

**VANITA VISHRAM WOMEN'S UNIVERSITY**  
**SCHOOL OF SCIENCE AND TECHNOLOGY**  
**DEPARTMENT OF BIOTECHNOLOGY**



**BACHELOR OF SCIENCE (B.Sc.) IN BIOTECHNOLOGY**  
**For Undergraduate (UG) Education**

**SEMESTER - 3**  
**Core Courses (CC)**

**Syllabus applicable to the students seeking admission in the  
following Program**

**B.Sc. Biotechnology w.e.f. the Academic Year 2022-23**

# BACHELOR OF SCIENCE (B.SC.) BIOTECHNOLOGY

## SEMESTER 3

### CORE COURSE PAPER

#### BIOCHEMISTRY-II

##### Course Objectives:

- To introduce students about metabolic pathways of biomolecules ranging from carbohydrates to nucleic acid.
- To make the students understand the chemical processes that takes place inside the cells of living organisms which are necessary to maintain life.
- To make the students aware about the disorders associated with abnormal metabolism.

##### Course Outcome:

Upon completion of the course, the student shall be able to comprehend

- How the biomolecules synthesized and utilized in living cells in order to maintain life.
- How the set of enzymes are involved in the metabolism of biomolecules.
- How the abnormal metabolism of biomolecules leads to abnormal metabolism.

#### BT11350 - THEORY COURSE CONTENT

(2 Credits)

BT11350 - THEORY COURSE CONTENT (2 Credits)		
UNIT1	<b>Carbohydrate Metabolism</b> <ul style="list-style-type: none"><li>• Introduction to Metabolism: Types (Anabolism, catabolism), Integration of metabolism.</li><li>• Gibb's free energy and redox potential</li><li>• ATP and reducing powers</li><li>• Oxidative Phosphorylation</li><li>• Electron Transport Chain</li><li>• Glycolysis</li><li>• Pentose phosphate pathway</li><li>• Citric acid cycle</li><li>• Gluconeogenesis</li></ul>	7 lectures

UNIT2	<p><b>Nucleic acid metabolism</b></p> <ul style="list-style-type: none"> <li>• Purine metabolism: Purine biosynthesis - Denovo pathway &amp; Salvage pathway, catabolism of purine nucleotides.</li> <li>• Pyrimidine metabolism: Pyrimidine biosynthesis – Denovo pathway, catabolism of Pyrimidine nucleotides.</li> </ul>	8 lectures
UNIT3	<p><b>Protein Metabolism</b></p> <ul style="list-style-type: none"> <li>• Introduction to protein metabolism - Transamination and deamination. Metabolism of aromatic amino acids (Phenyl alanine, tyrosine &amp; tryptophan).</li> <li>• Metabolism of sulphur-containing amino acids (cysteine, cystine &amp; methionine)</li> <li>• Metabolism of glycine, lysine, serine, glutamine, histidine.</li> </ul>	8 lectures
UNIT4	<p><b>Lipid Metabolism</b></p> <ul style="list-style-type: none"> <li>• Introduction to lipid metabolism. Fatty acid biosynthesis: synthesis of palmitic acid, Fatty acid synthase complex and its significance.</li> <li>• Synthesis of triacylglycerol and glycerophospholipids.</li> <li>• Metabolism of cholesterol. <math>\beta</math> Oxidation of Fatty acids &amp; <math>\alpha</math> Oxidation of Fatty acids.</li> <li>• Metabolism of ketone bodies &amp; regulation Lipoprotein metabolism.</li> </ul>	7 lectures

### SUGGESTED READING

1. Naik, P., 2011. Essentials of Biochemistry (for Medical Students). JP Medical Ltd.
2. Satyanarayana, U., 2013. Biochemistry. Elsevier Health Sciences.
3. Lehninger principles of biochemistry, ; by David L. Nelson and Michael M. Cox.
4. Kogut, M., 1975. Biochemistry: by Lubert Stryer WH Freeman and Company; San Francisco,
5. Murray, K., Rodwell, V., Bender, D., Botham, K.M., Weil, P.A. and Kennelly, P.J., 2009. Harper's illustrated biochemistry. 28. Citeseer, New York, United States.
6. JAIN, J., JAIN, S., JAIN, N., NAGAR, R., DELHI, N. and JAIN, L.S.H.N., epdf. pub\_fundamentals-of-biochemistry.

**BACHELOR OF SCIENCE (B.SC.) BIOTECHNOLOGY**  
**SEMESTER 3**  
**CORE COURSE PAPER**

**ENVIRONMENTAL BIOTECHNOLOGY**

**Course Objectives:**

- The objective of this course is to learn about the about assessment and management of Environmental Pollutions, solid and sewage waste treatment methods and application, Biodegradation and bioremediation and their practical approaches, Applications of Environmental Biotechnology like Bio-resources, Utilization of sewage and Agro-waste, Bioleaching, Biomining, Restoration of land, etc.
- The related experiments will help students to understand how immunologists think and work..

**Course Outcome:**

Upon completion of the course, the student shall be able to comprehend

- The types of pollutions, their assessment and management through biotechnological approaches and have knowledge to apply these techniques in real life problems.
- The types and various treatment methods for solid and sewage wastes.
- Acquire knowledge about Biodegradation of various compounds like halogenated, pesticides, herbicides, etc. Have knowledge about types of Bioremediations, methods and application as well as phytoremediation approaches will be acquired.
- The information of various Applications in Environmental Biotechnology, which can be useful for practical aspects.

**BT11360 - THEORY COURSE CONTENT**  
**(2 Credits)**

<b>UNIT1</b>	<p><b>Liquid waste management using living system</b></p> <ul style="list-style-type: none"> <li>• Types of liquid waste</li> <li>• Sources and characterization of waste water</li> <li>• Analysis of waste water</li> <li>• Treatment of waste water (Use of Microbial enzymatic techniques)</li> </ul>	7 lectures
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	<ul style="list-style-type: none"> <li>Waste water treatment at industrial level: Dairy, Sugar and Pharma</li> </ul>	
UNIT2	<p><b>Sludge and solid waste treatment and disposal</b></p> <ul style="list-style-type: none"> <li>Sources and characteristics of sludge</li> <li>Methods of sludge treatment and disposal: Preliminary operations, Sludge thickening, Stabilization, Conditioning, Disinfection, Dewatering, Heat drying, Ultimate disposal</li> <li>Septage and septage disposal</li> <li>Treatment and disposal of solid waste: incineration and landfilling</li> </ul>	8 lectures
UNIT3	<p><b>Biodegradation and Bioremediation</b></p> <ul style="list-style-type: none"> <li>Biodegradation of xenobiotic compounds</li> <li>Characteristics, Types, Hazards and General features of recalcitrant xenobiotic compounds</li> <li>Hydrocarbon degradation</li> <li>Biodegradation of halogenated compounds</li> <li>Biodegradation of pesticides and herbicides</li> <li>Use of mixed microbial population</li> <li>Practical approach</li> </ul>	8 lectures
UNIT4	<p><b>Applications of Environmental Biotechnology</b></p> <ul style="list-style-type: none"> <li>Bioenergy and Bio-resources</li> <li>Useful features, undesirable features of biofuels and area to focus for future research</li> <li>Bioremediation (in situ and ex-situ)</li> <li>Energy crops</li> <li>Modes of utilization of Biomass</li> <li>Biogas</li> <li>Biodiesel</li> <li>Microbial leaching: Bioleaching and Biomining</li> </ul>	7 lectures

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| <ul style="list-style-type: none"><li>• Restoration of degraded lands: biotechnological approaches</li><li>• Utilization of sewage and Agro-waste</li><li>• SCP production</li><li>• Mushroom production on agro-waste</li><li>• Vermicomposting</li></ul> |  |
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### **SUGGESTED READING**

1. Maier, R.M., Pepper, I.L. and Gerba, C.P., 2009. Introduction to environmental microbiology. In Environmental Microbiology (pp. 3-7). Academic Press.
2. Satyanarayana, U., 2013. Biochemistry. Elsevier Health Sciences.
3. Dubey, R.C., 1993. A textbook of Biotechnology. S. Chand Publishing.
4. Dubey, R.C., 2014. Advanced biotechnology. S. Chand Publishing.
5. Gupta, P.K., 1994. Elements of biotechnology. Rastogi Publications.

**BACHELOR OF SCIENCE (B.SC.) BIOTECHNOLOGY**  
**SEMESTER 3**  
**CORE COURSE PAPER**

**ENZYMOLGY**

**Course Objectives:**

- Enzymology is a requisite discipline which plays central role for many, such as biochemistry, genetic engineering, industrial biotechnology, clinical diagnostics as it is regulating all metabolic reactions, central dogmas of biology.
- Enzymology has so many applications in diverse areas like industries, genetic manipulation to get better life, forensic science which make it a favorite area of scientific exploration.

**Course Outcome:**

After this course, students will be having knowhow of

- The catalysts and enzymes; their working patterns. Mode of actions, inhibition, kinetics etc.
- Regulation of Enzyme activity.
- Strategies for extraction and purification of enzymes.
- Applications of enzymes.

**BT11370 - THEORY COURSE CONTENT**  
**(2 Credits)**

<b>UNIT1</b>	<p><b>Enzymes</b></p> <ul style="list-style-type: none"> <li>• History</li> <li>• Chemical nature and properties of enzymes: Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric &amp; oligomeric enzymes, zymogen or proenzyme, isoenzyme, Allosteric enzyme</li> <li>• Enzyme specificity</li> <li>• Nomenclature and classification of Enzymes.</li> <li>• Working of enzymes: Activation energy and transition state, enzyme activity, specific activity, Active site (common features of active sites)</li> </ul>	7 lectures
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	<ul style="list-style-type: none"> <li>• Introduction of lock and key model of enzyme</li> <li>• Enzyme kinetics: Michaelis-Menten equation and its derivation; Different plots for the determination of <math>K_m</math> and <math>V_{max}</math> and their physiological significance</li> <li>• Factors affecting Enzyme Activity</li> </ul>	
UNIT2	<p><b>Mechanisms and inhibition of enzymes</b></p> <ul style="list-style-type: none"> <li>• Enzyme inhibition: types of inhibition, suicide inhibitor.</li> <li>• Non protein enzymes</li> <li>• Other enzyme regulation techniques</li> <li>• Units of enzyme activity</li> </ul>	8 lectures
UNIT3	<p><b>Extraction and Purification of Enzymes</b></p> <ul style="list-style-type: none"> <li>• Factors affecting isolation of enzyme/ source selection of enzyme</li> <li>• Sources for enzyme production (Plant, animals and microbes)</li> <li>• Extraction of soluble, membrane bound enzymes (intracellular and extracellular enzymes)</li> </ul>	8 lectures
UNIT4	<p><b>Applications of enzyme</b></p> <ul style="list-style-type: none"> <li>• Purification of enzymes: preliminary and advanced methods</li> <li>• Clinical significance of enzymes/biological roles of enzymes</li> <li>• Advantages of enzyme</li> </ul>	7 lectures

### SUGGESTED READING

1. Larkins, J.A.M., Mosse, J. and Chapman, B., 2011, August. Is the evolution of biochemistry texts decreasing fitness? A case study of pedagogical error in bioenergetics. In Proceedings of The Australian Conference on Science and Mathematics Education.
2. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W., 2003. Illustrated Biochemistry.
3. Voet, D. and Voet, J.G., 2021. Biochemistry. John Wiley & Sons.
4. Campbell, M.K., Farrell, S.O. and McDougal, O.M., 2016. Biochemistry. Cengage Learning.
5. Price, N.C. and Stevens, L., 1999. The cell and molecular biology of catalytic proteins. In Fundamentals of Enzymology (pp. 118-153). Oxford University Press New York.



6. Cornish-Bowden, A., 2013. Fundamentals of enzyme kinetics. John Wiley & Sons.
7. Bisswanger, H., 2019. Practical enzymology. John Wiley & Sons.
8. Walters, D.E., 2000. The Organic Chemistry of Enzyme-Catalyzed Reactions By Richard B. Silverman. Academic Press, San Diego, CA. 2000. xvii+ 717 pp. ISBN 0-12-643745-9. \$89.95.

**BACHELOR OF SCIENCE (B.SC.) BIOTECHNOLOGY**  
**SEMESTER 3**  
**CORE COURSE PAPER**

**BIOTECHNOLOGY PRACTICAL III**

**Course Objectives:**

- To teach students various biochemical determination.
- To teach students various Environmental Biotechnology techniques.
- To teach students various enzyme activity related aspects.

**Course Outcome:**

Upon completion of the course, the student shall be able to

- Determine various biomolecules.
- Perform quality analysis of environmental samples.
- Determine various parameters of enzyme activities.

**BT11380 - PRACTICAL COURSE CONTENT**

**(2 Credits)**

1.	Estimation of blood glucose by oxidase method.
2.	Study of sampling technique and sample preservation. <ul style="list-style-type: none"> <li>• Collection of grab and composite sample.</li> </ul>
3.	Physical analysis of sewage/industrial effluent by measuring <ul style="list-style-type: none"> <li>• Acidity, Alkalinity</li> <li>• Hardness</li> <li>• Residual chlorine</li> </ul>
4.	To estimate total solids (TS), total dissolved solids (TDS) and suspended solids (SS) in the given water sample.
5.	To estimate dissolved oxygen (DO) content of wastewater by chemically modified winkler method of wastewater
6.	Determination of indices of pollution by measuring BOD & COD of different effluents
7.	Bacteriological analysis of water for determination of potability

	<ul style="list-style-type: none"> <li>• Standard plate count</li> <li>• Enumeration of coliforms by MPN technique (membrane filter action method for bacteriological analysis of fecal <i>streptococci</i>)</li> </ul>
8.	Study of air micro flora by settling plate technique
9.	To set up soil ecosystem using a Winogradsky column
10.	Visit to Biogas production plant/Biofuel (Ethanol) production plant/Vermicompost site, Biotech park, savli, BARC vadodra
11.	To determine Alkaline phosphatase enzyme activity from sprouted mung bean.
12.	To study effect of temperature on alkaline phosphatase enzyme activity.
13.	To study effect of pH on alkaline phosphatase enzyme activity.
14.	To study kinetics ( $K_m$ and $V_{max}$ ) of alkaline phosphatase enzyme.

### SUGGESTED READING

1. Singh, R., 2000. Introductory practical biochemistry. Alpha Science Int'l Ltd..
2. Jayaraman, J. and Jayaraman, J., 1981. Laboratory manual in biochemistry (pp. 75-76). Delhi, India:: Wiley Eastern.
3. Experimental Microbiology, by Rakesh J. Patel and Kiran R, Patel. Published by Aditya, Ahmedabad, Gajarat.
4. K.R. Aneja

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**BACHELOR OF SCIENCE (B.Sc.) IN BIOTECHNOLOGY**  
**For Undergraduate (UG) Education**

**SEMESTER - 3**  
**Skill Enhancement Course (SEC)**

**Syllabus applicable to the students seeking admission in the  
following Program**

**B.Sc. Biotechnology w.e.f. the Academic Year 2022-23**

**BACHELOR OF SCIENCE (B.SC.) BIOTECHNOLOGY**  
**SEMESTER 3**  
**SKILL ENHANCEMENT COURSE**

**BIOMATHEMATICS AND BIOSTATISTICS**

**Course Objectives:**

- The objective is to impart fundamental knowledge about Biomathematics and Biostatistics enhance their skill in scientific calculations which is helpful in research as well as analysis which will support scientific prediction and interpretation. It acquired adequate knowledge & necessary skills about different types of samples, its management as well as Data interpretation.

**Course Outcome:**

- Students will gain basic knowledge about scientific terminology with its calculating formula.
- They will also familiar with math and statistics for biological data which will help them for optimum analysis.

**BT15030 - THEORY COURSE CONTENT**  
**(2 Credits)**

UNIT1	<p><b>Aqueous solutions</b></p> <ul style="list-style-type: none"> <li>• Solutions: Definitions and Types</li> <li>• Solution preparation: Concentrations of solutions based on Volume, Weight &amp; Degree of saturation: Mole concept: Methods to calculate mole, Molarity, Molality, Normality, Formality, Mass concentration, Solutions of acids Basic rules for the preparation of solution</li> </ul>	7 lectures
UNIT2	<p><b>Acid Base Chemistry</b></p> <ul style="list-style-type: none"> <li>• Equilibrium constants</li> <li>• Acid and bases: Concept of Acid, Base and pH, pH Scale</li> <li>• Ionization of water, pH &amp; pOH, Ionization of weak acids and weak bases, Relationship between <math>K_a</math> and <math>K_b</math> for weak acids and bases, pH of solutions of weak acids, Hydrolysis of salts of weak acids and bases, Henderson-Hasselbalch equation</li> </ul>	8 lectures

	<ul style="list-style-type: none"> <li>• Buffer: buffer system, resistance of pH using buffer</li> <li>• Criteria for the selection of buffers</li> <li>• Preparation of different buffers</li> </ul>	
UNIT3	<p><b>Introduction and Basic methods of Biostatistics</b></p> <ul style="list-style-type: none"> <li>• Define: Biostatistics, Application of Biostatistics,</li> <li>• Sampling techniques, Data collection and presentation: types of data,</li> <li>• Methods of collection of primary and secondary data,</li> <li>• methods of data collection, graphical representation by histogram, polygon, ogive curves and pie diagram.</li> </ul>	8 lectures
UNIT4	<p><b>Basics of Central tendency and dispersion</b></p> <ul style="list-style-type: none"> <li>• Skewness and kurtosis (Population and samples)</li> <li>• Measure of central Tendency: Mean, Mode, Median</li> <li>• Measures of Dispersion: Mean Deviation, Standard Deviation</li> <li>• Quartile deviation, Decile deviation, Percentile deviation.</li> <li>• Population Variance, coefficient of variation Standard error of mean.</li> </ul>	7 lectures

### SUGGESTED READING

1. S. K. Sawhney, Randhir Singh, Introductory Practical Biochemistry, Narosa Publishers.
2. Irwin H. Segel, Biochemical calculations, 2<sup>nd</sup> Edition, John Wiley & Sons
3. Khan, I.A., Khanum, A. and Khan, S., 2004. Fundamentals of biostatistics. Ukaaz.
4. Rastogi, V.B., 2009. Fundamentals Of Biostatistics 2<sup>nd</sup> Ed. ANE Books Pvt Ltd.