Veer Bahadur Singh Purvanchal University

Jaunpur

Ordinance and Syllabus for

M. Sc. in Biochemistry

(Two-year (Four Semesters) Postgraduate Degree Program)

Faculty of Science

Under Choice Based Credit System (CBCS)

As per the guidelines of NEP-2020

w.e.f. 2024-25 (Session)

V.B.S. PURVANCHAL UNIVERSITY, JAUNPUR

Department of Biochemistry

Faculty of Science

Vision

Biochemistry department is committed to focusing on education, innovation, training and entrepreneurship to create a world class talent pool of competent and curious biochemists enabling them to take in national and global challenges.

Mission:

- To provide Biochemistry educational to generate quality workforce which fulfill the professional and societal need nationally and globally.
- To create awareness about potentials of Biochemistry with health issue and socio-ethical implications.
- To impart quality education to the students and enhance their skills by instilling spirit of innovation and creativity, which make them nationally and globally competitive.
- To provide an environment for the students and faculty for personal and professional growth
- To promote collaboration with Academia, research institutions and industries at national and international level to enhance education and research

V.B.S. PURVANCHAL UNIVERSITY, JAUNPUR

Ordinance governing 2 Years (4Semesters) Postgraduate Degree Program

M. Sc. in Biochemistry (Faculty of Sciences)

Under Choice Based Credit System (CBCS)

w.e.f. 2024-25 (Session)

The following ordinances have been framed governing the admission, course structure, examination and other allied matters relating to the two-year (four semesters) postgraduate degree programme (M.Sc.) in Biochemistry being offered by V.B.S. Purvanchal University.

A. ADMISSION AND EXIT

1. All matters relating to admission to this course shall be dealt with by the Admission Committee constituted for the purpose by the University.
2. The M.Sc. Biochemistry course is open to science graduates (with 3 year undergraduate degree of new or old system) with minimum of 50% of marks, from a recognized University (45% in case of SC/ST). Those who are appearing in final examination of B.Sc. in Mathematics/ Biology/Life Sciences/Agriculture/ B.V.Sc. & A.H. /M.B.B.S./B.Pharm/, B.Tech. in Biotechnology/Bioinformatics/Food Technology degree can also apply for admission and shall be eligible to appear in the Entrance Test for admission but they will have to produce a proof of being a graduate at the time of admission. However, students of VBS Purvanchal University can be given provisional admission by the Admission Committee in case of delayed results.
3. Admission in M.Sc. Biochemistry course will be based on the entrance test or merit as per the rules of the university.
4. The intake of students in this programme shall be fixed by V.B.S. Purvanchal University. The admission to M.Sc. Biochemistry courses shall be made through a merit based on Written Test conducted by **VBS Purvanchal University Combined Admission Test (PUCAT)**. The reservation norms for admission shall be guided by State Government/ University notification issued from time to time.
5. On selection for admission to the M.Sc. Biochemistry programme, shall deposit the prescribed fees to get their admission confirmed within the stipulated time period by the Admission Committee of the Department. If the candidate fails to do so their admission shall be automatically liable to be cancelled and the seat falling vacant shall be offered to another candidate as per the merit/category. There is no provision of Fee concession/exemption under any circumstances except the case related to Social Welfare Department, Uttar Pradesh Government. Fee refund policy shall be applicable as per the university norms.
6. Admission to M.Sc. Biochemistry programme cannot be claimed by any candidate as a matter of right. The Admission Committee of M.Sc. Biochemistry programme of the University shall have power to refuse, reject or cancel any admission if it possesses sufficient reasons to do so.
7. All teachers of the department shall function as Student Mentor (Advisors). Every student will be assigned a mentor (advisor) before commencement of the academic session to support the students for their overall development in all possible way related

to their academics/cocurricular/extracurricular/sports/personality development/soft skill/ cultural activitiesand offer all possible student support services.

2. COURSES OF STUDY AND EXAMINATION

2.1 M. Sc. Biochemistry Programme will be based on CBCS (Choice Based Credit System) mode and conducted in semester system.

2.2 Credit distribution

M.Sc. 1st semester	4 Theory papers of major/core courses (4 credit each)	=	16 credits
	1 Practical (4credits)	=	4 credits
	1 Minor elective from other faculty (4 credits)	=	4 credits
1st semester there will be			**24 credits**
M.Sc. 2nd semester	3 Theory papers of major/core courses (4 credits each)	=	12 credits
	1 Theory paper of major elective courses (4 credits)	=	4 credits
	1 Practical (4credits)	=	4 credits
	1 Major/core Industrial Training/Surveys/Research Project	=	8 credits
2nd semester there will be			**28 credits**
Thus, 1st year of M.Sc. will be of			**52 credits**
M.Sc. 3rd semester	3 Theory papers of major/core courses (4 credit each)	=	12 credit
	1 Theory paper of major elective courses (4 credit)	=	4 credit
	1 Practical (4credit)	=	4 credit
3rd semester there will be			**20 credits**
M.Sc. 4th semester	4 Theory papers of major elective courses (4 credits each)	=	16 credits
	1 Practical (4credits)	=	4credit
	1 Major/core Industrial Training/Surveys/Research Project	=	8 credits
4th semester there will be			**28 credits**
Thus, 2nd year of M.Sc. will be of			**48 credits**
Hence, two years (4 semesters) M.Sc. Biochemistry programme is of			**100 credits**

2.3 All four theory Major/core courses are compulsory in the first semester.

2.4 In the second and third semester, the student can choose one major elective course according to their interest and the resources available in the university /colleges.

2.5 All the theory papers in the fourth semester are major elective courses from which the student can choose any four elective courses as per their interest.

2.6 In the first year of post-graduation, the student will have to take only 1 minor elective course from other faculty of 4(four) credits.

2.7 To conduct the M.Sc. Biochemistry programme systematically and within a time bound frame, the department shall strictly adhere to academic calendar notified by the university in the beginning of academic session.

2.8 A candidate admitted to the M.Sc. Biochemistry programme shall pursue a regular

mode of study in all the four semesters and attend a minimum of 75% of the total classes held to be eligible for appearing in the semester examinations.

2.9 If a student fails to attend requisite classes (minimum of 75%) in a semester due to medical ground, there may be given relaxation of15% attendance (5% at the level of Head of Department and 10% at the level of Vice-Chancellor) on production of medical certificate.

2.10 Semester examinations of the M.Sc. Biochemistry programme shall be conducted by way of theory papers, practical and industrial training/surveys/research project. Each theory of major/core and elective paper will beof100 marks out of which 75 marks shall be allocated for End Semester Examination (ESE) and 25 marks for Continuous Internal Evaluation (CIE). The pattern of question papers for theory examinations will be as per the University norms.

2.11 Continuous Internal Evaluation (CIE) is an integral part of the courses and is compulsory for all students. The academic performance of a student is evaluated by assessing day to day performance, attendance, assignments, periodic tests, seminar presentation, subject's quiz, class discussion, etc. There shall be no mid-term examination of CIE will be held rather a teacher assess the student along with the class teaching.

The **25 Marks of CIE shall be allocated as given below:**
10marksfor Test/Subject' quiz,
10marksforpresentationalongwithassignment
05 marks for Class interactions, discussion, performance, attendance.

2.12 The responsibility of evaluating the internal assessment is vested on the teacher(s) who teaches the course.

2.13 One practical (4 credits of 100 marks) examination shall be conducted which will be assessed jointly by the internal examiner of the department and the external examiner nominated by the university at the end of each semester of 75 marks and 25 marks of internal practical are assessed by concerned teacher of the course and will be averaged before online submission.

2.14 The end semester examinations shall be held as per academic calendar notified by the university.

2.15 Industrial Training/Surveys /Research Project: In the first and second year, the student will have to do a major research project including internship/technical report/comprehensive review/online or field surveys work/training in industry or institute.

2.16 Industrial Training/Surveys/Research Project can also be interdisciplinary or multi-disciplinary.

2.17 The research project will be done under the guidance of a teacher (supervisor) of

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the department. In case of topic of the research project is interdisciplinary/ multidisciplinary, the student may carry out their research work under a Co-supervisor from outside the department viz Industry/Company/Technical Institute/Research Institute.

2.18 Bachelor's Degree (with Research) and postgraduate students will be required to undertake a research project of four credits (4 hours per week) in each semester.

2.19 Students will submit the final report (project report/dissertation) of the research project carried out in both the semesters at the end of the year, which will be assessed out of 100marks - 8 credits jointly by the respective supervisor and the external examiner nominated by the university or as per the directive of university at the end of the academic year. The student has to submit a project report/dissertation/technical report in hard bound form duly certified by the supervisor. The evaluation of the project/dissertation/technical report/comprehensive review of the student will be done through presentation and viva-voce examination.

2.20 If a student publishes any research papers from their research project work in the UGC-CARE listed Journals and published during the Programme, then they can be given additional marks up to25 in the evaluation of the research project (out of 100). The maximum received will be 100.

2.21 The marks obtained in the research project will be marked as grades and they will also be included in the calculation of CGPA.

2.22 Itwillbenecessarytotaketheexamforcreditvalidation.Creditwillbeincompletewithoutthe examination.

2.23 If a student qualifies for the examination on the basis of attendance in the class, however, is not able to give the examination due to any reason, then they can appear for the qualifying examination as per university PG ordinance- 2023, however, they will not need to attend the classes again.

2.24 Matterspertainingtothesyllabiandconductofexaminationshallbedealt with by the Board of Studies (BoS) constituted by the Vice-Chancellor.

2.25 The BoS shall recommend the panel of paper setters/examiners to the Vice-Chancellor. After getting approval from the Vice-Chancellor, the appointment letters shall be issued to the concerned paper setters/examiners by the Registrar/Controller of Examination of University.

2.26 Question papers for theory examination in sealed envelope shall be handed over/sent by registered post to the Registrar/Controller of Examination by the Examiners. Controller of Examinations will ensure the printing of question papers and fair conduct of the examinations.

2.27 The Registrar/Controller of the Examinations, with the approval of the Vice-Chancellor shall associate one or two members of the BoS for the moderation of the papers. The moderated papers shall have to be printed by the Registrar/Controller of the Examinations well before commencement of the Examinations.

2.28 After printing the questions papers in sealed covers, shall be handed over to the Examination Superintendent who will ensure the smooth and fair conduct of the examinations.

2.29 For appearing in the M.Sc. Biochemistry semester examination each student shall have to deposit a prescribed examination fee along with a copy of online filled examination form for online verification. Separate fees will also be charged for back and improvement papers as per university norms.

2.30 After the examinations, Controller of Examinations/Technical Cell for campus courses shall ensure the evaluation of the answer books and declaration of results of semester examinations within a reasonable time so as to enable the department to adhere to the Academic Calendar.

2.31 Practical examinations of semester VII (M.Sc.-I sem), VIII(M.Sc.-II sem), IX (M.Sc.-III sem) and X(M.Sc.-IV sem) shall be conducted by one internal and one external examiner nominated by the university.

2.32 The students of M.Sc. Biochemistry Programme shall be examined in the subjects in accordance with course curriculum and per the University PG programs ordinance-2023.

3. RESULTS,PROMOTIONANDIMPROVEMENT

3.1 If a student wants to leave after passing the first year of post-graduation by earning a minimum of 52 credits, then he will be awarded a bachelor's (with research) degree. After earning a minimum of 52+48 credits in the first and second year of post-graduation, the student will be awarded a master's degree in that main subject of that faculty.

3.2 The results of M. Sc. Biochemistry semester examination shall be declared pass as per the University PG programs ordinance-2023.

3.3 If a student fails in more than 4 papers in an academic year, he/she will not be promoted to the next year. Such student should be re-admitted as Ex. Student with coming batch and their seat will be counted as supernumerary.

3.4 Students, who failed in 4 or lower number of papers in the academic year will be awarded back and given two chances to reappear and pass in respective paper(s)in

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next year and the following year with regular semester examination. There will not be any supplementary/special examination for back/improvement papers. However, all such papers must be cleared within two years ending fourth semester.

3.5 In order to pass the 2-year M.Sc. Biochemistry programme the students must pass both the year separately. The final result shall be declared on the basis of the combined marks secured by a candidate in all the four semesters as per the University PG programs ordinance-2023.

3.6 Student securing highest number of marks during the course in the first attempt will be awarded the University Gold Medal for the same.

3.7 Conversion of Marks into Grades, Grade points and CGPA calculation shall be applicable as per University PG programs ordinance-2023.

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Master of Science in Biochemistry (M.Sc. Biochemistry) Programme

Syllabus Development as per Guidelines of National Education Policy-2020 (NEP 2020)

Syllabus Developed by				
Name	**BoS Convener/ Member/ Experts**	**Designation**	**Department**	**University**
Prof. Rajesh Sharma	Convener BoS Biochemistry	Professor	Biochemistry, Faculty of Science	Veer Bahadur Singh Purvanchal University, Jaunpur
Prof. Bechan Sharma	External Expert	Professor	Biochemistry,	Allahabad University, Allahabad

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SYLLABUS

MASTER OF SCIENCE IN BIOCHEMISTRY (M.SC. BIOCHEMISTRY)

Designed as per Syllabus Development Guidelines ofNational Education Policy-2020 (NEP-2020)

Year	Semester	Paper Code	Paper Title	Theory/Practical	Credits
M.Sc. I	I	B110101T	Biomolecules and Bioenergetics	Theory (Core)	4
		B110102T	Elements of Microbiology	Theory(Core)	4
		B110103T	Cell Biology	Theory(Core)	4
		B110104T	Genetics and Molecular Biology	Theory(Core)	4
		B110105P	Practical (Preparation of Solutions, Qualitative Analysis of Biomolecules)	Practical(Core)	4
			Minor (Other Faculty)	**Theory***	4
				Total Credit	**24**
M.Sc. I	II	B110207T	Instrumentation and Analytical Techniques	Theory (Core)	4
		B110208T	Enzymology	Theory (Core)	4
		B110209T	Immunology	Theory (Core)	4
		B110210T	r-DNA Technology and Applications	Theory (Elective)*	4
		B110211T	Tissue culture	Theory (Elective)*	4
		B110212P	Practical(Biochemical Tools and Techniques, Enzymes and Immunological Techniques)	Practical(Core)	4
		B110213R	Industrial Training/Surveys/Research Project	Industrial Training/Surveys/Research Project	8
				Total Credit	**28**
				*** Student must opt for any 01 of the 02 elective courses**	
M.Sc. II	III	B110314T	Human Physiology and Endocrinology	Theory (Core)	4
		B110315T	Intermediary Metabolism	Theory (Core)	4
		B110316T	Biostatistics and Bioinformatics	Theory (Core)	4
		B110317T	Plant Biochemistry	Theory (Elective)*	4
		B110318T	Nutritional Biochemistry	Theory (Elective)*	4
		B110319P	Practical (Human Physiology, Endocrinology, Biostatics and Biochemistry)	Practical(Core)	4
				Total Credit	**20**
				***Student must opt for any 01 of the 02 elective courses**	
M.Sc. II	IV	B110421T	Clinical Biochemistry	Theory (Elective)*	4
		B110422T	Pathophysiology of Human Diseases	Theory (Elective)*	4
		B110423T	Advanced Enzymology	Theory (Elective)*	4
		B110424T	Molecular Basis of Infectious Diseases	Theory(Elective)*	4
		B110425T	Basics of Forensic Science	Theory(Elective)*	4
		B110426T	Food Biochemistry	Theory(Elective)*	4
		B110427T	Environmental Biochemistry and Toxicology	Theory(Elective)*	4
		B110428T	I.P.R. Entrepreneurship Bioetihcs & Biosafety	Theory(Elective)*	4
		B110429P	Practical(Clinical Biochemistry and Pathology)	Practical	4
		B110430R	Industrial Training /Surveys/Research Project	Industrial Training/Surveys/Research Project	8
				Total Credit	**28**
				Student must opt for any 04 of the 08 elective courses	
				PROGRAMME CREDIT	**100**

Note: **1.** Up to first three semesters the marks allocated for continuous internal assessment (25 marks) will be evaluated on the basis of class attendance and a seminar. The seminar will be an integral part of the sessional and will be evaluated by all the faculty members of the department.

2. The detailed syllabus is given in the following pages. The numbers given in front of each topic/group of topics represent the number of periods (60 minutes each) allocated for teaching that topic(s).

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PROGRAM OUTCOMES (POs)

Bachelor's Degree with Research/M. Sc. Biochemistry

The program outcomes that a student should be able to demonstrate on completion of a post degree level program may involve academic, personal and behavioral as well as entrepreneurial and social competencies. After completion of the M. Sc. Biochemistry programme, the candidate should be able to:

- **PO 1:** The programme intends to develop a strong theoretical and practical background in various domains of biochemistry specially pathology, mechanism of disease and biomarkers of disease, various techniques for diagnosis, and modern techniques used in research and development.
- **PO 2:**The programme includes details of biomolecules, metabolism, clinical biochemistry, tools and techniques, enzymes, immune system, human physiology and endocrinology, cell biology, tissue culture, molecular biology, genetic engineering, biostatistics, bioinformatics, pathophysiology of human disease and infectious diseases, Food biochemistry, IPR, ethics, nutritional biochemistry and human ageing to make the living system more interesting as the need of the hour.
- **PO 3:**The practical courses will equip the students with laboratory skills in biochemistry, Pathology, microbial culture, PCR, Electrophoresis etc. Students will able to design and conduct experiments, as well as to analyze and interpret scientific data.
- **PO 4:**The programme will provide students with the knowledge and skill base that would enable them to undertake further studies in biochemistry and related areas or in multidisciplinary areas that involve biochemistry and help to develop a range of generic skills that are relevant in enhancing entrepreneurship skills among students.
- **PO 5:** The students will be exposed to a wide range of careers that combine biology, plants, pathology, research and medicine.

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PROGRAMME SPECIFIC OUTCOMES (PSOS)

Bachelor's Degree with Research /M. Sc. Biochemistry (I)

After completion of this course, students will be able to –

- **PSO1:**This course introduces fundamentals of structure and function of biomolecules. Students will be able to develop an understanding of the inter relationships within and between anatomical and physiological systems of the human body.
- **PSO2:**The students will learn the basic principles of biochemistry and accurate preparation of solutions, and buffers. The course is intended to develop a sound, fundamental understanding of bimolecular testing. This courses will enable students to apply for technical positions in government and private labs, academic and research institutes.
- **PSO3:**Students will develop an understanding of: Principle, working, and applications of biochemical tools & techniques to prepare them for independent execution of laboratory experiments using standard methods and techniques.
- **PSO4:**The students will develop an understanding of the basics of Immunology, types of Immune Responses, antigens and antibodies, histocompatibility, vaccines, and immunization. The course aims to develop an understanding of the concepts of enzyme dynamics. The students will also have understanding of basics of immunology, types of Blood grouping, cell counts, ELISA, Ouchterlony Double diffusion (ODD) and Separation of serum from blood & precipitation of Immunoglobulins
- **PSO5:** The students will be able to understand and apply the principles and techniques of molecular biology which prepares students for further career in molecular biology. Independently execute a laboratory experiment using the standard methods and techniques.
- **PSO6**: The principles of genetic engineering, gene cloning and related technologies will enable students to play an important role in applications of Biochemistry in various fields like agriculture, forensic sciences, industry and human health and make a career out of it. Students can have their own start-ups as well.

M. Sc. Biochemistry

After completing the two years degree course in M. Sc. Biochemistry, the students will be able to-

- **PSO1:**The students will develop the understanding of basic concepts of clinical biochemistry, they would able to relate clinical disorders with metabolic processes.The objective of this course is to develop an understanding of the concepts of enzyme and enzyme kinetics.
- **PSO2:**The student at the completion of the course will be able to have a detailed and conceptual understanding of Biochemistry molecular processes.
- **PSO3:**The student will be able to have a detailed and conceptual understanding of Tissue culture, Pathophysiology of Human Diseases, Basics of Forensic Science, Food Biochemistry, I.P.R. Entrepreneurship Bioetihcs & Biosafety, Environmental Biochemistry and Toxicology and Aging and Nutritional Biochemistry.
- **PSO4:**The basic tools of bioinformatics will enable students to analyze large amount of genomic data and its application to evolutionary biology. Apply knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics existing software effectively to extract information from large databases and to use this information in computer modeling.
- **PSO5:**The students will have hands-on training on qualitative estimation of important which will help them in getting employment in pathology labs and contribute to health care system. The courses will ensure employability in Hospitals/Diagnostics and Pathology labs with good hands-on training. It will also enable students to take up higher studies and Research as their career and work in renowned national and international labs. Students can have their own start-ups as well.
- **PSO 6 :** The Degree courses will enable students to go for higher studies like Masters and Ph.D in Biochemistry and Allied subjects.

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SEMESTER I

Programme/Class: Bachelor's Degree with Research /M. Sc. Biochemistry (I)	**Year:** First (I)	**Semester:** First (I)
SUBJECT: BIOCHEMISTRY		
Course Code: B110101T	**Course Title: Biomolecules and Bioenergetics**	

Course Outcomes (COs)

CO 1: The student after the completion of the unit will be able to understand, About usage pH and buffers, Concept of bioenergetics, Importance of biological oxidation- reduction reactions and about ATP. **CO 2:** The student after the completion of the unit will be able to understand, Classification, structure and properties of different saccharides, About complex carbohydrates, About quantitative and qualitative methods used for estimation. **CO 3:** The student after the completion of the unit will be able to understand Classification of different lipids. Iodine test, RM number. Different quantitative and qualitative methods for their estimation. **CO 4:** The student after the completion of the unit will be able to understand About classification and general properties of amino acids. How to synthesize peptide and their application. Different structure of proteins and protein folding. How to read Ramachandran Plot. Interaction between oxygen and hemoglobin. Different methods for quantitative and qualitative estimation of proteins. Learn about methods for the collection of different biological samples. **CO 5:** The student after the completion of the unit will be able to understand- Historical importance of nucleic acid. Hershey-Chase experiments. Structure and function of nucleotides. Different forms of DNA. Different methods for the quantitative and qualitative analysis of nucleic acid.

Credits: 4	**Core Compulsory**
Maximum Marks: 100 (75(UE)+25(CIE))	**Minimum Passing Marks:** As per University norms

Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	**Electrochemistry** – pH and buffers, Water, Bioenergetics – Concept of free energy and standard free energy. Biological oxidation-reduction reactions, redox potentials, relation between standard reduction potentials and free energy change (derivations and numerical included). High energy phosphate compounds: introduction, phosphate group transfer, free energy of hydrolysis of ATP and sugar phosphates.	12
II	**Carbohydrates:** Classification, structure, general properties and functions of mono-, oligo-, (Disaccharides), and polysaccharides. Complex carbohydrates, mucopolysaccharides, amino sugars, bacterial cell wall sugars, proteoglycans, glycoproteins, blood sugar compounds. Brief account of various quantitative and qualitative methods of estimation.	10
III	**Lipids:** Definition, classification, structure, properties and function of fatty acids, essential fatty acids, phospholipids, sphingolipids, cerebroside, steroids, bile acids, prostaglandins, waxes, terpenes, lipoamino acids, lipoproteins, proteolipids, lipopolysaccharides, iodine test, saponification, acid value, RM number, Brief account of various quantitative and qualitative methods of estimation.	12
IV	**Proteins:** Amino acids; classification and general properties, peptide synthesis, chemical/synthesis. Peptide sequencing, Primary (peptide conformation, N and C terminal, peptide cleavage), secondary (helix, sheet, random coil, Ramachandran plot), tertiary and quaternary structures of proteins, denaturationand renaturation. Protein folding. Oxygen hemoglobin interaction. Brief account of various quantitative and qualitative methods of estimation. Strategies for collection of biological samples.	14
V	**Nucleic Acids:** Historical perspectives; nucleic acids as genetic information carriers, experimental evidences, e.g., genetic transformation, Hershey-Chase experiments. Structure and function of nucleotides. Denaturation of DNA. Mitochondrial and chloroplast DNA. RNA and 3D structure of tRNA Helix transition. Linking number, twist and writhe; A, B and Z DNA. Brief account of various quantitative and qualitative methods of estimation.	12

Suggested Reading

1. Principles of Biochemistry (7th Edition) – Lehninger, Nelson and Cox. **Pub**:Macmillan
2. Harper's Illustrated Biochemistry, (31th Edition) – R.K. Murray, D.K. Garner, P.A. Mayersand V.W. Rockwell, Pub: McGraw Hill International Edition.
3. Biochemistry (3rd Edition) – G. Zubay., Pub: Wm. C. Brown Pub.
4. Biochemistry (6th Edition) – LubertStryer. Pub: W.H. Freeman and Com., NY.
5. Biochemistry – (4nd edition) D. Voet and J.G. VoetPub: John Willy and Son
6. Practical Biochemistry (3rd Edition) – David Plummer. Pub: Tata McGraw Hill
7. Practical Biochemistry (7th Edition) – K. Wilson and J. Walker. Pub: CambridgeUniv. Press, (U.K.)

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Programme/Class: Bachelor's Degree with Research /M. Sc. Biochemistry (I)	Year: First (I)	Semester: First (I)
SUBJECT: BIOCHEMISTRY		
Course Code: B110102T	Course Title: Elements of Microbiology	

Course Outcomes (COs)

Course outcomes:

CO 1: The student after the completion of the unit will be able to understand, History of microbiology. Nature of the microbial world, General features and differentiation between eukaryotic and prokaryotic cells. **CO 2:** The student after the completion of the unit will be able to understand General properties of bacteria and fungi. Learn about modern taxonomy. Learn about different media preparation and its importance. Different sterilization techniques. Methods for isolation and cultivation of bacteria and fungi. **CO 3:** The student after the completion of the unit will be able to understand, About the nutritional requirement for bacterial growth. About the factors which affects bacterial growth and reproduction. Introduction to extremophiles. **CO 4:** The student after the completion of the unit will be able to understand, Introduction to microbial metabolic pathways like glycolysis etc. About the role played by bacteria in industrial and domestic waste treatment. Introduction about food spoilage and food poisoning. **CO 5:** The student after the completion of the unit will be able to understand, General properties and discovery of plant and animal viruses. About DNA viruses. About RNA viruses. General properties and feature of prions and viroids.

Credits: 4	Core Compulsory
Maximum Marks: 100 (75(UE)+25(CIE))	Minimum Passing Marks: As per University norms

Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	Introduction, history, scope and relation with other sciences. Nature of microbial world. General features of eukaryotic and prokaryotic cells: Cell wall, cell membrane, capsules, pilli, flagella, tactic movement, storage granules, mesosomes, nucleoid etc.	12
II	Habitat, structure, reproduction and classification of bacteria, and fungi. Modern approaches of bacterial taxonomy (numerical taxonomy, *16SRNA* analysis etc.).Media preparation, sterilization methods: isolation and cultivation of bacteria and fungi.	10
III	Nutritional requirements of bacteria, definition of growth, mathematical expression of growth, measurement of growth, synchronous growth. Factors affecting growth (temperature, acidity, alkalinity, water availability and oxygen), reproduction. Introduction to extremophiles.	12
IV	Introduction to microbial metabolic pathways (glycolysis, TCA cycle, PP pathway, ED pathway and β keto adipate pathway). Microorganisms in biogeochemical cycles. Role of microorganisms in treatment of domestic and industrial wastes. Elementary account of food spoilage and food poisoning (*Botulinum* and *Staphylococcal* food poisoning)	14
V	Viruses – General properties, bacterial, plant and animal viruses: discovery, classification and lysogeny, DNA viruses: positive strands, negative strand and RNA viruses: General feature of HIV virus. General features of prions and viroids.	12

Suggested Reading

1. Prescott's Microbiology, (9th Edition) – Willey, Sherwood and Woolverton. Pub: McGraw-Hill Science Engineering
2. Microbiology Principles And Explorations (9th Edition), J.G. Black, Pub: John Wiley and Sons
3. Microbiology: An Introduction by Gerard J. Tortora, (12th Edition), Pub: Pearson
4. Fundamentals of microbiology: Jeffrey: C. Pommerville. (10th Edition), Pub: Jones & Bartlett Learning;
5. Microbiology: Michael J.Pelczar, JR (6th Edition), Pub: Tata Mc. Graw- Hill Publishing Company limited.

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Programme/Class: Bachelor's Degree with Research / M. Sc. Biochemistry (I)	**Year:** First (I)	**Semester:** First (I)

SUBJECT: BIOCHEMISTRY

Course Code: B110103T	**Course Title: Cell Biology**

Course Outcomes (COs)

After the completion of the course, the student will: **CO 1:** Understand about plant and animal cell and different cellular organelles.**CO 2:** Understand about bio membrane and their action mechanism. P and F type pumps and working of ABC transporters.Techniques for studying membranes. **CO 3:** Understanding about chromatin, histone and non- histone proteins, packing of DNA, satellite DNA.**CO 4:** Know about cell cycle and its mechanism. Also, they will know about cell-cell adhesion and communication and cell division.**CO 5:** Understanding about cancer, programmed cell death and apoptosis.

Credits: 4	**Core Compulsory**
Maximum Marks: 100 (75(UE)+25(CIE))	**Minimum Passing Marks:** As per University norms

Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	Diversity of cell size and shape, Cell theory. Plant and animal cells: Variation in structure and function. Cellular organelles: Structure and functions of Cell wall, Plasma membrane, Nucleus, Mitochondria, Chloroplast, Endoplasmic reticulum, Centrosome, Lysosome, Peroxisome, Glyoxisome, Cytoskeleton (microfilament, microtubule and intermediate filament).	14
II	Membrane Biology: Biomembrane, organization of chloroplast and mitochondrial membrane system. Membrane transport: channels, transporter and pump. P and F-type pumps and ABC transporters. Active and passive transport. Ion channels and electrical properties of membranes. Protein Transport Pathways: Signal hypothesis, Vesicular Traffic. Techniques to study membranes: FRAP, FRET, use of spin labeling and polarity dependent fluorescence probes to determine membrane state changes.	14
III	Chromatin: Hetrochromatin, euchromatin, Histone and Non-histone proteins, packing density, Nucleosome: size, variable linkers, Solenoid structure, packing of DNA, Intron, Exon, Replicon, Recon, Cistron, Muton, Satellite DNA, Cot value, Reassociation kinetics, C value paradox. Satellite DNA, Polytene and Lampbrush chromosomes.	12
IV	Cell cycle: A brief description of molecular mechanisms of cell cycle regulation. Cell interaction: Cell–Cell adhesion and communication, Cell differentiation, cell division by mitosis and meiosis.	10
V	Biochemistry of Cancer: Carcinogenesis, characteristics of cancer cells, agents promoting carcinogenesis, Oncogenes, virus-induced cancer and metastasis. Programmed cell death: Apoptosis– role of Caspases and mitochondria mediated pathway of apoptosis.	10

Suggested Reading

1. Molecular biology of the cell, (4th Edition) – Bruce Albert, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts and Peter Walter, Pub: G.S. Garland science Taylor and Francis Group New York – NY 10001
2. Molecular Cell Biology, (5th Edition) H. Lodish, A. Berk P. Matsudaira Chris A.Kaiser, M.Krieger. M. P. Scott, L. Zipursky, J. Darnell. Pub: W.H. Freeman and Com., NY.
3. Cell and Molecular Biology: Concepts and Experiments:Gerald Karp, VIthEdsBiochemistry – West & Todd **Pub:** Oxford IBH,
4. Biochemistry – Debjyoti Das.–**Pub:** Academic Publishers Kollkata
5. Practical Biochemistry – David Plummer. **Pub**: Tata McGraw Hill
6. Practical Biochemistry – K. Wilson and J. Walker. **Pub**: Cambridge Univ. Press, (U.K.)

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Programme/Class: Bachelor's Degree with Research / M. Sc. Biochemistry (I)	Year: First (I)	Semester: First (I)

SUBJECT: BIOCHEMISTRY

Course Code: B110104T	Course Title: Genetics and Molecular Biology

Course Outcomes (COs)

After the completion of the course, the student will: **CO 1:** Understand the inheritance of parental character and about Mendel's Law of inheritance, Know about importance of nucleic acid as a genetic material, genome organization. **CO 2:** Explain the concept of gene and genetic code, Mitochondrial inheritance, and chromosomal abnormalities. **CO 3:** students will understand about mutation and its type. Types of mutagens and their screening, role of chromosome and DNA in mutation, and genetic recombination. **CO 4:** Have the knowledge about replication in prokaryotes and eukaryotes. Mechanism of transcription and translation. **CO 5:** Have knowledge regarding post transcriptional modifications and RNA processing. Know about trp and lac operons.

Credits: 4	Core Compulsory
Maximum Marks: 100 (75(UE)+25(CIE))	Minimum Passing Marks: As per University norms

Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	Recapitulation of Mendel's Law of inheritance: Linkage, crossing over and gene mapping through traditional methods. Nucleic acids as genetic material, genome organization (satellite DNA), Law of DNA consistence, C value paradox, Cot analysis, repetitive DNA. Classes of DNA sequences and nucleases. Numerical and structural changes in chromosomes.	12
II	Concept of gene fine structure and analysis: gene organization in prokaryotes and eukaryotes, polycistronic genes, split genes, promoter and enhancer. Genetic code: Deciphering genetic code, degeneracy, unusual codons in mitochondria and prokaryotes. Population genetics	12
III	Mutation: Types, mechanisms and their mapping. Types of mutagens and their screening through Ames test. Molecular basis of spontaneous and induced mutations and their role in evolution. DNA damage and repair. Molecular mechanism of genetic recombination in prokaryotes: Transformation, Conjugation and Transduction	12
IV	Replication of genetic material in Prokaryotes and Eukaryotes. Mechanism of transcription in prokaryotes and eukaryotes, transcription factors, RNA polymerases, initiation, elongation and termination. Translation: Initiation, elongation and termination	12
V	Post transcriptional modification and RNA processing (mRNA, tRNA and rRNA, si RNA). Introns, exons, spliceosome, Regulation of gene expression: Regulatory elements, positive and negative control, operon concepts – lac and trp. Attenuation. An overvie w of regulation of gene expression in prokaryotes and eukaryotes. Cis acting sites and trans acting molecules.Transposable genetic elements	12

Suggested Reading

1. Genetics: Analysis and Principles by Robert J. Brooker, (06th Edition), Pub: McGraw-Hill Education
2. Principles of Genetics by Eldon J. Gardner, (12thEdition), Pub: John Wiley & Sons;
3. Lewin's GENES XII, (12thEdition), Pub: Jones and Bartlett Publishers,
4. Molecular Biology of gene by Watson, (07th Edition), Pub: Pearson Education
5. Genetics by Strickberger (03th Edition), Pub: Pearson Education
6. Cell and Molecular Biology (8th Edition) – De Robertis and De Roberties, Pub: B.I. Publishers Pvt Ltd. N. Delhi

Programme/Class: Bachelor's Degree with Research / M. Sc. Biochemistry (I)	**Year:** First (1)	**Semester:** First (I)

SUBJECT: BIOCHEMISTRY

Course Code: B110105P	**Course Title: Practical** (Preparation of Solutions, Qualitative Analysis of Biomolecules)

Course Outcomes:

Course outcomes: After the successful course completion, learners will develop following attributes

1. Preparation of various solutions, Preparation of Buffers
2. Perform Qualitative and quantitative test of Biomolecules: Carbohydrates, Lipids, Protein
3. Microbial culture and microbial test- isolation, staining,
4. Perform spot test for amino acids in a given sample

Credits: 4	**Core Compulsory**
Maximum Marks: 100(75(UE)+25(CIE))	**Minimum Passing Marks:** As per University norms

Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 0-0-8

Topics	Practical Hours: 120
1. Safety measures in laboratories, Washing and sterilization of lab ware 2. Preparation of normal and molar solutions, Preparation of buffers 3. Qualitative test of carbohydrates: Molisch Test, Fehling's Test: Barfoed's Test, Seliwanoff's Test, Bial's Test, Starch iodine test 4. Quantitative estimation of proteins by Lowry et al., 1951 method 5. Saponification, Acid value and iodine no of fats, 6. MDA estimation in fats by Esterbauer and Cheeseman (1990) 7. Preparation of various culture media for fungi and bacteria. 8. Staining of bacteria simple and differential staining 9. Isolation of pure culture of microorganisms – Plating, Streaking and spreading 10. Isolation of soil organisms, plate streaking method. 11. Growth measurement by serial dilution and optical density. 12. Nucleus staining of blood cells by haematoxylin. 13. UV- sensitivity in bacteria and isolation of mutants. 14. Ames test, Isolation of DNA from human blood or buccal mucosa. 15. Isolation of Auxotroph's bacteria. 16. Diauxic growth curve on lactose/glucose as carbon source in bacteria. 17. Numerical problems on classical genetics.	

Suggested readings

1. Biochemistry – (4nd edition) D. Voet and J.G. VoetPub: John Willy and Son
2. Practical Biochemistry (3rd Edition) – David Plummer. Pub: Tata McGraw Hill
3. Practical Biochemistry (7th Edition) – K. Wilson and J. Walker. Pub: Cambridge Univ. Press, (U.K.)
4. Prescott's Microbiology, (9th Edition) – Willey, Sherwood and Woolverton. Pub: McGraw-Hill Science Engineering
5. Microbiology Principles And Explorations (9th Edition), J.G. Black, Pub: John Wiley and Sons
6. Genetics: Analysis and Principles by Robert J. Brooker, (06th Edition), Pub: McGraw-Hill Education
7. Principles of Genetics by Eldon J. Gardner, (12thEdition), Pub: John Wiley & Sons;

Programme/Class: Bachelor's Degree with Research / M. Sc. Biochemistry (I)	**Year:** First (I)	**Semester:** First (I)
SUBJECT: BIOCHEMISTRY		
Course Code: to be provided by other faculty	**Course Title: Minor (Other Faculty)**	
Minor Other Faculty: 1(one) minor elective paper from any other faculty (a subject other than the main subject)		
Credits: 4	**Minor elective(Optional)**	
Maximum Marks: 100 (75(UE)+25(CIE))	**Minimum Passing Marks:** As per University norms	

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SEMESTER II

Programme/Class: Bachelor's Degree with Research / M.Sc. Biochemistry (I)	Year: First (I)	Semester: Second (II)

SUBJECT: BIOCHEMISTRY

Course Code: B110207T	Course Title: Instrumentation And Analytical Techniques

Course Outcomes (COs)

CO1: Students will learn the principle and mechanism of microscope, centrifuge and their applications. **CO2**:Students will learn the principle and mechanism of chromatography, biosensor, FISH, Microarray, centrifuge and their applications. **CO3**:Students will learn the principle and mechanism of Electrophoresis, PCR, DNA sequencing, Blotting techniques and their applications. **CO 4**:Students will learn the principle and mechanism of Spectroscopy, NMR, XRD, Mass spectroscopy and their applications. **CO 5**: Students will learn the principle and mechanism of various tracer techniques and their applications.

Credits: 4	Core Compulsory
Maximum Marks: 100 (75(UE)+25(CIE))	Minimum Passing Marks: As per University norms

Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	Microscopy: Principles and types; Light, phase contrast, fluorescence, electron (SEM, TEM) microscopy, confocal microscopy. Centrifugation: Introduction and principles of laboratory centrifuges, differential centrifugation, ultracentrifugation, and density gradient centrifugation.	12
II	Chromatography: Principles and types; Adsorption, partition, gel filtration, ion exchange, affinity, paper, thin layer, gas chromatography, HPLC, FPLC, UPLC, RRLC, chromatofocussing. Electrochemistry – pH and buffers. Bioanalyzer. Biosensors: basic techniques, enzyme electrode, organic salt electrodes, immunoelectrodes, Microbial biosensors. Chemiluminescence and fluorescence concept. FISH. Microarray, Flow cytometer and its applications.	12
III	Electrophoresis: Principles, PAGE, agarose gel electrophoresis, isoelectric focusing, isotachophoresis, Two dimensional electrophoresis, pulse field electrophoresis. Polymerase Chain reaction (PCR), RT-PCR, DNA sequencing: Sanger's Method, Automated sequencing. Next generation sequencing. DNA fingerprinting and foot printing, blotting techniques: Southern, Western and Northern blotting.	12
IV	Photometry: Theory, Beer's Lambert's law, instrumentation and applications of visible photometry, spectrophotometry (UV, visible, IR) and fluorimetry, atomic absorption and emission spectroscopy, nuclear magnetic resonance spectroscopy, electron paramagnetic resonance spectroscopy, mass spectroscopy, X-ray diffraction.	12
V	Optical methods for determination of molecular structure; Absorption of polarized light, optical rotatory dispersion, hypochromism, circular dichroism and infrared dichroism in relation to composition and structure of biomolecules. Tracer techniques: autoradiography, detection and measurement of isotopes; Geiger–Müller Counter, Liquid scintillation counter Cherenkov counting	12

Suggested Reading

1. Physical Biochemistry D. Friefelder (2nd Edition) Pub: W.H. Freeman & Com
2. Practical Biochemistry– K. Wilson and J. Walker (7th Edition). Pub: CambridgeUniv. Press.
3. Molecular Cloning : a laboratory manual: Sambrook and Russel (Vol I, II, III)

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Programme/Class: Bachelor's Degree with Research / M.Sc. Biochemistry (I)	**Year:** First (I)	**Semester:** Second (II)

SUBJECT: BIOCHEMISTRY

Course Code: B110208T	**Course Title: Enzymology**

Course Outcomes (COs)

CO 1: Students will learn the enzymes classification and nomenclature.**CO 2:** Students will learn the principle and mechanism of various factors affecting the enzyme activity. **CO 3:** Students will learn the mechanism of enzyme activity and its regulation.**CO 4:** Students will learn the various equations related to principle and mechanism of enzymes activity. **CO 5:** Students will learn various methods to induce and inhibit the enzyme activity.

Credits: 4	**Core Compulsory**
Maximum Marks: 100 (75(UE)+25(CIE))	**Minimum Passing Marks:** As per University norms

Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	General properties of enzymes (physical and chemical). Classification and nomenclature of enzymes.	10
II	Factors affecting rate of enzyme activity: pH, temperature, concentration of enzyme, concentration of substrates, and other factor. Forces involved in enzyme substrate complex formation.	12
III	Mechanism of Enzyme Action: active site, allosteric site. Zymogen or proenzymes, anti-enzymes, coenzymes and cofactors, isoenzyme, ribozymes and abzymes. Feed-back inhibition and covalent modification of enzymes.	12
IV	Enzyme Kinetics: Michaelis: Menten initial rate equation assumption, Briggs:Haldane Steady State approach; Michaelis: Menten equation and Haldane relationship. Methods for determination of K_m and V_{max},	14
V	Enzyme inhibition and activation – Types of enzyme inhibition (competitive, noncompetitive and uncompetitive). Types of activators. Determination of inhibition and activation constant. Quality assessment programme.	12

Suggested Reading

1. Enzyme structure and mechanism – A.R. Fersht (W.H. Freeman), II Eds
2. The Enzyme Vol. 1 and 2 – P.D. Boyer (Academic Press), 3rd Eds
3. Enzyme Kinetics – K.M. Plaownan (M.C. Grow Hill), 10th Eds
4. Enzyme Kinetics – I.H. Segal (Willey and Sons), 3rd Eds
5. Enzymatic reaction mechanism – C.S. Wash (Freeman), 2nd Eds
6. Enzymes – T. Palmer, 2nd Eds
7. Enzymes kinetics – Dixan and Webb, 3rd Eds

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Programme/Class: Bachelor's Degree with Research / M.Sc. Biochemistry (I)	**Year:** First (I)	**Semester:** Second (II)

SUBJECT: BIOCHEMISTRY

Course Code: B110209T	**Course Title: Immunology**

Course Outcomes (COs)

The student at the completion of the course will learn to understand:**CO 1:** Students will learn the Basic concepts of Immunology. **CO 2:** Students will learn the Nature of antigen and antibody. **CO 3:** Students will learn the mechanism of Activation of T and B cells by antigen and its regulation. **CO 4:** Students will learn the various Hypersensitivity type I, II, III, and IV type. **CO 5:** Students will learn Monoclonal antibody Production and various methods in immunology.

Credits: 4	**Core Compulsory**
Maximum Marks: 100 (75(UE)+25(CIE))	**Minimum Passing Marks:** As per University norms

Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	Basic concepts of Immunology – (a) Innate and acquired Immunity (b) concept of humoral and cell mediated Immunity.Organization and structure of lymphoid organs.Cell and the immune system: Memory, specificity, diversity, self Vs non-self discrimination, B lymphocytes, T lymphocytes, Macrophages, Dendritic cells, NK cells, Eosinophils, Basophils, Neutrophils, Mast cells.Immunization – Active and passive. Vaccines; types and importance	12
II	Nature of antigen and antibody: Antigen Vs Immunogen, Superantigen, heptanes , types and structure of antibody – (i) constant and variable region Fab and Fc (ii) Isotype and idiotype. Generation of diversity in immune response: clonal selection theory, concept of antigen specific receptor, BCR, TCR, the genes encoding antigen: specific receptors on T and B lymphocytes, genetic rearrangements, class switch, comparison of receptor on B and T lymphocytes, mechanism of immune response and generation of immunological diversity.	12
III	Activation of T and B cells by antigen: Antigen processing, antigen presentation on T cells, products and factors released by T cell activation: interleukins, interferons, B cells activating factors. Complement system: classical and alternative pathways.Central role of MHC genes and products in immune response. T cell recognition of antigen and MHC products, structure of MHC gene complex, polymorphism of MHC genes and products. Allograft, graft versus host and mixed leukocyte response.Cell mediated cytotoxicity, mechanism of T cell and NK cell mediated lysis, ADCC, macrophage cytotoxicity.	12
IV	Hypersensitivity type I, II, III, and IV type.Antigen antibody interactions: detection and estimation of antigen and antibody, primary and secondary reactions, antibody affinity and acidity, equilibrium dialysis, precipitation and agglutination reactions, complement fixation test, RIA, ELISA, immunoblotting, immunofluorescence, biotin-avidin assay	12
V	Monoclonal antibody: Production by hybridoma technology, application. Immunodeficiency: T cell, B cell, combined B and T cell deficiencies, defect in phagocytes and complement components, secondary immunodeficiency, AIDS.	12

Suggested Reading

1. Kuby Immunology, (8th Edition). Pub:WH Freeman
2. Fundamental Immunology by William E Paul, (7th Edition). Pub:Lippincott Williams and Wilkins
3. Janeway's Immunobiology (9th Edition). Pub:Garland Science
4. Immunology by Riott and Riott (13th Edition). Pub:Wiley-Blackwell

Other course books published in Hindi must be prescribed by the University/College

Modified in BOS Meeting, July 27, 2024

Programme/Class: Bachelor's Degree with Research / M.Sc. Biochemistry (I)	Year: First (I)	Semester: Second (II)

SUBJECT: BIOCHEMISTRY

Course Code: BI10210T	Course Title: **Recombinant DNA Technology and Applications**

Course Outcomes (COs)

The student at the completion of the course will learn to understand: **CO 1:** Students will learn the concepts Host: Vector systems and various molecular enzymes in genetic engineering. **CO 2:** Students will learn the Preparation of competent cells and their transformation. **CO 3:** Students will learn the mechanism of Screening and characterization of cloned DNA. **CO 4:** Students will learn the various molecular techniques in genetic engineering. **CO 5:** Students will learn DNA sequencing technique.

Credits: 4	Elective
Maximum Marks: 100 (75(UE)+25(CIE))	Minimum Passing Marks: As per University norms

Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	Host: Vector systems, cloning vectors (plasmids, phages, cosmids, bacterial artificial chromosomes and yeast artificial chromosomes), shuttle vectors, expression vectors, and screening and selection methods for recombinants. HACS. Enzymes used for manipulating DNA (restriction endonucleases, methylases, polymerases, ligases, kinases and nucleases).	12
II	Preparation of competent cells and their transformation. Isolation of DNA (plasmid, cosmid, phage and genomic DNA) and RNA from prokaryotes and eukaryotes. Construction of genomic and cDNA library.	12
III	Screening and characterization of cloned DNA, restriction mapping and RFLP analysis. Southern, Western and Northern Hybridization probe preparation, heterologous and homologous Expression of cloned genes in cultured cells, synthetic oligonucleotides probes. *In situ* hybridization. Antibodies in screening of library.	12
IV	PCR and its application. Site directed mutagenesis. DNA: protein interaction: gel mobility shift assay, DNA foot printing, protein: protein interaction. Principles and method of genetic engineering and gene targeting. Real time PCR and SNPs.	12
V	DNA sequencing: Sanger's Method, Automated sequencing. Application of recombinant DNA technology in agriculture, health and industry. RNA Interference.	12

Suggested Reading

1. Gene Cloning and DNA Analysis: An Introduction: TA Brown, Vth Eds
2. Human Molecular Genetics: PA Reads, III Eds
3. Gene Cloning and Manipulation by Christopher Howe, II Eds
4. Principles of gene cloning, Old and primrose VthEds

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Modified in BOS Meeting, July 27, 2024

Programme/Class: Bachelor's Degree with Research / M.Sc. Biochemistry (H)	**Year:** First (I)	**Semester:** Second (II)

SUBJECT: BIOCHEMISTRY

Course Code: BH102TT	**Course Title:** Tissue Culture

Course Outcomes (COs)

The student at the completion of the course will learn to understand:**CO 1:** Detail about transgenic animals and their role in biochemistry, **CO 2:** Detail about gene delivery methods for the animals, **CO 3:** Detail about history, Cryo and organogenic differentiation in tissue culture. **CO 4:** Detail about plant tissue culture, **CO 5:** Detail about animal tissue culture

Credits: 4	**Elective**
Maximum Marks: 100 (75(UE)+25(CIE))	**Minimum Passing Marks:** As per University norms

Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	Introduction to the techniques of plant tissue culture. Concept ofcellular totipotency,Laboratory requirement and basic aseptic techniques, Plant Culture media: composition and preparation	12
II	Cell culture: Initiation and maintenance of callus and suspension cultures Organogenesis, somatic embryogenesis, factors affecting somatic Embryogenesis, ArtificialSeeds.Protoplast isolation, culture and fusion, selection of hybrid cell Somaclonal and Gametoclonal variationClonal propagation (Micropropagation)	12
III	Transgenesis: Methodologies, in plants, recent plant transformation technologies, basis of tumor formation, hairy root, features of Ti &Ri plasmids, mechanisms of DNA transfer, role of virulence genes, use of Ti and Ri as vectors, binary vectors	12
IV	Application of plant transformation for productivity and performance: Herbicides resistance, phosphoinothricin, glyphosate, sulfonyl urea, atrazine, insect resistance, Bt genes, non-Bt like protease inhibitors, virus resistance, coat protein mediated, disease resistance, long shelf life of fruits and flowers.	12
V	Plant secondary metabolites: Control mechanisms and manipulationof alkaloids and industrial enzymes (Shikimate and PHA pathway),biodegradable plastics, therapeutic proteins, Edible vaccines,purification strategies. Green house Technology. Biotic and Abioticstress.	12

Suggested Reading

1. An Introduction To Plant Tissue Culture: M K Razdan. , **Pub:**Oxford(India).
2. Plant Tissue Culture H D Kumar, ,**Pub:** Agro Bios. India
3. Plant Tissue Culture: Kalyan Kumar De: **Pub:** The New Central Book Agency, Calcutta, India
4. Fundamentals of Plant Biotechnology – AmlaBatra, **Pub**: Capital Publishing Co.

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Programme/Class: Bachelor's Degree with Research / M.Sc. Biochemistry	**Year:** First (I)	**Semester:** Second (II)

SUBJECT: BIOCHEMISTRY

Course Code: BBIOC12P	**Course Title: Practical** (Biochemical Tools and Techniques, Enzymes and Immunological Techniques)

Course Outcomes:

Course outcomes: After the successful course completion, learners will develop the uses of various molecular technical instrument like electrophoresis, PCR, PAGE and learn the advanced steps necessary for the enzymology, molecular biology and clinical biology.

Credits: 4	**Core Compulsory**
Maximum Marks: 100 (75(UE)+25(CIE))	**Minimum Passing Marks:** As per University norms

Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 0-0-8

	Topics	**No. of Practical Hours**
	1. Isolation of casein from milk and its quantification 2. Fractionation of egg proteins and its quantification 3. Preparation of buffers and titration curve of glycine 4. Determination of absorption maxima of BSA protein 5. Paper chromatography – Separation of amino acids 6. Horizontal and vertical gel electrophoresis 7. SDS PAGE for protein 8. Estimation of achromic point of salivary amylase. 9. Effect of varying substrate concentration on enzyme activity. 10. Effect of varying enzyme concentration on enzyme activity. 11. Estimation of Km and Vmax for an enzyme. 12. Effect of temperature and pH on enzyme activity. 13. Effect of inhibitors on enzyme activity. 14. Preparation of protease/ amylase entrapped in alginate beads and determination of percent entrapment. 15. Study the kinetics of the rate of protein hydrolysis by protease entrapped alginate beads 16. Determination of Blood group 17. Determination of hypersensitivity 18. Immunoblotting 19. Isolation and quantification of plasmid DNA, genomic DNA and RNA of *E. coli*/blood sample 20. Competent cells preparation of *E. coli*DH5 α cells 21. Transformation and selection of trans formant of *E. coli*DH5 α cells using antibiotics and X gal selection 22. Unit determination of restriction enzyme activity 23. Restriction digestion of DNA and gene cloning 24. Demonstration of PCR	120

Suggested Reading

1. Practical Biochemistry – K. Wilson and J. Walker (7th Edition). Pub: CambridgeUniv. Press.
2. Molecular Cloning a laboratory manual: Sambrook and Russel (Vol I, II, III)
3. Gene Cloning and DNA Analysis: An Introduction: TA Brown, Vth Eds
4. Kuby Immunology (7th Edition). Pub:WH Freeman
5. Fundamental Immunology by William E Paul, (7th Edition). Pub:Lippincott Williams and Wilkins
6. Enzymes – T. Palmer 2nd Eds

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Programme/Class: Bachelor's Degree with Research / M.Sc. Biochemistry (I)	**Year:** First (I)	**Semester:** Second (II)
SUBJECT: BIOCHEMISTRY		
Course Code: BI10213R	**Course Title: Industrial Training/Surveys/Research Project I**	
This research project can be interdisciplinary / multi-disciplinary. This research project can also be in the form of industrial training / internship / survey work etc.		
Credits: 8	**Core Compulsory**	
Maximum Marks: 100* **(75(UE)+25(CIE))**	**Minimum Passing Marks:** As per University norms	
*** Students will submit the final report (project report/dissertation) of the research project carried out in both the semesters at the end of the year, which will be assessed jointly by the supervisor and the external examiner nominated by the university at the end of the year out of 100* marks**		

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Programme/Class: Bachelor's Degree with Research / M.Sc. Biochemistry (I)	Year: First (1)	**Semester:** Second (II)
SUBJECT: BIOCHEMISTRY		
Course Code: B110213R	**Course Title: Industrial Training/Surveys/Research Project I**	
This research project can be interdisciplinary / multi-disciplinary. This research project can also be in the form of industrial training / internship / survey work etc.		
Credits: 8	**Core Compulsory**	
Maximum Marks: 100* (75(UE)+25(CIE))	**Minimum Passing Marks:** As per University norms	
*** Students will submit the final report (project report/dissertation) of the research project carried out in both the semesters at the end of the year, which will be assessed jointly by the supervisor and the external examiner nominated by the university at the end of the year out of 100* marks**		

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SEMESTER III

Programme/Class: Bachelor's Degree with Research / M.Sc. Biochemistry (II)	Year: Second(2)	Semester: Third (III)

SUBJECT: BIOCHEMISTRY

Course Code: B110314T	Course Title: Human Physiology and Endocrinology

Course Outcomes (COs)

The student at the completion of the course will learn to understand: **CO 1:** Students will learn detail about the blood composition and their functions and various disorders associated to it.**CO 2:** Students will learn the mechanism of food digestion. **CO 3:** Students will learn the mechanism of muscle contraction and regulation. **CO 4:** Students will learn the detail about nervous system and their regulation. **CO 5:** Students will learn the detail about respiratory system and their regulation.**CO 6:** Students will learn the detail about various hormones production, their action and regulation.

Credits: 4	Core Compulsory
Maximum Marks: 100 (75(UE)+25(CIE))	Minimum Passing Marks: As per University norms

Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	Blood – Composition and functions of plasma, erythrocytes including Hb, leucocytes and thrombocytes, plasma proteins, Blood coagulation mechanism and regulation, transfer of blood, Disturbances in blood clotting mechanism – Hemorrhagic disorders – hemophilia, acquired prothrombin complex disorders.	10
II	Digestive system – Composition, functions and regulation of saliva, gastric, pancreatic intestinal and bile secretions, Digestion and absorption of carbohydrates, lipids, proteins, and nucleic acids. Vitamins – Dietary sources, biochemical functions and specific deficiency diseases associated with fat and water soluble vitamins. Hypervitaminosis, nutritional requirements of vitamins during infancy, childhood, adolescence, pregnancy, lactation and aging. Minerals – nutritional significance of dietary calcium, phosphorus, magnesium, iron, iodine, zinc and copper.	10
III	Muscle Biochemistry – Skeletal muscle structure, Plasmolemma, transverse tubules, sarcoplasmic reticulum and myofibrils. Actinmyosin, tropomyosin components. Molecular mechanism of muscle contraction, role of calmodulin. Comparative anatomy of heart structure, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above.	10
IV	Nervous System – Neuromorphology – Organization of neurons Dendrites and axons, glial cells, astrocytes, oligodendrocytes. Neurophysiology: Excitation neurons, generation and conduction of action potential, saltatory conduction, ion channels and transport of ions, Biochemistry of vision and odor reception.	10
V	Respiratory system - Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.Excretory system - Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance,	10
VI	Endocrinology: Mechanism of hormone action, signaling pathways, G proteins, second messengers, lipids as signaling molecules. Chemistry, functions, deficiency conditions and feedback controls of hormones produced by: Pituitary. Thyroid. Parathyroid. Pancreas. Gonads: Ovary, Testis. Pineal gland. Other hormone producing structures. Autocrine and paracrine compounds.	10

Suggested Reading

1. Principles of Animal Physiology: Christopher D, II Eds
2. Biochemistry – Harper 28th
3. Textbook of Medical Physiology: Gyton and Hall 12thEds

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Programme/Class: M. Sc. Biochemistry (II)	Year: Second (II)	Semester: Third (III)

SUBJECT: BIOCHEMISTRY

Course Code: B110315T	Course Title: Intermediary Metabolism

Course Outcomes (COs)

The student at the completion of the course will learn to understand:**CO 1:** Students will learn detail about the metabolic connection and production of bile. **CO 2:** Students will learn the detail of carbohydrates metabolism. **CO 3:** Students will learn the detail of Lipids metabolism. **CO 4:** Students will learn the detail of protein metabolism. **COV:** Students will learn the detail of nucleic acid metabolism.

Credits: 4	Core Compulsory
Maximum Marks: 100 (75(UE)+25(CIE))	**Minimum Passing Marks:** As per University norms

Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	Intermediary metabolism – Approaches for studying metabolism.Porphyrin – Biosynthesis and degradation of porphyrins. Production of bile pigments.	10
II	Carbohydrates – Glycolysis, Rapaport cycle, Role of 2,3 BPG, Citric acid cycle, oxidative phosphorylation, chemiosmotic coupling theory, mechanism of ATP synthesis, uncouplers ; pentose phosphate pathway, glycogenesis, gluconeogenesis and glycogenolysis, Cori cycle. Glyoxalate cycle, synthesis of lactose. Hormonal regulation of carbohydrate metabolism Energetics of metabolic cycle.	14
III	Lipids: Introduction, hydrolysis of triacylglycerols; α, β and oxidation of fatty acids. Oxidation of odd numbered fatty acids, fate of propionate, role of carnitine, degradation of complex lipids. Fatty acid biosynthesis (acetyl CoA carboxylase, fatty acid synthase).Lipid biosynthetic pathway for triacylglycerols, phosphoglycerides and sphingomyelin. Prostaglandins. Metabolism of cholesterol and its regulation. Formation of ketone bodies, Metabolism in starvation	14
IV	Amino Acids: Metabolism of amino acid (Transamination, decarboxylation, oxidative and non: oxidative deamination of amino acids). Special metabolism of methionine, histidine, phenylalanine, tryptophan, lysine, valine, leucine and isoleucine. Urea cycle and its regulation.	12
V	Nucleotides: Biosynthesis and degradation of purine and pyrimidine nucleotides and its regulation. Purine salvage pathway, interconversion of nucleotides	10

Suggested Reading

1. Intermediary Metabolism:Otto Hoffmann:Ostenh
2. Principles of Biochemistry – A.L. Lehninger, Vth
3. Biochemistry – Stryer, Vth
4. Biochemistry – D. Voet, J and G Voet, II
5. Biochemistry – Harper, 28th
6. Biochemistry – David Rawn, ^{IV}
7. Biochemistry – Zubay and ZubayIII

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Programme/Class: :M. Sc. Biochemistry (II)	Year: Second (II)	Semester: Third (III)
SUBJECT: BIOCHEMISTRY		
Course Code: B110316T	Course Title: Biostatistics & Bioinformatics	

Course Outcomes (COs)

(SECTION A): BIOINFORMATICS

This course introduces the basic principles of Bioinformatics and after completion of this course, students will be able to: **CO 1**:Understand the basic theories and practical of common computational tools **CO 2:**Understand databases which facilitate investigation of molecular biology and evolution-related concepts.Critically analyse and interpret results of their studies with the help of bioinformatics tools**CO 3:** Understand phylogenetic analysis and Primer designing with bioinformatics tools.

(SECTION B): BIOSTATISTICS

On completion of this course,students should be able to :**CO 4** Gain broad understanding in statistics;Recognize importance and value of statistical thinking, training, and approach to problem solving, on a diverse variety of disciplines.**CO 5** Critically analyse and interpret results of their study.

Credits: 4	Core Compulsory
Maximum Marks: 100 (75(UE)+25(CIE))	Minimum Passing Marks: As per University norms

Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	History, aims of Bioinformatics, Definition and Concepts, Components of Bioinformatics, Basic tools, Scope of Bioinformatics in molecular biology and Computers, Introduction, classification and generation of computers, components of a computer system, input andoutput devices. Computers in biology and medicine.Role of internet in Bioinformatics.	12
II	NCBI; publicly available tools; resources at EBI; resources on web Biological Data Base: Primary, Secondary and Composite database;Nucleotide sequence databases;Protein sequence databases;Structural sequence databases:	12
III	Sequence analysis; Sequence alignment: Types and methods; phylogenetic analysis.Primer designing;Role of Bioinformatics in drug discovery and development	12
IV	Scope of biostatistics, Variables in biology. Collection, classification, tabulations and diagrammatic presentation of statistical data Concepts of statistical population and sample. Measures of central tendencies and Dispersion. Simple measure ofSkewness and kurtosis.	12
V	Probability – Definition, simple theorems of probability and simple application of probability.Correlation, correlation coefficient, standard error of estimate and regression, linear regressions, leastsquare method of fitting. Basic idea of significance, testing level of significance, random variations. Chi-square ($\chi 2$) test, ANOVA.	12

Suggested Reading

1. Mount David W.. Bioinformatics: Sequence and Genome Analysis. Publisher: Cold Spring Harbor Laboratory Press
2. Baxevanis Andreas D. Bioinformatics: A Practical Guide to the Analysis of Genes and
3. Proteins, Latest Edition. Publisher: New York, John Wiley & Sons, Inc.
4. Teresa Attwood, Parry-Smith David J. Introduction to Bioinformatics. Publisher: Pearson Education (Singapore) Pte.Ltd.
5. Gibas Cynthia, JambeckPer. Developing Bioinformatics Computer Skills. Publisher: Shroff Publishers and distributors O'Reilly Media, Inc., Latest Edition
6. Biostatistics – Garret
7. Encyclopedia of Biostatistics – Peter Armitage& Theodore Colton
8. Statistics – Schaum's Series Publication.
9. Statistical analysis – A computer oriented approach IInd Ed. Academic Press New York
10. Fundamentals of statistics – D.N. Elhance

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Programme/Class: M. Sc. Biochemistry (II)	Year: Second (II)	Semester: Third (III)

SUBJECT: BIOCHEMISTRY

Course Code: B110317T	Course Title: Plant Biochemistry

Course Outcomes (COs)

The student at the completion of the course will learn to understand:**CO 1:** Students will learn detail about thePhotosynthesis, **CO 2:** Students will learn the detail of Nitrogen metabolism**CO 3:** Students will learn the detail of Plant hormones, **CO 4:** Students will learn the detail of Stress Metabolism in Plants. **CO 5:** Students will learn the detail of secondary plant metabolism.

Credits: 4	Elective
Maximum Marks: 100 (75(UE)+25(CIE))	Minimum Passing Marks: As per University norms

Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	Photosynthesis: Photosynthetic apparatus, pigments of photosynthesis, role of carotenoids, photosynthetic unit, photosystems I and II and their location; Hill reaction, photosynthetic electron transport and generation of NADPH and ATP, cyclic and noncyclic photophosphorylation, complexes associated with thylakoid membranes; C3, C4 and CAM pathway of carbon reduction and their regulation, photorespiration.	12
II	Nitrogen metabolism: Biochemistry of biological nitrogen fixation. Nitrate assimilation and its regulation, incorporation of ammonia into organic compounds, Structural features of nitrate reductase and nitrite reductase.	12
III	Plant hormones: Biosynthesis, storage, breakdown and transport. Functions and mode of action of Auxin, Gibberelins, Abscisic acids, Ethylene and Cytokinins. Plant tissue culture: General introduction, Initiation and maintenance of callus and suspension cultures.	12
IV	Stress Metabolism in Plants: Responses of plants to biotic (pathogen and insects) and abiotic (Environmental stresses, salinity, water stress, heat, chilling anaerobiosis, heavy metals, radiations) and their impact on plant growth and metabolism. Photoreceptors: Photopreception and its role in plant response regulation and Structure and function of phytochromes, cryptochromes and phototropins. Stomatal movement; photoperiodism and biological clocks.	12
V	Special features of secondary plant metabolism: Terpenes (classification, biosynthesis), tannins, waxes. Alkaloids: Classification, biosynthesis of nicotine, functions of alkaloids. Toxins of plant origin: Mycotoxins, Phytohaemagglutinin, Trypsin inhibitors, Lethyrogens, Plant nitriles, Protein toxins (Ricin, Abrin).	12

Suggested Reading

1. Plant Physiology: C. Hopkins, IV Eds
2. Plant Physiology: Salisbury and Ross, IV Eds
3. An Introduction to Plant Tissue culture: MK Razdan.,
4. Plant Tissue culture: HD Kumar.,
5. Plant Tissue Culture: Kalyan Kumar De.,
6. Principles of Biochemistry – A.L. Lehninger, Fifth Edition
9. Biochemistry – Harper, 31th Eds
10. Plant Physiology By Taiz and Zeiger 3rd edition

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Programme/Class: :M. Sc. Biochemistry (II)	Year: Second (II)	Semester: Third (III)
SUBJECT: BIOCHEMISTRY		
Course Code: B110318T	Course Title: Nutritional Biochemistry	

Course Outcomes (COs)

The student at the completion of the course will learn to understand:**CO 1:** The importance of food nutrition in the health and various parameter for the measurement of health, **CO 2:** Importance of Carbohydrates in the nutrition and health, **CO 3:** Importance of Lipids in the nutrition and health, **CO 4:** Importance of Protein in the nutrition and health, **CO 5:** Importance of Vitamins and Minerals in the nutrition and health

Credits: 4	Elective
Maximum Marks: 100 (75(UE)+25(CIE))	Minimum Passing Marks: As per University norms

Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	**Introduction to Nutrition and Energy Metabolism:** Defining nutrition, role of nutrients. Unit of energy, Biological oxidation of foodstuff. Measurement of energy content of food, Physiological energy value of foods, SDA. Measurement of energy expenditure. Direct and indirect calorimetry, factors affecting thermogenesis, energy utilization by cells, energy output – Basal and resting metabolism, physical activity, factors affecting energy input - hunger, appetite, energy balance Energy expenditure in man. Estimating energy requirements, BMR factors Recommended nutrient intakes (RNI) and recommended dietary allowances for different age groups.	12
II	**Carbohydrates:** Review functions of carbohydrates. Digestion, absorption,utilization and storage, hormonal regulation of blood glucose. Dietary requirements and source of carbohydrates, Dietary fiber, role of fiber in lipid metabolism, colon function, blood glucose level and GI tract functions.	10
III	**Lipids:** Review of classification, sources, functions, digestion, absorption, utilization and storage. Essential fatty acids; Functions of EFA, RDA, – excess and deficiency of EFA. Lipotropic factors, role of saturated fat, cholesterol, lipoprotein and triglycerides. Importance of the following: a) Omega – fatty acids. Omega 3/ omega 6 ratio b) Phospholipids c) Cholesterol in the body d) Mono, polyunsaturated and saturated fatty acids.	12
IV	**Proteins:** Review of functions of proteins in the body, Digestion and absorption. Essential and nonessential amino acids. Amino acid availability antagonism, Toxicity and imbalance, Amino acid supplementation. Effects of deficiency. Food source and RDA for different age group. Amino acid pool. NPU, Biological value, Nitrogen balance. PEM and Kwashiorkor.	14
V	**Vitamins And Minerals:** Vitamin A, C, E,K, B complex and D Dietary sources, RDA, Adsorption, distribution, metabolism and excretion (ADME), Deficiency. Calcium, phosphorus and iron - distribution in the body digestion, Absorption, Utilization, transport, excretion, balance, deficiency, toxicity, sources, RDA. Calcium: Phosphorus ratio, Role of iron in prevention of anemia. Iodine and iodine cycle. Iodine, Fluoride, Mg, Cu, Zn, Se, Manganese, chromium, molybdenum distribution in the human body, Physiology, function, deficiency, toxicity and sources.	12

Suggested readings

1. Textbook of Biochemistry with Clinical Correlations (2011) Devlin, T.M. John Wiley & Sons, Inc. (New York),
2. Nutrition for health, fitness and sport (2013) ; Williams.M.H,Anderson,D.E. Rawson,E.S. McGraw Hill international edition.
3. Krause's Food and Nutrition Care process.(2012); Mahan, L.K Strings,S.E, Raymond,J. Elsevier's Publications.
4. The vitamins, Fundamental aspects in Nutrition and Health (2008); G.F. Coombs Jr. Elsevier's Publications.
5. Principles of Nutritional Assessment (2005) Rosalind Gibson. Oxford University Press.

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Programme/Class: M.Sc. Biochemistry (I)	Year: Second (II)	Semester: Third (III)
SUBJECT: BIOCHEMISTRY		
Course Code: B110319P	Course Title: Practical (Human Physiology, Endocrinology, Biostatics and Biochemistry)	

Course Outcomes (COs)

The student at the completion of the course will learn to understand:
Uses of clinical sample in diagnosis of diseases, various clinical biomarkers, antioxidant potential. Despite these student will also learn the biostatical methods to analyses the research data as well as bioinformatics of drugs interaction, primer designing etc.

Credits: 4	Core Compulsory
Maximum Marks: 100 (75(UE)+25(CIE))	Minimum Passing Marks: As per University norms

Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 0-0-8

	Topics	No. of Lectures
	1. Collection storage and transportation of biological samples. 2. Collection of blood and preparation of serum, plasma and erythrocytes 3. Osmotic fragility of Erythrocytes 4. Determination of Malondialdehyde in plasma and RBCs membrane 5. Estimation of antioxidant potential of plasma. 6. Estimation of micronutrients viz. Iron, iodine and vitamin A. 7. Estimation of SGPT, SGOT, Alkaline phosphatase, total cholesterol, triglycerides in serum 8. Determination of Hb, cell count, ESR blood samples. 9. Measurement of antioxidant potential of food. 10. Detection of amino acids by 2D paper chromatography. 11. Purification of proteins by dialysis. 12. Estimation of cholesterol. 13. Estimation of bile pigments. 14. Antioxidant potential measurement by DPPH and ABTS methods 15. Biostatistics: Diagrams and graphs; measure of central tendencies and dispersion , measure of skewness and kurtosis, Probability, Normal, Binomial and Poisson distribution, correlation and regression, Normal deviates and students "T" test; Chi Square test, Analysis of variance, Correlation analysis, Regression analysis. 16. Analysis of sequence data and searching of research papers from various national and international journals 17. Retrieval of gene and protein sequences from data bank 18. Sequence comparisons and alignment (8P) 19. Visualisation and other utilities (PDB viewer) 20. Extraction, separation and determination of absorption spectra of plant pigments. 21. Extraction and partial purification of plant proteins by ammonium Sulfate / Acetone fractionation.	120

Suggested readings:

1. Textbook of Biochemistry with Clinical Correlations (2011) Devlin, T.M. John Wiley & Sons, Inc. (New York),
2. Nutrition for health, fitness and sport (2013) ; Williams.M.H,Anderson,D.E, Rawson,E.S. McGraw Hill international edition
3. Teresa Attwood, Parry-Smith David J. Introduction to Bioinformatics. Publisher: Pearson Education (Singapore) Pte.Ltd.
4. Gibas Cynthia, JambeckPer. Developing Bioinformatics Computer Skills. Publisher: Shroff Publishers and distributors O'Reilly Media, Inc., Latest Edition
5. Biostatistics – Garret
6. Intermediary Metabolism:Otto Hoffmann:Ostenh
7. Principles of Biochemistry – A.L. Lehninger, Vth
8. Textbook of Medical Physiology: Gyton and Hall 12thEds

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SEMESTER IV

Programme/Class: M. Sc. Biochemistry (II)	Year: Second (II)	Semester: Fourth (IV)
SUBJECT: BIOCHEMISTRY		
Course Code: B110421T	Course Title: Clinical Biochemistry	

Course Outcomes (COs)

The student at the completion of the course will learn to understand:**CO 1:** The type of various clinical sample, their isolation and preservation, Laboratory safety and regulations **CO 2:** Importance of Carbohydrates metabolism and disorders specially diabetes, **CO 3:** Importance of Lipids and proteinmetabolic disorders and their diagnosis, **CO 4:**Enzymes as diagnostic tools in health and diseases **CO 5:**Basic concepts of Health and Nutrition.

Credits: 4	Elective
Maximum Marks: 100 (75(UE)+25(CIE))	Minimum Passing Marks: As per University norms

Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	Types of Samples, Sample Processing, composition and types of blood specimens, sample collection, venipuncture, preservation, influence of nutrition, drugs, posture, etc., use of anticoagulants; Care of the specimens, identification, transport, storage, influence of temperature, freezing/thawing; Laboratory safety and regulations – Safety awareness, safety equipment, Diagnostic efficiency, Method evaluation, Quality Control and quality management, concepts of Good Laboratory Practices (GLP).	12
II	Disorders of carbohydrate metabolism – Insulin dependent and insulin independent, glucose and galactose tolerance tests, sugar level in blood, renal threshold for glucose, factors influencing blood glucose level. Regulation of blood glucose concentration, melituria, glycogen storage diseases, pentosuria, galactosemia.	12
III	Disorders of lipids: plasma lipoproteins, cholesterol, triglycerides and phospholipids in health and disease, hyperlipidemia, hyperlipoproteinemia, Gaucher's disease, ketone bodies, Obesity, Ketosis. Inborn Errors of metabolism – Phenylketonuria, alkaptonuria, albinism, tyrosinosis, maple syrup urine disease, sickle cell anemia.	12
IV	Enzymes as diagnostic tools – Enzymes in health and diseases. Serum Enzymes, Biochemical diagnosis of diseases by enzyme assays – SGOT, SGPT, aldolase, amylase, CPK, cholinesterase, LDH. Clinical aspects of gastric secretion analysis, tests of gastric, biomolecular markers.	12
V	Health and Nutrition-Basic concepts of Health and Nutrition: Dietary requirement of carbohydrates, lipids and proteins, Biological value of proteins. Malnutrition – Prevention of malnutrition, improvement of diets, roles of vitamins. Recommended dietary allowances. Protein: calorie malnutrition under different physiological conditions. Basal metabolic rate: factors affecting BMR, measurement and calculation of BMR. Body mass index (BMI), Calorific value and biological value of biomolecules in foods. Specific Dynamic action (SDA).	12

Suggested Reading

1. Textbook of Biochemistry With Clinical Correlations: Thomas M. Devlin; 7^{the}Eds
2. Marks' Basic Medical Biochemistry: A Clinical Approach: Lippincott Williams and Wilkins; III Eds
3. A Laboratory Manual for human blood analysis, by M K Bhasin and S M S Chahal,
4. Principles of Biochemistry – A.L. Lehninger, V Eds
5. Biochemistry – D. Voet, J and G Voet, II
6. Biochemistry – Harper, 28thEds
7. Nutritional Biochemistry:S. Ramakrishnan and S. Venkat Rao. III Eds

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Programme/Class: M. Sc. Biochemistry (II)	**Year: Second (II)**	**Semester:** Fourth(IV)
SUBJECT: BIOCHEMISTRY		
Course Code: B110422T	**Course Title: Pathophysiology of Human Diseases**	

Course Outcomes (COs)

The student at the completion of the course will learn to understand:**CO 1:** Various types of diseases associated with Liver, their symptoms, diagnosis and treatment.**CO 2:**Various types of diseases associated with Heart, their symptoms, diagnosis and treatment.**CO 3:**Various types of diseases associated with Kidney, symptoms, diagnosis and treatment.**CO 4:**Various types of diseases associated with Eye, their symptoms, diagnosis and treatment.**CO 5:**Various types of diseases associated with Neurons, their symptoms, diagnosis and treatment. **CO 5:**Various types of diseases associated with skeletal system and bone.

Credits: 4	**Elective**
Maximum Marks: 100 (75(UE)+25(CIE))	**Minimum Passing Marks:** As per University norms

Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	Hepatic disorder/ Diseases - Biochemical functions - Excretory and Secretory, Synthetic, Detoxification and Drug Metabolism, Liver function alterations during disease – Jaundice, Fatty liver, Cirrhosis, Tumors, Reye Syndrome, Drug- and Alcohol-Related Disorders, Assessment of liver function/liver - Function tests: Bilirubin, Urobilinogen in Urine and Faeces, Serum Bile Acids, Enzymes, Tests Measuring Hepatic Synthetic Ability, Tests Measuring Nitrogen Metabolism, Hepatitis.	12
II	Cardiovascular disorder/Diseases - Pathologic conditions of the heart, Cardiovascular Disease, Congenital heart Defects, Heart Failure, Diagnosis of heart disease - Laboratory Diagnosis of Myocardial Infarction, biomolecular markers, Electrocardiogram (ECG), Echocardiography. Effects of blood pressure on various organ functions.	12
III	Renal disorder/Diseases - Glomerular Filtration, Tubular Function, Elimination of Nonprotein Nitrogen Compounds, Gall stone formation, Clearance Measurements, Urine Electrophoresis, Pathophysiology – Glomerular Diseases, Tubular Diseases, Obstruction, Renal Calculi, Renal Failure. Alteration of urine composition under pathological condition and clinical significance Abnormalities in Nitrogen Metabolism – Uremia, hyperuricemia, porphyria and factors affecting nitrogen balance. Kidney and bladder problems with ageing, Enlarged prostate.	12
IV	Eye/ Vision related disorder/Diseases- Cataract, Night Blindness, glaucoma, color blindness.	8
V	Neurological Disorders/Disease- Neurological disorder in progressive ageing, Parkinson's and Alzheimer's disease, Dementia, Multiple sclerosis, Circadian rhythm and disorders, Arthritis, Macular degeneration, Bipolar disorder,	10
VI	Skeletal system and Bone Related disorder/Diseases -Osteoporosis, Arthritis, osteoarthritis, rheumatoid arthritis.	6

Suggested Reading

1. Harrison's Principles of Internal Medicine, Twenty-First Edition (Vol.1 & Vol.2)
2. Textbook of Biochemistry With Clinical Correlations: Thomas M. Devlin; 7^{the}Eds
3. Marks' Basic Medical Biochemistry: A Clinical Approach: L. Williams and Wilkins; III Eds
4. A Laboratory Manual for human blood analysis, by M K Bhasin and S M S Chahal,
5. Biochemistry – Harper, 28thEds
6. Nutritional Biochemistry: S. Ramakrishnan and S. Venkat Rao. III Eds
7. Harrisons: Internal Medicine
8. Human Physiology by Gyton
9. Human Physiology of C.C. Chatterjee

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Programme/Class: M. Sc. Biochemistry (II)	Year: Second (II)	Semester: Fourth (IV)

SUBJECT: BIOCHEMISTRY

Course Code: B110423T	Course Title: Advance Enzymology

Course Outcomes (COs)

The student at the completion of the course will learn to understand: **CO 1:** Fast reaction Kinetics of enzymes and various Experimental techniques to measure the kinetics.**CO 2:** Regulation of enzymes activity. **CO 3:** Various Mechanism of enzyme action **CO 4:**Physicochemical properties and mechanism of action of specific common enzymes.**CO 5:**Immobilization of various enzymes by chemical and physical methods.

Credits: 4	Elective
Maximum Marks: 100 (75(UE)+25(CIE))	Minimum Passing Marks: As per University norms

Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	Fast reaction Kinetics – Experimental techniques (continuous flow, stopped flow, quenched flow and relaxation methods). Two substrate systems – kinetic mechanisms – sequential and ping-pong pathways, Cleland representation and nomenclature of initial rate equations for random, ordered and ping pong pathways and their primary and secondary plots, methods of determining kinetic pathways, inhibition by high substrate concentrations.	12
II	Regulation of enzyme activity: feedback inhibition, allosteric concept, qualitative description of concerted and sequential models, positive and negative cooperativity, halfsite reactivity, covalent modification.	12
III	Mechanism of enzyme action: concept of active site, chemical modification, general mechanistic principles. Multifunctional and multi enzyme systems and their significance.	12
IV	Physicochemical properties and mechanism of action of enzymes; chymotrypsin, lysozyme, alcohol dehydrogenase, glyceraldehydes – 3 phosphate dehydrogenase, aldolase.	12
V	Immobilization of enzymes by chemical and physical methods, effect of partition on kinetics and on changes in pH hydrophobicity. Brief account of role of enzymes in synthetic industry, food industry, medicines, Synzymes.	12

Suggested Reading

1. Enzyme Kinetics – K.M. Plaownan (M.C. Grow Hill), 10th
2. Enzyme Kinetics – I.H. Segal (Willey and Sons), III Eds
3. Enzymatic reaction mechanism – C.S. Wash (Freeman), 2nd Eds
4. Immobilized enzymes – M.D. Trevan (Willey), II Eds
5. Enzymes – T. Palmer, II Eds
6. Enzymes kinetics – Dixan and Webb.

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Modified in BOS Meeting, July 27, 2024

Programme/Class: M. Sc. Biochemistry (II)	Year: Second (II)	Semester: Fourth (IV)

SUBJECT: BIOCHEMISTRY

Course Code: B110424T	Course Title: **Molecular Basis of Infectious Diseases**

Course Outcomes (COs)

The student at the completion of the course will learn to understand: **CO 1:** Type of infectious agents in human diseases, **CO 2:**Detail about bacterial disease and their preventive methods **CO 3:**Detail about Viral disease and their preventive methods, **CO 4:**Detail about various parasite in human disease and their preventive methods, **CO 5:**Detail about Fungal disease and their preventive methods

Credits: 4	**Elective**
Maximum Marks: 100 (75(UE)+25(CIE))	**Minimum Passing Marks:** As per University norms

Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	Classification of infectious agents: Bacteria, viruses, protozoa and fungi. Past and present emerging and re-emerging infectious diseases and pathogens. Source, reservoir and transmission of pathogens, Antigenic shift and antigenic drift. Overview of viral and bacterial pathogenesis. Infection and evasion.	12
II	Overview of diseases caused by bacteria: Detailed study of tuberculosis: History, causative agent, molecular basis of host specificity, infection and pathogenicity, diagnostics, therapeutics, inhibitors and vaccines. Drug resistance and implications on public health. Other bacterial diseases including Typhoid, Diphtheria, Pertussis, Tetanus, Typhoid and Pneumonia.	10
III	Overview of diseases caused by viruses: Detailed study of AIDS, history, causative agent, pathogenesis, Diagnostics, Drugs and inhibitors. Other viral diseases including hepatitis, influenza, rabies, chikungunya and polio.	12
IV	Diseases caused by parasites: Detailed study of malaria, history, causative agents, vectors, life cycle, Host parasite interactions, Diagnostics, drugs and Inhibitors, resistance, vaccine development. Other diseases including leishmaniasis, amoebiasis.	14
V	Classification of infectious fungi: Fungal diseases, general characteristics. Medical importance of major groups, pathogenesis, treatment.	12

Suggested Reading

1. Prescott, Harley, Klein's Microbiology (2008) 7th Ed., Willey, J.M., Sherwood, L.M., Woolverton, C.J. Mc Graw Hill International Edition (New York) ISBN: 978-007- 126727. 44
2. Mandell, Douglas and Bennett.S, Principles and practices of Infectious diseases, 7th edition, Volume, 2. Churchill Livingstone Elsevier.
3. Sherris Medical Microbiology: An Introduction to Infectious Diseases by Kenneth
4. J. Ryan, C. George Ray, Publisher: McGraw-Hill
5. Medical Microbiology by Patrick R. Murray, Ken S. Rosenthal, Michael A. Pfaller, Elsevier Health Sciences

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Programme/Class: M. Sc. Biochemistry (II)	Year: Second (II)	Semester: Fourth (IV)

SUBJECT: BIOCHEMISTRY

Course Code: B110425T	Course Title: Basics of Forensic Science

Course Outcomes (COs)

Course Outcomes: The student at the completion of the course will learn to understand:

CO 1: Detail about forensic science laboratory and its organization and service, **CO 2:** Detail about classification of fire arms and explosives, **CO 3:** Detail about hand writing and analysis, **CO 4:** Detail about fingerprintingin identifying the suspect, **CO 5:** Detail about DNA fingerprintingin identifying the suspect.

Credits: 4	Elective
Maximum Marks: 100 (75(UE)+25(CIE))	Minimum Passing Marks: As per University norms

Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	Introduction and principles of forensic science, forensic science laboratory and its organization and service, tools and techniques in forensic science, branches of forensic science, role of modus operandi in criminal investigation. Classification of injuries and their medico-legal aspects, method of assessing various types of deaths.	12
II	Classification of fire arms and explosives, introduction to internal, external and terminal ballistics. Chemical evidence for explosives.	10
III	General and individual characteristics of handwriting, examination and comparison of handwritings and analysis of ink various samples.	12
IV	Role of the toxicologist, significance of toxicological findings, Fundamental principles of fingerprinting, classification of fingerprints, development of finger print as science for personal identification	12
V	Principle of DNA fingerprinting, application of DNA profiling in forensic medicine, Investigation Tools, Evidence Preservation, Search and Seizure of Computers, Introduction to Cyber security.	14

Suggested Reading

1. Prescott, Harley, Klein's Microbiology (2008) 7th Ed., Willey, J.M., Sherwood, L.M., Woolverton, C.J. Mc Graw Hill International Edition (New York) ISBN: 978-007- 126727. 44
2. Mandell, Douglas and Bennett.S, Principles and practices of Infectious diseases, 7th edition, Volume, 2. Churchill Livingstone Elsevier.
3. Sherris Medical Microbiology: An Introduction to Infectious Diseases by Kenneth
4. J. Ryan, C. George Ray, Publisher: McGraw-Hill
5. Medical Microbiology by Patrick R. Murray, Ken S. Rosenthal, Michael A. Pfaller, Elsevier Health Sciences

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Modified in BOS Meeting, July 27, 2024

Programme/Class: M. Sc. Biochemistry (II)	Year: Second(II)	Semester: Fourth (IV)
SUBJECT: BIOCHEMISTRY		
Course Code: B110426T	Course Title: Food Biochemistry	
Course Outcomes (COs)		
The student at the completion of the course will learn to understand: **CO 1:** Detail about history of Biochemistry in food, **CO 2:** Detail about food and beverages obtain by the food fermentation, **CO 3:** Detail about enzymes uses in food industries, **CO 4:** Detail about diseases caused by adulteration/spoiled food, **CO 5:** Detail about various methods to identify the adulteration and spoiled food.		
Credits: 4	Elective	
Maximum Marks: 100 (75(UE)+25(CIE))	Minimum Passing Marks: As per University norms	
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0		

Unit	Topics	No. of Lectures
I	Historical Background, Composition of Food, Improvement of food resources through Biochemistry (e.g. Golden Rice, Flavor savor tomato), Traditional fermented foods (meat, fish, bread, sauerkraut, tea)	12
II	Food Fermentations: Fermented milk, Cheese, Butter, Yoghurt. Alcoholic beverages (Beer, Wine, distilled beverages), Pickles, Soy products. Value addition products: High Fructose Corn Syrup, Invert Sugars, Edible fungus: Mushrooms. Concept of pre and Probiotics. Food preservation and storage.	10
III	Enzymes in Food Industry: Carbohydrase, Proteasase, Lipases, Modification of food using enzymes: Role of endogenous enzymes in food quality, Enzymes use as processing aid and ingredients. Growth of microorganisms in food: Intrinsic and extrinsic factors. Food Spoilage (microbial and non-microbial) Control mechanisms of food spoilage: Physical and Chemical	12
IV	Food and water borne diseases: Gastroenteritis, Diarrhea, Salmonellosis, Typhoid, Cholera, Polio, Hepatitis, Food borne intoxications: Staphylococcal, Bacillus, Clostridium etc. Detection of food-borne pathogens. Food preservation: Food adulteration and prevailing food standards in India. Source of microorganisms in milk and their types. Microbiological examination of milk (standard plate count, direct microscopic count, reductase and phosphatase test). Dehydration and pasteurization of milk.	14
V	Estimation of Total Plate Count in any food sample. Detection of Salmonella, E. coli in food material. MBRT test of milk samples. Malt preparation for beer making. Cheese making (Non-ripened cheese). Sauerkraut production,Acetic acid/Vinegar Production and estimation of the product. Toxin detection in the food materials. Effect of internal factors on microbial growth in food i.e. pH, Temperature, Water Activity.	12

Suggested Reading

1. Ray B and Bhunia A. 2008. Fundamental Food Microbiology, 4th Ed., CRC press, Taylor and Francis Group
2. Martin RA and Maurice OM. 2008. Food Microbiology, 3rd Ed., The Royal Society of Chemistry, Cambridge
3. James M J.. 2000. Modern Food Microbiology, 6th Ed. Aspen Publishers, Inc., Gaithersburg,Maryland
4. Frazier WC, and Westhoff DC. Food Microbiology. Fourth edition, MacGraw Hills publication
5. Lopez GFG, Canaas G, Nathan EV. Food Sciences and Food biotechnology.
6. Adams AR, and Moss MO. Food Microbiology. Third edition, Royal Society of Chemistry publishing .
7. Hohn T and Leisinger KM. Biotechnology of Food Crops in Developing Countries.

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Modified in BOS Meeting, July 27, 2024

Programme/Class: M. Sc. Biochemistry (II)	Year: Second (II)	Semester: Fourth (IV)
SUBJECT: BIOCHEMISTRY		
Course Code: B110427T	**Course Title: Environmental Biochemistry and Toxicology**	

Course Outcomes (COs)

The student at the completion of the course will learn to understand: **CO 1:** Detail about the Environmental pollution viz. air, water, sound etc. and global concern, **CO 2:** Detail about the Effluent Treatment **CO 3:** Detail about Metabolic disposition of xenobiotic compounds and their detoxification, **CO 4:** Detail about Principle of Biochemical toxicology in nature **CO 5:** Detail about various methods of Biodegradation and Bioremediation.

Credits: 4	**Elective**
Maximum Marks: 100 (75(UE)+25(CIE))	**Minimum Passing Marks:** As per University norms

Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	Environmental pollution- Air pollution : Particulate matter; compounds of carbon and sulfur, their interaction and effects on atmosphere; greenhouse effects: other type of pollution: Sound, thermal and radioactive pollution, harmful effects of UV rays, Ozone layer depletion, Ozone hole, chlorofluorocarbon and their substitution; Water Pollution: types of water bodies and their general characteristic, chief pollutant in domestic, industrial and agricultural wastes, effects of pollutants on flora and fauna.	14
II	Effluent Treatment-Types and nature of domestic, agricultural and industrial effluents (fertilizer, dairy, sugar mill, leather and tannery), wastes & byproducts and their treatments and recycling,	12
III	Metabolic disposition of xenobiotic compounds-Types of xenobiotics, their physical and chemical properties, Phase-I & II reaction, detoxification of xenobiotics by microorganisms, role of cytochrome P_{450} in detoxification.	12
IV	Principle of Biochemical toxicology: Properties of xenobiotics, type of chemical alternation, molecular mechanism of toxicology development, dose response relationship, risk assessment of chemicals; acute, short term and chronic toxicity studies, metabolic disposition, carcinogenicity and mutagenicity studies.	12
V	Biodegradation and Bioremediation-Microbial degradation of pesticides, lignin, detergent, dye, petrol and petroleum products, ways and means for abatement of environmental pollution.	10

Suggested Reading

1- Hayes' Principles and Methods of Toxicology, Sixth Edition - CRC Press
2- Prescott, Harley and Klein's Microbiology, (7th Edition, 2008) – Willey, Sherwoodand Woolverton. **Pub:** McgrawHill, International Ed.
3- Microbiology – Principles and Exploration (5th Edition, 2002), J.G. Black, **Pub**:John Wiley and Sons
4- Fundamentals of microbiology: Jeffrey: C. Pommerville 7th Eds

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Programme/Class: M. Sc. Biochemistry (II)	Year: Second (II)	Semester: Fourth (IV)

SUBJECT: BIOCHEMISTRY

Course Code: B110428T	Course Title: I.P.R. Entrepreneurship Bioetihcs & Biosafety

Course Outcomes (COs)

The student at the completion of the course will learn to understand: **CO 1:** The importance of patents of intellectual properties, **CO 2:**biological safety, Bioethics and Ethical Issues, **CO 3:** Importance of GMO in health, **CO 4:**Biological weapons. Ethical use of animals in laboratory, **CO 5:** Bioethics in relation to profession, society, and biomedicine

Credits: 4	Elective
Maximum Marks: 100 (75(UE)+25(CIE))	Minimum Passing Marks: As per University norms

Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 4-0-0

Unit	Topics	No. of Lectures
I	Introduction to Indian Patent Law. World Trade Organization and its related intellectual property provisions. Intellectual/Industrial property and its legal protection in research, design and development. Patenting in Biochemistry, economic, ethical and depository considerations.	12
II	Historical background, introduction to biological safety cabinets, primary containment for biohazards, biosafety levels of specific microorganisms, recommended biosafety levels for infectious agents and infectedanimals. Bioethics: Necessity of Bioethics, different paradigms of Bioethics – National & International. Ethical issues against the molecular technologies	10
III	Definition of genetically modified organisms (GMOs) and living modified organisms (LMOs) by government of India. Roles of institutional biosafety committee, review committee on genetic manipulation (RCGM), genetic engineering approval committee (GEAC) for GMO applications in food and agriculture, environmental release of GMOs. Biosafety assessment of pharmaceutical products such as drugs/vaccines etc.	12
IV	Definition, historic evolution, codes and guidelines, universal principles. Key to the environmentally responsible use of biotechnology, ethical implications of biotechnological products and techniques. Social and ethical implications of biological weapons. Ethical use of animals in laboratory	14
V	Bioethics in relation to profession, society, and biomedicine. Gradation of moral and ethical norms from simpler to higher levels for initiating right actions Guidelines and codes having relevance tobioethics.	12

Suggested Reading

1. Bioethics and Biosafety, 1st edition (2008), M. K Sateesh, I K International Pvt Ltd, ISBN-13: 978-8190675703.
2. The Cambridge Textbook of Bioethics, 1st edition (2008), Peter A. Singer and A.
3. M. Viens;Cambridge University Press, ISBN-13: 978-0511545566.
4. Foundation of Bioethics, 2nd edition (1996), E. H Tristram; Oxford University Press, ISBN-13: 9780195057362.
5. Social science: An introduction to the study of society, 14th edition (2010), Hunt,
6. E. F.,andColander, D. C. ; Peason/Allyn and Bacon, Boston, ISBN-13: 978- 020570271.
7. Principles of Biomedical Ethics, 6th edition (2011), Beauchamp Tl, Childress JF; Oxford University Press, 2001.
8. A Companion to Bioethics, 2nd edition (2012), Helga Kuhse, Peter Singer; John Wiley and Sons,
9. Bioethics: An Introduction to the History, Methods, and Practice, 1st edition (1997), Nancy Ann Silbergeld Jecker, Albert R. Jonsen, Robert A. Pearlman; Jones and Bartlett Learning, ISBN-13: 978-0763702281.

Modified in BOS Meeting, July 27, 2024

Programme/Class: M. Sc. Biochemistry (II)	Year: Second (II)	Semester: Fourth (IV)
SUBJECT: BIOCHEMISTRY		
Course Code: B110429P	**Course Title: Practical (Clinical Biochemistry and Pathology)**	

Course Outcomes (COs)

The student at the completion of the course will learn to understand:
The collection and storage of Biological sample, analysis and study the various clinical results. Students will also learn the guidelines of various handling methods in references to infectious disease, various biosafety level (BSL). Ideas about national international patenting-requirement, procedures, Case Studies of patents, trademarks, copyright

Credits: 4	**Core Compulsory**
Maximum Marks: 100 (75(UE)+25(CIE))	**Minimum Passing Marks:** As per University norms

Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 0-0-8

	Topics	No. of Lectures
	1. Collection storage and transportation of biological samples. 2. Determination of sugar in fasting, PP, random blood samples. 3. Estimation of antioxidant potential, SOD, catalase, GPx, GR in blood samples. 4. Estimation of cholesterol in biological sample 5. Estimation of markers of liver function test 6. Estimation of markers of kidney function test 7. Analysis of Electrocardiogram (ECG) 8. Estimation of markers of heart diseases 9. Determination of specific activity of enzyme (Amylase/Protease/ Invertase). 10. Microscopic examination of infectious microbes 11. Handling of biological infectious agents 12. Guidelines to control infectious diseases 13. Demonstration of various biosafety level (BSL), or pathogen/protection level laboratory 14. Demonstration of PCR and analysis of abnormalities. 15. Demonstration of Karyotyping of abnormal individual. 16. Food adulteration test 17. Saponification no, acid value and iodine no fatty acids 18. Estimation the nutritional value in the food. 19. Practices of food sampling and analysis parameters 20. The designing and use of the Bioethics Consultation Form 21. Handling of biological safety cabinets; primary containment for biohazards 22. Filling of Patents(Demo) 23. Group Activity: Ideas, discussion about national international patenting-requirement, procedures 24. Case Studies of patents, trademarks, copyright.	120

Suggested Reading

1. Harrison's Principles of Internal Medicine, Twenty-First Edition (Vol.1 & Vol.2)
2. Textbook of Biochemistry With Clinical Correlations: Thomas M. Devlin; 7^{the}Eds
3. Marks' Basic Medical Biochemistry: A Clinical Approach: L. Williams and Wilkins; III Eds
4. A Laboratory Manual for human blood analysis, by M K Bhasin and S M S Chahal,
5. Bioethics and Biosafety, 1st edition (2008), M. K Sateesh, I K International Pvt Ltd,
6. Foundation of Bioethics, 2nd edition (1996), E. H Tristram; Oxford University Press,
7. Ray B and Bhunia A. 2008. Fundamental Food Microbiology, 4th Ed., CRC press,
8. Enzyme Kinetics – I.H. Segal (Willey and Sons), III Eds
9. Enzymatic reaction mechanism – C.S. Wash (Freeman), 2nd Eds

Programme/Class: M. Sc. Biochemistry (II)	**Year:** Second (II)	**Semester:** Fourth (IV)
SUBJECT: BIOCHEMISTRY		
Course Code: B110430R	**Course Title: Industrial Training/Surveys/Research Project II**	
This research project can be interdisciplinary / multi-disciplinary. This research project can also be in the form of industrial training / internship / survey work etc.		
Credits: 8	**Core Compulsory**	
Maximum Marks: 100*(75(UE)+25(CIE))	**Minimum Passing Marks:** As per University norms	
*** Students will submit the final report (project report/dissertation) of the research project carried out in both the semesters at the end of the year, which will be assessed jointly by the supervisor and the external examiner nominated by the university at the end of the year out of 100* marks**		

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