatographic and spectrophotometric techniques to isolate and estimate biochemical constituents from biological samples.

## Course Articulation Matrix Mapping

| COs  | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|------|------|------|------|------|------|------|------|------|------|-------|-------|-------|
| CO 1 | ✓    | ✓    |      | ✓    |      |      |      |      |      |       |       |       |
| CO 2 | ✓    |      | ✓    |      |      |      | ✓    |      |      |       |       |       |
| CO 3 |      | ✓    |      | ✓    |      |      |      |      |      |       |       |       |
| CO 4 | ✓    |      |      | ✓    |      | ✓    |      |      |      |       |       |       |

**SCHEME OF EXAMINATION**  
**B.Sc. BIOCHEMISTRY: VI SEMESTER**  
**COMPULSORY PAPER - SKILL ENHANCEMENT (PROJECT**  
**WORK/INTERNSHIP)**  
**Code: BCPW 605**  
**Duration: 3 hours Max. Marks: 50**

**A. Internal Assessment:** Internal assessment marks to be allotted based on the continuous evaluation: **10 Marks**

**B. Evaluation of Report:** **40 Marks**

### B. Evaluation of Report (Distribution of 40 marks)

**I. Work carried out:** **20 Marks**

**II. Preparation of Report** (Based on the contents of dissertations): **10 Marks**

Distribution of marks: Introduction with review of literature – 2 Marks, Materials and methods – 1 Marks, Result and discussion and summary - 4 Marks, References – 1 Mark, Plates containing original photographs - 2 Marks)

**Note:** The report submitted by the candidate shall be assessed /evaluated by two examiners of the concerned subject. In case internal examiners are not available the external examiners may be preferred.

**III. Presentation and Viva-voce** (PPT slides preferably or charts): **10 Marks**

(Preparation of PPT slides or charts – 4 Marks, presentation – 6 Marks)

**Note:** Presentation to be done individually even if the project is carried out in team.

**GROUP II: ELECTIVE PAPER  
(SUPPORTIVE TO THE DISCIPLINE OF STUDY)  
SEMESTER III**

|                      |                           |                       |                 |            |
|----------------------|---------------------------|-----------------------|-----------------|------------|
| Program Name         | <b>B.Sc. Biochemistry</b> |                       | <b>Semester</b> | <b>III</b> |
| Course Title         | <b>Cell Biology</b>       |                       |                 |            |
| Course Code          | BCE 303                   |                       | No of Credits   | 2          |
| Contact Hours        | 2 Hours/Week              | Duration of SEA/ Exam |                 | 2 Hours    |
| Formative Assessment | 10                        | Summative Assessment  |                 | 40         |

**. Course Outcomes:**

1. Describe the structural organization and functions of prokaryotic and eukaryotic cells, including cellular organelles and membranes.
2. Explain the role and structure of various cytoplasmic organelles involved in biosynthesis, energy production, and intracellular transport.
3. Analyze the components of the cytoskeleton and their involvement in maintaining cell shape, motility, and intercellular connectivity.
4. Differentiate between passive and active transport mechanisms across biological membranes, including the role of transport proteins like the Na<sup>+</sup>/K<sup>+</sup>-ATPase.

**UNIT I:**

**14 Hours**

Cell & Organelles- Cell structure, Cell wall, Cell membrane-structure and functions, Nucleus, Cytoplasm and its organelles- Endoplasmic reticulum, Golgi complex, Mitochondria, Lysosome, Ribosomes, Peroxisomes.

**UNIT II:**

**14 Hours**

Cytoskeleton- Microtubules, Microfilaments, Cell junctions. Cell Transport mechanism- Passive transport – types, Glucose transport mechanism. Active transport- types, Na<sup>+</sup>-K<sup>+</sup> transporting ATPase system.

**References:**

1. Text book of Medical Biochemistry- MN Chatterjee and Rana Shinde

2. Text book of cell and molecular biology – Ajoy Paul
3. Biochemistry – U. Sathyanarayana and U. Chakrapani
4. Cell Biology- C.B. Power
5. Text book of Biochemistry- D.B. Vasudevan and Sreekumari S.
6. Principles and Techniques of Biochemistry and Molecular Biology- Keith Wilson and John Walker

### Course Articulation Matrix Mapping

| COs  | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|------|------|------|------|------|------|------|------|------|------|-------|-------|-------|
| CO 1 | ✓    | ✓    |      |      |      |      |      |      |      |       |       |       |
| CO 2 | ✓    |      | ✓    |      |      |      |      |      |      |       |       |       |
| CO 3 |      | ✓    |      | ✓    |      |      |      |      |      |       |       |       |
| CO 4 | ✓    | ✓    |      |      |      | ✓    |      |      |      |       |       |       |

## GROUP II: ELECTIVE PAPER (SUPPORTIVE TO THE DISCIPLINE OF STUDY)

### SEMESTER IV

|                      |                                               |                       |               |         |
|----------------------|-----------------------------------------------|-----------------------|---------------|---------|
| Program Name         | B.Sc. Biochemistry                            |                       | Semester      | IV      |
| Course Title         | Food- Environmental Biochemistry & Hematology |                       |               |         |
| Course Code          | BCE 403                                       |                       | No of Credits | 2       |
| Contact Hours        | 2 Hours/Week                                  | Duration of SEA/ Exam |               | 2 Hours |
| Formative Assessment | 10                                            | Summative Assessment  |               | 40      |

### Course Outcomes:

1. Understand the structure, classification, and nutritional importance of biomolecules such as carbohydrates, proteins, lipids, and vitamins.
2. Explain the digestion, absorption, and metabolic fate of macronutrients and relate them to lifestyle disorders like obesity, atherosclerosis, and diabetes mellitus.
3. Describe the composition and functions of blood, the role of hemoglobin, and disorders such as anemia, jaundice, and sickle cell anemia.
4. Analyze environmental factors such as air and water pollution, food adulteration, and their biochemical implications on human health.

**UNIT I:****14 Hours**

Biochemistry of food- Biomolecules- carbohydrates, proteins, lipids, Vitamins. Digestion of carbohydrates, proteins and lipids. ATP. Obesity, Atherosclerosis, Diabetes Mellitus. Blood- Composition, RBC, WBC, Platelets-Functions, hemoglobin- functions. Blood clotting, Anemia, sickle cell anemia, Jaundice.

**UNIT II:****14 Hours**

Environmental Biochemistry- Definition, -Alteration in atmospheric temperature- Causes and consequences of alteration in atmospheric temperature – Chemical stress and pollution: air pollution- Definition, sources, indicators, Health effects. Water pollution: Definition, sources, Health effects and Importance of pure water. Food contamination, Processing of food, natural toxins, Food adulteration.

**References:**

1. Text book of Medical Biochemistry- MN Chatterjee and Rana Shinde
2. Text book of cell and molecular biology – Ajoy Paul
3. Biochemistry – U. Sathyanarayana and U. Chakrapani
4. Cell Biology- C.B. Power
5. Text book of Biochemistry- D.B. Vasudevan and Sreekumari S.
6. Principles and Techniques of Biochemistry and Molecular Biology- Keith Wilson and John Walker

**Course Articulation Matrix Mapping**

| COs  | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 |
|------|------|------|------|------|------|------|
| CO 1 | ✓    | ✓    |      |      |      |      |
| CO 2 | ✓    |      | ✓    |      | ✓    |      |
| CO 3 | ✓    | ✓    |      | ✓    | ✓    | ✓    |
| CO 4 | ✓    | ✓    |      |      |      | ✓    |

## SCHEME OF EXAMINATION

### ELECTIVE PAPERS (BCE 303 and BCE403)

| Question No. | PART A                                                                           | MARKS          |
|--------------|----------------------------------------------------------------------------------|----------------|
| <b>I</b>     | Answer any FIVE Questions out of SIX Questions (Give 3 questions from each unit) | <b>5x2=10</b>  |
|              | <b>PART B</b>                                                                    |                |
|              | Answer any TWO Question out of FOUR Questions (Give 2 questions from each unit)  | <b>2x5=10</b>  |
| <b>II</b>    | <b>UNIT I</b>                                                                    | <b>5</b>       |
| <b>III</b>   | <b>UNIT II</b>                                                                   | <b>5</b>       |
| <b>IV</b>    | <b>UNIT I</b>                                                                    | <b>5</b>       |
| <b>V</b>     | <b>UNIT II</b>                                                                   | <b>5</b>       |
|              | <b>PART C</b>                                                                    |                |
|              | Answer any TWO Question out of FOUR Questions (Give 2 questions from each unit)  | <b>10x2=20</b> |
| <b>VI</b>    | <b>UNIT I</b>                                                                    | <b>10</b>      |
| <b>VII</b>   | <b>UNIT II</b>                                                                   | <b>10</b>      |
| <b>VIII</b>  | <b>UNIT I</b>                                                                    | <b>10</b>      |
| <b>IX</b>    | <b>UNIT II</b>                                                                   | <b>10</b>      |