



**Karmaveer Bhaurao Patil University,
Satara**

**Syllabus for
B. Sc. I Biochemistry**

**Under
Faculty of Science and Technology
(As per NEP 2020)**

With effect from Academic Year 2024 - 2025

Structure of the course:

1. TITLE : Biochemistry

2. YEAR OF IMPLEMENTATION:- Syllabus will be implemented from June, 2024 onwards.

3. PREAMBLE :

This syllabus is framed to give sound knowledge with understanding of biochemistry to undergraduate students.

The goal of the syllabus is to make the study of biochemistry popular, interesting and encouraging to the students for higher studies including research. The aim of syllabus is to prepare the students to gain knowledge in life sciences.

The new and updated syllabus is based on a basic and applied approach with vigour and depth. At the same time, precaution is taken to make the syllabus comparable to the syllabi of Karmaveer Bhaurao Patil University, Satara other universities and the needs of industries and research.

The syllabus is prepared after discussion at length with number of faculty members of the subject and experts from industries and research fields.

The units of the syllabus are well defined, taking into consideration the level and capacity of students.

4. GENERAL OBJECTIVES OF THE COURSE / PAPER :

- 1) To make the students knowledgeable with respect to the subject and its practicable applicability.
- 2) To promote understanding of basic and advanced concepts in biochemistry.
- 3) To expose the students to various emerging areas of biochemistry.
- 4) To prepare students for further studies, helping in their bright career.
- 5) To expose the students to different processes used in industries and in research field.

6) To develop their ability to apply the knowledge of biochemistry in day to day life.

7) To prepare the students to accept the challenges in life sciences.

8) To develop skills required in various industries, research labs and in the field of human health.

5. **DURATION:** The course shall be a full time course.

6. **EXAM PATTERN:** Semester.

7. **MEDIUM OF INSTRUCTION:** English.

8. **EXAMINATION STRUCTURE:** As per college guidelines

9. **STRUCTURE of B.Sc. I Biochemistry:**

1. Semester I (No. of Courses – 02 and Practical)

2) Semester II (No. of Courses – 02 and Practical)

Sr. No.	Subject	Sem	Course	Course Title
1	Biochemistry	Sem I	Course BBCT 111	Molecules of Life I
			Course BBCT 112	Basics of Energetics and Nutrition
			Practical BBCT 113	Practical (Based on BBCT 114 and BBCT 115)
		Sem II	Course BBCT 121	Molecules of Life II
			Course BBCT 122	Metabolism of Biomolecules
			Practical BBCT 123	Practical (Based on BBCT 124 and BBCT 125)

10. Structure and titles of the course of B.Sc. I for Semester I and II

Total credits - 2, Total Hours – 30 per theory course Total credits - 2, Total Hours – 60 per practical course				
Sem	Course Code	Course Title	Unit	Unit name
Sem I	BBCT 111	Molecules of Life I	Unit I	Amino Acids
			Unit II	Proteins
			Unit III	Enzymes
			Unit IV	Enzyme Kinetics
	BBCT 112	Basics of energetics and Nutrition	Unit I	Nutrition
			Unit II	Calorimetry
			Unit III	Biological Oxidation
			Unit IV	Vitamin and Coenzymes
	BBCP 113	Practical	Practical	Practical (Based on BBCT 114 and BBCT 115)
	Sem II	BBCT 121	Molecules of Life II	Unit I
Unit II				Carbohydrates II – Di and Polysaccharides
Unit III				Nucleotides and Nucleic Acids
Unit IV				Lipids
BBCT 122		Metabolism of biomolecules	Unit I	Oxidation of Glucose
			Unit II	Utilization and synthesis of Carbohydrates
			Unit III	Lipid Metabolism
			Unit IV	Amino Acid Metabolism
BBCT 123	Practical	Practical	Practical (Based on BBCT 124 and BBCT 125)	

11. OTHER FEATURES :

(A) LIBRARY :

Reference Books – Latest Editions, Journals and Periodicals.

(B) Specific equipments necessary to run the course:

OHP, Computer, L.C.D. Projector.

(C) INTERNET

(D) LIST OF THE LABORATORY EQUIPMENTS :

1. Colorimeter
2. Spectrophotometer
3. pH meter
4. Electrophoresis apparatus
5. Computer with printer and internet
6. Water bath
7. Incubator
8. Mixer
9. Oven
10. Balance
11. Suction pump
12. Centrifuge machine
13. Heating mantle with magnetic stirrer
14. Soxhlet extraction apparatus.
15. Micropipetes
16. Glassware
17. Chromatographic jar
18. Chromatography column
19. PCR machine
20. Rasmol software

SEMESTER – I
Course BBCT 111 - Molecules of Life I
Credit: - 02 (30 Hours)

Course objectives: Student should be able to ...

1. learn the biomolecules and their physiological significance.
2. know structure and role of various biomolecules.
3. learn biocatalyst action and other details.
4. understand the bond formation and stability of biomolecules.

SEMESTER-I		
BBCT 111 - Molecules of Life I (Total Credits 2)		No. of hours (30 hours)
Unit I	<p>Amino Acids</p> <p>A) Definition, Nomenclature, B) L and D forms of amino acids C) Structure and classification of amino acids based on nature of side chain</p> <p>i) Neutral amino acids: Hydrocarbon chain amino acids - Glycine, Alanine, Valine, Leucine, Isoleucine. Hydroxy amino acids - Serine, Threonine. Sulfur containing amino acids - Cysteine, Methionine. Aromatic amino acids - Phenylalanine, Tyrosine, Tryptophan. Heterocyclic amino acids - Proline.</p> <p>ii) Acidic amino acids and their amides: Aspartic acid, Glutamic acid, Asparagine, Glutamine.</p> <p>iii) Basic amino acids: Lysine, Arginine, Histidine</p> <p>D) Zwitterion and isoelectric pH.</p>	7
Unit II	<p>Proteins</p> <p>A) Definition, classification based on functions of proteins B) Peptide bond formation, nature and properties. C) Structural studies of proteins – Primary structure, Secondary structure, Tertiary structure Quaternary structure. D) Forces involved in maintaining different structural levels of proteins. E) Structure and function of oxytocin and myoglobin.</p>	8

Unit III	Enzymes A) Definition, Explanation of terms – Holoenzyme, Apoenzyme, Coenzyme, Prosthetic group, Cofactor. B) Classification of enzymes into in to six major classes with one example of each class. EC number of enzymes. C) Enzyme as catalyst, concept of activation energy in enzyme catalysed reaction. D) Units of enzyme activity, Specific activity, Turnover number, E) Enzyme specificity, Types of specificity. F) Active site of enzyme and its features. G) Theories of mechanism of enzyme action - Lock and key and induced fit theory.	7
Unit IV	Enzyme Kinetics A) Factors affecting enzyme activity - substrate concentration, pH, temperature. B) Enzyme kinetics – Derivation of Michaelis - Menten equation, plot, advantages, disadvantages C) Significance of Km and Vmax. D) Line weaver Burk equation and plot, advantages, disadvantages. E) Enzyme inhibition - competitive, non-competitive inhibition. K) Isoenzymes of LDH and its clinical importance.	8

Course outcomes: Students will be able to ...

1. recall the structure, role of biomolecules and their physiological significance.
2. illustrate the structure and role of various proteins.
3. explain biocatalyst and their action.
4. analyse mechanism of kinetics about the enzymes.

Reference Books:

1. Jermy M. Berg, Gregory J. Gatto, Justin K. Hines, John L. Tymoczko, Lubert Stryer; 2023, Biochemistry; Tenth edition, Springer Verlag.
2. Albert L. Lehninger, David L. Nelson and Cox; 2021, Lehninger's Principles of Biochemistry, Eighth edition, WH Freeman.
3. U. Satyanarayan; 2017, Biochemistry, Fifth edition, Elsevier India.
4. Watson, 2017, Molecular biology of the gene; Seventh edition, Pearson education.
5. Voet, Voet and Pratt; 2016, Fundamentals of Biochemistry, Fifth edition,

- John Wiley and Sons.
6. Lodish et. al. 2016, Molecular Cell Biology; Eight edition, WH Freeman.
 7. G. M. Cooper and R. E. Hausman; 2015, The Cell: A Molecular Approach; Seventh edition; Oxford University Press.
 8. J. Koolman and K. Roehm; 2013, Color Atlas of Biochemistry; Third edition; Thieme.
 9. T. Palmer, B. Philip; 2007, Enzymes; Second Edition, Horwood Publication.
 10. J. Jain, N. Jain and S. Jain; 2005, Fundamental of Biochemistry; Sixth Edition ; S. Chand Publication,
 11. A. C. Deb; 2001, Fundamentals of Biochemistry; Seventh edition; New Central Book Agency.

Course **BBCT 112 - Basics of Energetics and Nutrition**
Credit: - 02 (30 Hours)

Course objectives: Student should be able to ...

1. learn about energy generation mechanisms in cell.
2. know structure, function and reaction mechanisms of vitamins.
3. understand various food requirements of body and nutrition.
4. learn BMR and calorimetric significance of food.

BBCT 112 - Basics of energetics and Nutrition (Total Credits 2)		No. of hours (30 hours)
Unit I	Nutrition A) Nutrition, food, nutrient definition, Balanced diet B) Nutritional importance of i) Carbohydrate ii) Protein iii) Lipid C) Nutritional value of vitamins D) Nutritional value of minerals.	8
Unit II	Calorimetry A) Caloric value of food stuffs and its measurement (Bomb calorimeter) B) Respiratory quotient value C) BMR and its measurement (Douglass bag method)	7

	D) Factors affecting BMR and its significance. Composition and nutritive value of Indian food.	
Unit III	Biological Oxidation A) High-energy compounds and their significance viz. ATP, PEP, 1, 3-BPG. B) Mitochondrial respiratory chain. D) Components and carriers of ETC (Fe-S, Coenzyme Q, Cytochrome, Complex I, Complex II, Complex III, Complex IV). D) Mechanism of oxidative phosphorylation - chemiosmotic hypothesis. E) Inhibitors of ETC.	8
Unit IV	Vitamins and Coenzymes A) Definition, classification of vitamins; Sources, RDA value, structure and coenzyme form, biochemical functions and deficiency symptoms of water soluble vitamins viz. Vitamin C, Thiamine, Riboflavin, Niacin, Pyridoxine.	7

Course outcomes: Student will be able to ...

1. explain about energy generation mechanisms in cell.
2. illustrate various food requirements of body and nutrition.
3. elaborate BMR and calorimetric significance of food.
4. recall about vitamins and their physiological role, requirement etc.

Reference Books:

1. Jermy M. Berg, Gregory J. Gatto, Justin K. Hines, John L. Tymoczko, Lubert Stryer; 2023, Biochemistry; Tenth edition, Springer Verlag.
2. Albert L. Lehninger, David L. Nelson and Cox; 2021, Lehninger's Principles of Biochemistry, Eighth edition, WH Freeman.
3. U. Satyanarayan; 2017, Biochemistry, Fifth edition, Elsevier India.
4. J. D. Watson et al., 2017, Molecular biology of the gene; Seventh edition, Pearson education.
5. Voet, Voet and Pratt; 2016, Fundamentals of Biochemistry, Fifth edition, John Wiley and Sons.
6. Lodish et al. 2016, Molecular Cell Biology; Eight edition, WH Freeman.
7. G. M. Cooper and R. E. Hausman; 2015, The Cell: A Molecular Approach; Seventh edition; Oxford University Press.
8. J. Koolman and K. Roehm; 2013, Color Atlas of Biochemistry; Third

edition; Thieme.

9. T. Palmer, B. Philip; 2007, Enzymes; Second Edition, Horwood Publication.
10. J. Jain, N. Jain and S. Jain; 2005, Fundamental of Biochemistry; Sixth edition; S. Chand Publication,
11. G. P. Talwar, L. M. Shrivastav; 2002, Text Book of Biochemistry and Human Biology; Third edition, Prentice hall India Learning Private ltd.
12. A. C. Deb; 2001, Fundamentals of Biochemistry; Seventh edition; New Central Book Agency.

Practical Course – I, BBCP 113

(Lab II - Based on BBCT 111 and BBCT 112) **Credit: - 02**

Course objectives: Student should be able to ...

1. update with techniques and experimental systems required in biochemical research.
2. know the techniques used to study enzymes.
3. update with techniques used to isolate biomolecules.
4. know how to use the instruments.

SEMESTER-I	
BBCP 116, Practical Course-I, (Total Credits 2) (Lab II - Based on BBCT 111 and BBCT 112)	No. of hours (60 hours)
1. Control and Accuracy in Biochemical practical. 2. Preparation of solutions (Normal/ Molar/ Percent). 3. Preparation of stock and working solutions. 4. Volumetric estimation of glycine by formal titration method. 5. Colorimetric estimation of protein by Biuret method. 6. Precipitation of protein by using salt. 7. Precipitation of protein by using its pI value. 8. Qualitative detection of amino acids. 9. Isolation of albumin from egg. 10. Study of effect of temperature on protein 11. Detection of urease activity from bengal gram. 12. Detection of phenol oxidase activity from potato. 13. Isolation of casein from milk. 14. Characterization of casein obtained from milk. 15. Estimation of vitamin-C from biological samples.	60

Course outcomes: Student will be able to ...

1. analyze biomolecules with techniques used in laboratories.
2. examine various biochemical methods to study biomolecules.
3. apply knowledge of instruments for molecular study.
4. identify biomolecules from biological samples.

Reference Books for Practical -

1. Sadashivam and Manikam, 2018, Biochemical methods; Third edition, New age international publisher.
2. David Plummer; 2017, An Introduction to Practical Biochemistry; Third edition, McGraw Hill Education.
3. S. Sawhney, R. Singh; 2015, Introductory practical Biochemistry; First edition, Alpha science international ltd.
4. Rajgopal and Toora; 2014, Practical Biochemistry, Third edition, Ahuja publishing house.
5. Dr. A. C. Deb, 2013, Viva and Practical Biochemistry; First edition, New central book agency (p) ltd,
6. J. Jayraman, 2011, Laboratory Manual in Biochemistry; Second edition, New age international publisher.
7. P.M. Swamy, 2008, Laboratory manual on Biotechnology; First edition, Rastogi publications.
8. S. Harisha; 2008, Biotechnology Procedures and Experiments Handbook; First edition, Laxmi publication.
9. Gyorgy Hegyi et al.; 2014, Introduction to Practical Biochemistry; Second edition, Eotvos Lorand University.
10. G. Sattanathan, S. Padmapriya, B. Balamuralikrishnan; 2020, Practical Manual of Biochemistry; First edition, Skyfox Publishing Group.

SEMESTER II

Course BBCT 121 - Molecules of Life II

Credit: - 02 (30 Hours)

Course objectives: Student should be able to ...

1. learn the biomolecules and their physiological significance.
2. know structure and role of biomolecules.
3. know about chemical and structural details of DNA and RNA.
4. understand the lipid and membrane biochemistry.

SEMESTER-II		No. of hours (30 hours)
BBCT 121 - Molecules of Life II (Total Credits 2)		
Unit I	Carbohydrates I – Monosaccharides A) Definition, aldoses and ketoses, Classification B) Brief account of Monosaccharides: Trioses – Glyceraldehydes, Dihydroxyacetone, Tetroses – Erythroses, Erythrulose, Pentoses – Ribose, Ribulose, Hexoses – Glucose, Fructose C) Hemiacetal and hemiketal ring formation of sugars D) Conformation of sugars – alpha, beta E) Glycosidic bond formation and its significance. F) Derived Monosaccharides: Deoxy sugars (deoxy ribose), sugar-acids (L-ascorbic acid), Amino sugars (glucosamine, galactosamine, Nacetyl glucosamine).	8
Unit II	Carbohydrates II – Di and Polysaccharides A) Disaccharides: Maltose, Lactose, Sucrose - Emphasis must be on nature of linkage, reducing properties and hydrolysis studies with acid and enzymes. B) Polysaccharides: Types, Structure and biological role of Starch, Glycogen, Cellulose. C) Mucopolysaccharides: Hyaluronic acid, Heparin.	7
Unit III	Nucleotides and Nucleic acids A) Definition, types, Distinction between DNA and RNA B) Chemical composition of nucleic acids i) purines ii) pyrimidine iii) phosphate iv) sugars, C) Nucleosides and nucleotides	8

	D) Representation of primary structure of polynucleotide chain E) Watson Crick model of DNA F) Structure and functions of mRNA, rRNA and tRNA.	
Unit IV	Lipids A) Definition, Functions and classification of lipids B) Structure and functions of i) Simple lipids: triglyceride and fatty acids ii) Compound lipids: Phospholipids, viz. lecithin, cephalin iii) Derived lipids: steroids (cholesterol). C) Fatty acids – Occurrence, properties, nomenclature, representation D) Classification of Fatty acids – Even and odd, Size, Saturated and unsaturated. E) Essential and non-essential fatty acids, functions and deficiency of EFA. F) Properties of triacylglycerol – Hydrolysis, Saponification, Rancidity, Iodine number. G) Lipid bilayer and Fluid mosaic model of membrane.	7

Course outcomes: Student will be able to ...

1. recall the biomolecules and their physiological significance.
2. elaborate the structure and role of biomolecules.
3. analyse chemical and structural details of DNA and RNA.
4. explain the lipid and membrane biochemistry.

Reference Books:

1. Jermy M. Berg, Gregory J. Gatto, Justin K. Hines, John L. Tymoczko, Lubert Stryer; 2023, Biochemistry; Tenth edition, Springer Verlag.
2. Albert L. Lehninger, David L. Nelson and Cox; 2021, Lehninger's Principles of Biochemistry, Eighth edition, WH Freeman.
3. U. Satyanarayan; 2017, Biochemistry, Fifth edition, Elsevier India.
4. Watson, 2017, Molecular biology of the gene; Seventh edition, Pearson education.
5. Voet, Voet and Pratt; 2016, Fundamentals of Biochemistry, Fifth edition, John Wiley and Sons.
6. Lodish et al. 2016, Molecular Cell Biology; Eight edition, WH Freeman.
7. G. M. Cooper and R. E. Hausman; 2015, The Cell: A Molecular Approach; Seventh edition; Oxford University Press.
8. J. Koolman and K. Roehm; 2013, Color Atlas of Biochemistry; Third

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9. T. Palmer, B. Philip; 2007, Enzymes; Second edition, Horwood Publication.
10. J. Jain, N. Jain and S. Jain; 2005, Fundamental of Biochemistry; Sixth Edition ; S. Chand Publication,
11. A. C. Deb; 2001, Fundamentals of Biochemistry; Seventh edition; New Central Book Agency.

Course BBCT122 - Metabolism of Biomolecules

Credit: - 02 (30 Hours)

Course objectives: Student should be able to ...

1. understand various biochemical processes and their physiological significance.
2. learn about energy generation pathways in cell.
3. know the structure, function and reaction mechanisms of the molecules.
4. learn about various metabolic pathways.

SEMESTER-II		
Course BBCT122 - Metabolism of Biomolecules (Total Credits 2)		No. of hours (30 hours)
Unit I	Complete Oxidation of Glucose A) Glycolysis silent features and significance B) Aerobic glycolysis - glucose to pyruvate synthesis and its energetic C) Anaerobic glycolysis - glucose to lactate synthesis and its energetic D) Oxidation of pyruvate to acetyl CoA E) PDH complex composition, reaction mechanism, F) TCA cycle – reactions and its energetics G) TCA cycle – significance and amphibolic nature	7
Unit II	Utilization and Synthesis of Carbohydrates A) Overview of carbohydrate metabolism B) Gluconeogenesis C) Significance of Glycogen metabolism D) Glycogenesis E) Glycogenolysis F) Hexose Monophosphate Shunt	8

Unit III	Lipid Metabolism A) β - Oxidation of fatty acid (Palmitic acid): activation of fatty acid, carnitine transport system, β - oxidation cycle, significance, energetic; B) Biosynthesis of fatty acid (Palmitic acid) and significance, C) Structure of Fatty acid synthetase complex (Eukaryotes). D) Ketone bodies synthesis E) Ketone bodies utilization	8
Unit IV	Amino Acid Metabolism A) General reaction of amino acid metabolism B) Transamination C) Deamination D) Decarboxylation E) Urea cycle	7

Course outcomes: Student will be able to ...

1. explain various biochemical processes in glucose metabolism.
2. illustrate energy generation pathways in cell.
3. analyse structure, function and reaction mechanisms of the metabolites.
4. elaborate various metabolic pathways of amino acids.

Reference Books:

1. Jermy M. Berg, Gregory J. Gatto, Justin K. Hines, John L. Tymoczko, Lubert Stryer; 2023, Biochemistry; Tenth edition, Springer Verlag.
2. Albert L. Lehninger, David L. Nelson and Cox; 2021, Lehninger's Principles of Biochemistry, Eighth edition, WH Freeman.
3. U. Satyanarayan; 2017, Biochemistry, Fifth edition, Elsevier India.
4. J. D. Watson et al., 2017, Molecular biology of the gene; Seventh edition, Pearson education.
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6. Lodish et al. 2016, Molecular Cell Biology; Eight edition, WH Freeman.
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11. G. P. Talwar, L. M. Shrivastav; 2002, Text Book of Biochemistry and

Human Biology; Third edition, Prentice hall India Learning Private ltd.
12. A. C. Deb; 2001, Fundamentals of Biochemistry; Seventh edition; New
Central Book Agency.

Practical Course-II, BBCP 123

(Lab V - Based on BBCT 121 and BBCT 122)

Credit: - 02

Course objectives: Student should be able to ...

1. learn techniques and experimental systems required in biochemical research.
2. know techniques used to enzymes study.
3. recall various biochemical methods to study biomolecules.
4. know how to use the instruments.

BBCT 123, Practical Course-II (Total Credits 2) (Lab V - Based on BBCT 121 and BBCT 122)	No. of hours (60 hours)
1. Isolation of starch from potatoes. 2. Characterization of starch obtained from potatoes. 3. Observation of starch granules under microscope. 4. Extraction of lecithin from egg yolk. 5. Study of saponification value of oil. 6. Qualitative analysis of saturated and unsaturated lipids. 7. Qualitative detection of DNA and RNA. 8. Detection of reducing carbohydrate from solution – Glucose 9. Detection of reducing carbohydrate from solution - Fructose 10. Detection of non reducing carbohydrate from solution – Sucrose 11. Detection of non reducing carbohydrate from solution - Starch 12. Osazone test for reducing sugars. 13. Qualitative detection of amylase activity. 14. Detection of normal constituents of urine. 15. Estimation of urea by DAM methods.	60

Course outcomes: Student will be able to

1. analyse saponification value of lipids.
2. identify biomolecules from samples.
3. apply techniques used to isolate biomolecules.

4. apply knowledge of instruments biochemical research.

Reference Books for Practicals:

1. Sadashivam and Manikam, 2018, Biochemical methods; Third edition, New age international publisher.
2. David Plummer; 2017, An Introduction to Practical Biochemistry; Third edition, McGraw Hill Education.
3. S. Sawhney, R. Singh; 2015, Introductory practical Biochemistry; First edition, Alpha science international ltd.
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7. P.M. Swamy, 2008, Laboratory manual on Biotechnology; First edition, Rastogi publications.
8. S. Harisha; 2008, Biotechnology Procedures and Experiments Handbook; First edition, Laxmi publication.
9. Gyorgy Hegyi et al.; 2014, Introduction to Practical Biochemistry; Second edition, Eotvos Lorand University.
10. G. Sattanathan, S. Padmapriya, B. Balamuralikrishnan; 2020, Practical Manual of Biochemistry; First edition, Skyfox Publishing Group.

Guntakar