

Sant Gadge Baba Amravati University, Amravati

Faculty: Science and Technology

Programme: B.Sc. (Bio-chemistry)

POs:

Students of undergraduate general degree programme at the time of graduation would be able to

PO1.Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2.Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO7. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

PSOs:

Upon completion of the programme successfully, Student would be able to -

1. Understand structure, energy value and function of Biomolecules.
2. Prepare buffers of different pH, can perform chromatography of plant pigments and separate biomolecules by electrophoresis, perform structural analysis of substances using NMR and ESR.
3. Apply knowledge of biomolecule metabolism to diagnose various diseases and their root causes.
4. Formulate and design various biomedical enzyme-based marker kits and apply in winery, leather, dairy and detergent industry.
5. Analyse unknown DNA samples using molecular biology techniques and perform plant tissue culture of medicinally important endangered plant species.
6. Interpret reason of abnormal blood reports, probable cause and effects on human health.

Employability Potential of the Programme:

Biochemistry is the branch of science which deals with study of chemistry of living organisms. Biochemistry focuses on processes happening at molecular level. It focuses on what happening inside our cells, studying components like proteins, lipids, carbohydrates, nucleic acid, vitamins and hormones. The cumulative demand for trained and skilled manpower in the area of Biochemistry requires in depth functional knowledge of modern biology through hands-on training to the students.

The degree of Bachelor of Science in Biochemistry (Choice Based Credit System) aims to introduce various aspects of Biochemistry and interdisciplinary subjects to the students. The program in Biochemistry as one of the core subjects is designed to cultivate a scientific attitude and interest towards the modern areas of Biochemistry in particular and life science in general. This will help the students to become critical and curious in their outlook.

The courses are designed to impart the essential basics in Biochemistry at the initial level of graduation. The basic courses are infused with application in modern life sciences, and awareness on Biochemistry and its influence in human life. The integration of various courses in the program is aimed to develop proficiency in the theory as well as practical experiments, common equipment, laboratory, along with the collection and interpretation and presentation of scientific data in proper manner.

Beside this, the students will be equipped with knowledge in the newer areas of Biochemistry and its application in medical science, agriculture, industry, proteomics, genomics, metabolomics, bioinformatics, nano-biotechnology etc. This will create awareness about Biochemistry and contribution of Biochemistry among the society. At the end of the course, the students are expected to have good working knowledge in the field of Bio-chemistry and in addition knowledge gained from courses of interdisciplinary in nature.

Students will surely have an urge to continue higher studies in Biochemistry and contribute significantly in the development. The present syllabus is restructured anticipating the future needs of Biochemistry with more emphasis on imparting hands-on skills. The main thrust is laid on making syllabus compatible with developments in Education, Research and Industrial sectors. The Theory and Practical course in new restructured course will lead to impart skill-set essentials to further Biochemistry.

Biochemistry is the molecular basis of life. Degree program in Biochemistry teaches students how inanimate, lifeless chemicals combine to produce a functional living organism. A significant attraction of the course is the ability to combine in-depth scientific knowledge with practical laboratory skills and the career opportunity in all sectors. After successful completion of three years degree course in Biochemistry, student will be well versed with laboratory skills and transferable skills.

Laboratory Skills:

Students are trained in

- Laboratory safety practices
- Accurate weighing and reagent preparation
- Skillful handling of basic and advanced instruments
- Calibration of basic instruments like pH meter, micropipettes etc
- Advanced techniques like:
 1. Chromatography
 2. Electrophoresis.
 3. Spectrometry
 4. Polymerase Chain Reaction (PCR)
 5. Plant Tissue Culture

6. Animal Tissue Culture

- Logical thinking
- Analysis and interpretation of results
- Collection, organization and presentation of data

Transferable Skills:

During the course student will develop skills other than laboratory skills that are transferable across the number of career areas. These are:

- Analytical skill
- Report writing skill
- Presentation skill
- Time management
- Creative thinking
- Problem solving
- Planning
- Observational skill

Job Opportunities: After successful completion of B.Sc. in Biochemistry, student may continue further studies like M.Sc. in Biochemistry and then Ph.D. in Biochemistry and make career in research field. Students have opportunities in private as well as public sectors.

Private Sector: Biochemist can work in quality control, quality assurance and R & D divisions of companies like- Biotech companies, Pharmaceutical companies, Chemical manufacturing companies, Food and Drink (includes brewing), Health and Beauty Care, Medical Instrument companies, Agricultural companies, Research Companies and Laboratories etc.

Public Sectors: Blood Service, Cancer research institutes, Environmental Pollution Control, Forensic Science, Hospitals, National Blood Services, Overseas Development, Public Health Entities, Public Health Laboratories, Agriculture and fisheries etc.

Government Sector: Syllabus has been design keeping in view that students can apply for various government post filled by Maharashtra Public Service Commission (MPSC), Union Public Service Commission (UPSC), Food Corporation of India, Forensic department, Health department and Food and Drug Administration. These departments recruit successful candidates for the post of Food safety officers in food and drug administration, Assistant Chemical Analyzers in forensic laboratories of Maharashtra and other states all over India, Laboratory

Technicians in Clinical pathology laboratories Health department and Food Corporation of India, Sanitary inspectors for schools etc.

Job profiles: Biochemist, Biologist, Biomedical Scientist, Biotechnologist, Chemical Examiners, Chemist, Clinical Scientist, Food Scientist, Forensic Scientist, Laboratory Technician, Microbiologist, Research Associates, Research Officers, and Research Scientist etc.

Thus syllabus has been prepared anticipating the requirements of B.Sc. Biochemistry students under CBCS Program. The contents have been drawn to accommodate the widening horizons of the Biochemistry discipline and reflect the changing needs of the students.

Hence, Board of Studies in Biochemistry (Including Microbiology and Food Science) in its meeting held on **10 / 07 /2023** resolved to accept the revised syllabus for **B. Sc. Part II Semester III and IV (Bio-chemistry)** based on Choice Based Credit System (CBCS) as per UGC guidelines. The detailed syllabus for each paper is appended with a list of suggested readings.

Sant Gadge Baba Amravati University Amravati
Scheme of teaching, learning & Examination leading to the Degree Bachelors of Science (Choice Based Credit System) (Three Years Six Semesters Degree Programme- C.B.C.S)

(B.Sc. Part-II) (Semester-III) BIOCHEMISTRY

Sr .N o.	Subjects	Subject Code	Teaching & Learning Scheme							Duration of Exams Hrs.	Examination and Evaluation Scheme						
			Teaching Period Per week				Credits				Maximum Marks				Minimum Passing		
			L	T	P	Total	Theory	Practical	Total		Theory + MCQ External	Skill Enhancement module Internal	Practical		Total Marks	Marks	Grade
1	BCM (3S) Intermediary metabolism (Theory)	BCM (3S)T	6			6	4.5		4.5	3 hours	80	20	Internal	External	100	40	p
2	BCM (3S) Practical	BCM (3S) Pr			6	6		2.25	2.25	3 Hours			25	25	50	25	p
3	Total		6		6	12	4.5	2.25	6.75	6 hours	80	20	25	25	150	65	P

Syllabus Prescribed for 2023-2024 UG Programme

Programme: UG in Biochemistry

Semester-III

Code of the Course /Subject	Title of the Course/Subject	Total Number of Periods
BCM-(3S)T	Intermediary Metabolism	90

Cos

After completion of the course, students shall be capable of:

- Explain the metabolism of carbohydrates
- Compare and contrast aspects of lipid metabolism
- Discuss the important biochemical steps in the metabolism of amino acids
- Discuss the important biochemical steps in the metabolism of nucleotide and porphyrin
- Students will be exposed with the fact that perturbations in the carbon metabolism can lead to various disorders such as diabetes and cancer.

COURSE MODULE	UNIT	CONTENT
DSC	Unit-I Carbohydrate Metabolism	a. Glycolysis and its regulation, Gluconeogenesis and its significance, TCA Cycle and its regulation, Amphibolic nature of TCA Cycle. b. HMP pathway and its significance, Glycogen synthesis in liver and muscles, Glycogenolysis, Hormonal regulation of glycogen metabolism, Glyoxalate bypass. c. Mitochondrial ETC, Oxidative phosphorylation. (15 Periods)
	Unit-II Fatty acid metabolism	a. Hydrolysis and biosynthesis of triacylglycerols, transport of fatty acid into mitochondria.

		<p>b. β- Oxidation of saturated and unsaturated fatty acids, ATP yields from fatty acids, biosynthesis of saturated and unsaturated fatty acids.</p> <p>c. Production and utilization of Ketone bodies. (15 Periods)</p>
	<p>Unit-III Membrane lipid and lipoproteins Metabolism</p>	<p>a. Biosynthesis of Phospholipids (Glycerophospholipid)- Phosphatidate, Lecithin, Cephalin , Phosphatidyl inositol and cardiolipin .</p> <p>b. Biosynthesis of sphingolipids (Ceramide, cerebroside, Sphingomyelin), Cholesterol biosynthesis and its regulation.</p> <p>c. Plasma Lipoproteins and its metabolic roles: Chylomicrons, VLDLs, LDLs, HDLs. (15 Periods)</p>
	<p>Unit-IV Amino acid Metabolism</p>	<p>a. General reactions of amino acid metabolism such as transamination, oxidation deamination and decarboxylation.</p> <p>b. Urea cycle and its regulation.</p> <p>c. Degradation and biosynthesis of amino acids Glycine, Serine, Cysteine, Methionine, Phenylalanine and Tyrosine. (15 Periods)</p>
	<p>Unit-V Nucleotide and Porphyrin Metabolism</p>	<p>a. Sources of atoms in purines and pyrimidine molecules. Salvage and denovo pathway of biosynthesis of purines and pyrimidines, Catabolism of Purines and Pyrimidines.</p> <p>b. Regulation of purines and pyrimidine biosynthesis. Biosynthesis of deoxy ribonucleotides , ribonucleotides and thymidylate synthesis .</p> <p>c. Biosynthesis and degradation of porphyrins (15 Periods)</p>
SEM	<p>Major Metabolic Diseases/Disorders</p>	<p>a. Hyperuricemia & gout: Normal range of uric acid in serum Causes of hyperuricemia, estimation of serum uric acid Gout: primary and secondary gout, treatment of gout, estimation of serum uric acid.</p> <p>b. Hypercholesterolemia: Normal range of serum cholesterol, Causes, and control of hypercholesterolemia, Diagnosis (Lipid profile) : Estimation of serum Cholesterol, CPK, Triglycerides, LDL-Cholesterol and HDL-Cholesterol, Overview of Atherosclerosis</p>

		<p>c. Hyperglycemia and Diabetes mellitus: Overview of glucose homeostasis, Definition of Diabetes, overview of classification and causes of Diabetes, Diagnosis of Diabetes: Glucose tolerance test, estimation of fasting and post meal blood glucose level, Treatment of Diabetes, Metabolic complications of Diabetes, Management of diabetes.</p> <p>d. Phenylketonuria: Introduction, inheritance pattern, effect on central nervous system and skin pigmentation, diagnosis.</p> <p style="text-align: right;">(15 Periods)</p>
		<p>COs</p> <p>By the end of this module, the students will be able to:</p> <ol style="list-style-type: none"> 1. Explain Causes and features of Important metabolic diseases/syndrome. 2. Explain diagnosis and treatment of important metabolic diseases/ disorder . 3. Communicate and discuss how errors in metabolic process lead to development of various diseases.
**Activities for SEM :	<ol style="list-style-type: none"> 1. Class test (10M) 2. Assignment (5M) 3. Visit to Clinical Laboratory/Group discussion /Seminars and projects/Any innovative activity (5M). 	

Syllabus Prescribed for 2023-2024 UG Programme

Programme: UG in Biochemistry

Semester-III

Code of the Course /Subject	Title of the Course/Subject	Total Number of Periods
BCM-(3S)Pr	BCM-(3S)Practical	06 / per week /per batch

COs

Upon completion of the course, the student would be able to:

1. Perform quantitative analysis of glucose, amino acid, proteins, cholesterol, Uric acid, Inorganic phosphate etc.
2. Isolate glycogen from liver.

Practical: 3S Biochemistry

List of Practical/Laboratory Experiments/Activities etc.

- 1) Estimation of blood glucose by GOD/POD Method.
- 2) Isolations of glycogen from liver and estimation by GOD/POD method.
- 4) Estimation of amino acid by ninhydrin method
- 5) Estimation of Serum cholesterol
- 6) Estimation of Serum uric acid
- 7) Estimation of protein by Bradford method.
- 8) Colorimetric estimation of inorganic phosphate in serum by Fiske-Subbarow method.
- 9) Demonstration of urease activity on urea.

The distribution of marks for the practical examination shall be as follows:

External Examination		Internal Examination	
Performance of any two experiments	20 marks	Attendance & students performance	10 Marks
Viva-voce	05 marks	Practical Record book	10 Marks
		MCQ/ Objective test	05 Marks
Total	25 Marks	Total	25 Marks

Course Material/Learning Resources

- 1) Text Book of Biochemistry by Dr. O. P. Agrawal.
- 2) Text book of Biochemistry (Intermediary metabolism) by A.B. Patil and S. M.Patil (Nabh Prakashan)
- 3) Essentials of Biochemistry by Dr. M. C. Pant.
- 4) Text book of Biochemistry by West and Todd.
- 5) Practical manual in Biochemistry by Jairaman.
- 6) Text book of Biochemistry by Sucheta Dandekar.
- 7) Text book of Biochemistry by U. Sattyanarayan
- 8) Fundamentals of Biochemistry by J. L. Jain
- 9) Lehninger, A I., (1982), Principles of Biochemistry, Butterworth Publishers, New York
- 10) Fundamentals of Biochemistry (1999) by Donald Voet, Judith Voet, Charlotte Pratt, John Wiley & Sons, N.Y. 145 146
- 11) Biochemistry 3rd edition (1994) by Lubert Stryer WH Freeman and Co. San Francisco.
- 12) An Introduction to Practical Biochemistry by David T Plummer
- 13) Metabolism by Ravi L.Dabhade and Dr.Pooja Rana ,Nirali Prakashan

Sant Gadge Baba Amravati University Amravati

Scheme of teaching, learning & Examination leading to the Degree Bachelors of Science (Choice Based Credit System) (Three Years Six Semesters Degree Programme- C.B.C.S)

(B.Sc. Part-II) (Semester-IV) BIOCHEMISTRY

Sr .N o.	Subjects	Subject Code	Teaching & Learning Scheme							Duration of Exams Hrs.	Examination and Evaluation Scheme						
			Teaching Period Per week				Credits				Maximum Marks				Minimum Passing		
			L	T	P	Total	Theory	Practical	Total		Theory + MCQ External	Skill Enhancement module Internal	Practical		Total Marks	Marks	Grade
1	BCM (4S) Enzymology (Theory)	BCM (4S)T	6			6	4.5		4.5	3 hours	80	20	Internal	External	100	40	p
2	BCM (4S) Practical	BCM (4S) Pr			6	6		2.25	2.25	3 Hours			25	25	50	25	p
3	Total		6		6	12	4.5	2.25	6.75	6 hours	80	20	25	25	150	65	P

Syllabus Prescribed for 2023-2024 UG Programme

Programme: UG in Biochemistry

Semester-IV

Code of the Course /Subject	Title of the Course/Subject	Total Number of Periods
BCM-(4S) T	Enzymology	90

COs

After the completion of this course, the student will be able to:

- Describe nomenclature and classification of enzymes and coenzymes.
- Apply knowledge on enzyme kinetics for laboratory and research purpose.
- Predict the type of enzyme inhibition from kinetic data.
- Apply the knowledge on isolation and purification of enzymes for practical purpose
- Describe the major applications of enzymes in industry and medicine.

COURSE MODULE	UNIT	CONTENT
DSC	Unit-I Basic enzymology	a. General characteristics, nomenclature, IUB classification of enzymes. b. Holoenzymes, apoenzymes, coenzymes, cofactors, activators, inhibitors, active site, metalloenzyme, marker enzyme, monomeric and oligomeric enzymes. c. Unit of enzyme activity, isoenzyme, multienzyme complexes, enzyme specificity. (15 Periods)
	Unit-II Enzyme kinetics & Enzyme Inhibition	a. Significance of energy of activation and free energy, Derivation of Michalis Menton equation for unisubstrate reaction, Km and its significance, Line Weaver Burk plot and its limitation. b. Factors affecting enzyme activity Substrate concentration, enzyme conc., pH, temperature, Bisubstrate reactions- sequential and ping- pong mechanism with examples.

		c. Reversible and irreversible inhibition, competitive, noncompetitive and uncompetitive inhibition (15 Periods)
	Unit-III Coenzymes & Cofactors	a. Allosteric enzymes: Characteristics and models of allosteric enzyme regulation . b. Role of coenzymes in enzyme catalysis- NAD/NADP, FAD/FMN, Coenzyme- Q, Biotin, Cobamide, Lipoamide, TPP, THF, Pyridoxal phosphate. c. Role of cofactors/metal ions in enzyme catalysis: Metalloenzymes and metal activated enzymes, role of metal as structural element during enzyme catalysis, role of metal ions in oxidation reduction reactions. (15 Periods)
	Unit-IV Mechanism of enzyme Action	a. Acid-base catalysis, covalent catalysis, Mechanism of action of chymotrypsin and carboxypeptidase. b. Proximity and orientation effect, strain and distortion effect. c. Mechanism of action- Lock and Key hypothesis Induced fit model. (15 Periods)
	Unit-V Application of Enzymes	a. Enzyme immobilization and their applications. b. Application of enzyme in food industry: Enzyme in milk processing and cheese production, tenderization of meat, baking industry, Use of enzymes in detergents and leather industry, Enzymes used in Fermentation c. Medical applications of enzymes : 1. In treatment of diseases such as leukemia, skin cancer, blood clots, cyanide poisoning etc . 2. In diagnosis of diseases such as hepatic disorder, heart related disorder, bone disorder, pancreatic disorder etc. (15 Periods)
SEM	Extraction and purification of enzymes	a. Methods for isolation of crude enzyme from plant, animal and microbial sources. b. Methods of characterization of enzymes; development of enzymatic assays

		<p>c. Precipitation of enzymes by organic solvents such as acetone, ethanol etc or by neutral salt like ammonium sulfate , dialysis, purification of enzymes using chromatography techniques such as ion exchange chromatography, gel filtration chromatography , affinity chromatography etc. (15 Periods)</p>
	<p>COs: By the end of this module, the students will be able to:</p> <ol style="list-style-type: none"> 1. Extract enzyme from plant, animal and microbial sources. 2. Design and perform Enzyme Assay 3. Purify enzyme by using techniques such as precipitation, dialysis, Chromatography etc. 	
	<p>**Activities</p> <ol style="list-style-type: none"> 1. Class test (10M) 2. Assignment (5M) 3. Educational Visit /Group discussion /Seminars and projects/Any innovative activity (5M). 	

Syllabus Prescribed for 2023-2024 UG Programme

Programme: UG in Biochemistry

Semester-IV

Code of the Course /Subject	Title of the Course/Subject	Total Number of Periods
BCM-(4S)Pr	BCM-(4S) Practical	6 periods /per week/per batch

COs:

By the end of this module, the students will be able to:

1. Extract enzyme from plant or animal or microbial sources and perform its qualitative assay.
2. Determine optimum pH, Optimum temperature and optimum substrate concentration of enzymes.
3. Study effect of inhibitor on enzyme activity.

Practical: 4S Biochemistry

List of Practical/Laboratory Experiments.

1. Determination of achromic point of salivary amylase.
2. Estimation of reducing sugar by dinitrosalicylic acid method.
3. To study effect of temperature on Salivary Amylase or any other suitable enzyme.
4. To study effect of pH on Salivary Amylase or any other suitable enzyme.
5. To study effect of substrate concentration on salivary amylase or any other suitable enzyme and determination of K_m and V_{max}
6. To study effect of inhibitor on suitable enzyme
7. Extraction and assay of Phenol oxidase from fruits such as apple etc.
8. Immobilization of enzymes.
9. Extraction of suitable enzyme from Animal or plant tissue

The distribution of marks for the practical examination shall be as follows:

External Examination		Internal Examination	
Performance of any two experiments	20 marks	Attendance & students performance	10 Marks
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		MCQ/ Objective test	05 Marks
Total	25 Marks	Total	25 Marks

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- 4) Text book of Biochemistry by West and Todd.
- 5) Practical manual in Biochemistry by Jairaman.
- 6) Essentials of Food and Nutrition, Volume I & II by Swaminathan.
- 7) Text book of Biochemistry by Sucheta Dandekar.
- 8) Text book of Biochemistry by U. Sattyanarayan
- 9) Fundamentals of Biochemistry by J. L. Jain
- 10) Lehninger, A I., (1982), Principles of Biochemistry, Butterworth Publishers, New York.
- 11) Palmer T., (1985). Understanding Enzymes. 2nd Ed., Ellis Horwood Ltd., Chichester
- 12) Price, N. C, Stevens, L, (1989), Fundamentals of Enzymology, 2"d Ed.,Oxford Sci. Publ., Oxfor
- 13) Fundamentals of Biochemistry (1999) by Donald Voet, Judith Voet, Charlotte Pratt, John Wiley & Sons, N.Y. 145 146
- 14) Biochemistry 3rd edition (1994) by Lubert Stryer WH Freeman and Co. San Francisco.
- 15) General Enzymology by M.S. Deshpande and N.S. Kulkarni (Himalaya Publication House)