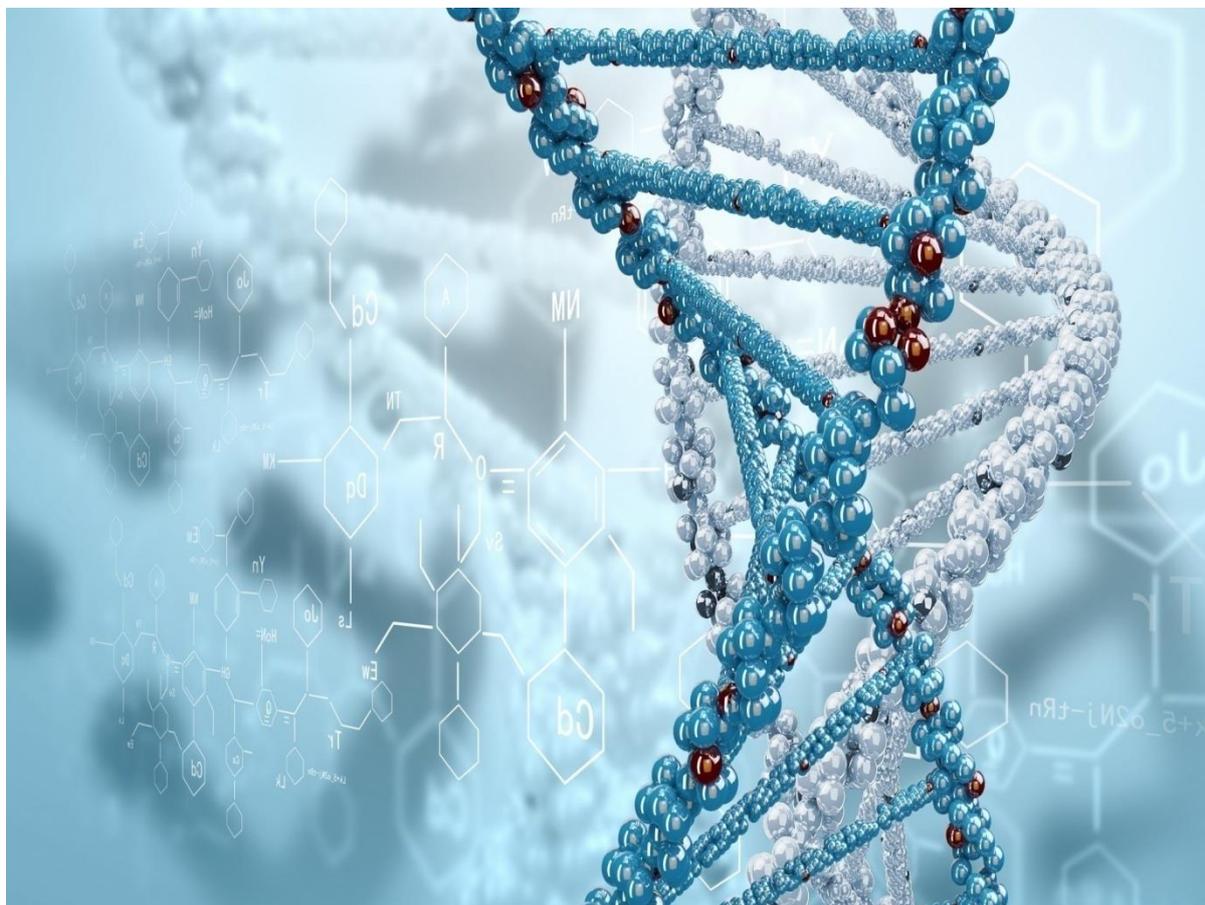


# **PROGRAMME PROJECT REPORT**

## **Master's in Biochemistry Programme (2 Year Programme in accordance with NEP-2020)**



**School of Sciences**

**U. P. Rajarshi Tandon Open University, Prayagraj**

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## 1. Master's Degree Programme

The National Education Policy (NEP) 2020 envisions a new vision that enable an individual to study one or more specialized areas of interest at a deep level, and also develop capabilities across a range of disciplines including sciences, social sciences, arts, humanities, languages, as well as professional, technical, and vocational subjects. The NEP 2020 focuses on the formulation of expected learning outcomes for all higher education programmes. It states that “National Higher Education Qualifications Framework (NHEQF)” shall be align with the National Skills Qualifications Framework (NSQF) to ease the integration of vocational education into higher education. It also points out that higher education qualifications leading to a degree/diploma/certificate shall be described by the NHEQF in terms of Outcome Based Education (OBE).

The design of M.Sc.- **Biochemistry** programme in line with NHEQF offers opportunities and avenues to learn core subjects but also to explore additional avenues of learning beyond the core subjects for holistic development of a learner.

The uniform grading system will also enable potential employers in assessing the performance of the learner. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on learner's performance in examinations, guidelines framed by the UGC are followed. Hence, adoption of NHEQF helps to overcome the gap between university degree and employability by introducing skills and competencies in the graduates.

## 2. M.Sc.- Biochemistry Programme

The structure and duration of postgraduate programme of Master's in Biochemistry in accordance with NEP 2020 includes multiple exit options within this period, with appropriate certifications:

- Level 8: A **Bachelor' Degree (Research)** for 4 year programme after completing 4th year of 4-year B.Sc. programme **OR PG Diploma in Biochemistry** after completing 1st year (2 semesters) of study of M.Sc. programme.
- Level 9: A **Master in Science (Biochemistry)** program after 2 years (4 semesters) of study;

### 2.1 Programme Mission & Objectives

In line with the mission of the University to provide flexible learning opportunities to all, particularly to those who could not join regular colleges or universities owing to social, economic and other constraints, the 2-year Post-Graduate Programme in Biochemistry aims at providing holistic and value based knowledge and guidance to promote scientific temper in everyday life. The program offers a platform to the learners to fulfill the eligible criteria in various scientific jobs in government and private sector.

The Master of Biochemistry Programme aims at the following objectives:

- Develop a broad academic and practical literacy in cell biology, nutritional chemistry, enzymology, bioinformatics, microbiology and biotechnology. Study of clinical biochemistry will be very useful in analysis and measuring of biochemical parameters that will be useful in diagnosis and medical care.
- Provide strong core training so that graduates can adapt easily to changes and new demands from industry.
- Enable students to understand not only how to apply certain methods, but when and why they are appropriate.

- Integrate fields within zoology, botany, microbiology and chemistry in biochemistry is very useful to understand the physiology of living being and their metabolic processes.
- Expose students to real-world problems in the classroom and through experiential learning.

### 2.2 Relevance of the Programme with Mission and Goals

The 2-year Post-Graduate Programme in M.Sc.- Biochemistry is designed with the objective of equipping learners to cope with the emerging trends and challenges in the scientific domain. In congruence with goals of the University the Programme also focuses to provide skilled manpower to the society to meet global demands. The Programme is designed in such a manner so that a successful learner can go for higher studies as well as join the medical and pharmaceutical industry.

### 2.3 Nature of Prospective Target Group of Learners

The Program is targeted to all individuals looking to earn a post graduation degree for employment, further higher education, promotion in career, professional development.

### 2.4 Appropriateness of Programme to be conducted in ODL mode to acquire specific skills & competence

Learning outcomes after Level 8		
Learning Outcomes	Elements of the descriptor	Level 8 Bachelor' Degree (Research) OR PG Diploma in Biochemistry
LO 1	Knowledge and understanding	<ul style="list-style-type: none"> <li>• advanced knowledge about a specialized field of enquiry, with depth in one or more fields of learning within a broad multidisciplinary/interdisciplinary context.</li> <li>• a coherent understanding of the established methods and techniques of research and enquiry applicable to the chosen fields of learning.</li> </ul>
LO 2	Skills required to perform and accomplish tasks	<ul style="list-style-type: none"> <li>• a range of cognitive and technical skills required for performing and accomplishing complex tasks relating to the chosen fields of learning,</li> <li>• cognitive and technical skills relating to the established research methods and techniques,</li> </ul>
LO 3	Application of knowledge and skills	<ul style="list-style-type: none"> <li>• apply the acquired advanced technical and/or theoretical knowledge and a range of cognitive and practical skills to analyse the quantitative and qualitative data gathered drawing on a wide range of sources for identifying problems and issues relating to the biochemistry</li> <li>• apply advanced knowledge relating to research methods to carryout research and investigations to formulate evidence-based solutions to complex and unpredictable problems.</li> </ul>
LO 4	Generic learning outcomes	<ul style="list-style-type: none"> <li>• listen carefully, read texts and research papers analytically and present complex information in a clear and concise manner to different groups/audiences,</li> <li>• communicate technical information and explanations, and the findings/results of the research studies</li> <li>• present in a concise manner one's views on the relevance and applications of the findings of research and evaluation studies in the context of emerging developments and issues.</li> </ul>

		<ul style="list-style-type: none"> <li>• pursue self-paced and self- directed learning to upgrade knowledge and skills that will help accomplish complex tasks and pursue higher level of education and research.</li> <li>• problematize, synthesize and articulate issues and design research proposals,</li> <li>• define problems, formulate appropriate and relevant research questions,</li> </ul>
LO 5	Constitutional, humanistic, ethical and moral values	<ul style="list-style-type: none"> <li>• embrace and practice constitutional, humanistic, ethical, and moral values in one's life.</li> <li>• adopt objective, unbiased, and truthful actions in all aspects of work and professional practice.</li> </ul>
LO 6	Employment ready skills, and entrepreneurship skills and mindset	<ul style="list-style-type: none"> <li>• managing complex technical or professional activities or projects, requiring the exercise of full personal responsibility for output of own work as well as for the outputs of the group as a member of the group/team.</li> <li>• exercising supervision in the context of work having unpredictable changes.</li> </ul>

<b>Learning outcomes after Level 9</b>		
<b>Learning Outcomes</b>	<b>Elements of the descriptor</b>	<b>Level 9 (Master's in - Biochemistry)</b>
LO 1	Knowledge and understanding	<ul style="list-style-type: none"> <li>• advanced knowledge about a specialized field of enquiry with a critical understanding of the emerging developments.</li> <li>• advanced knowledge and understanding of the research principles, methods, and techniques applicable professional practice.</li> <li>• procedural knowledge required for performing and accomplishing complex and specialized professional tasks relating to teaching, and research and development.</li> </ul>
LO 2	Skills required to perform and accomplish tasks	<ul style="list-style-type: none"> <li>• advanced cognitive and technical skills required for performing and accomplishing complex tasks.</li> <li>• advanced cognitive and technical skills required for evaluating research findings and designing and conducting relevant research that contributes to the generation of new knowledge,</li> <li>• specialized cognitive and technical skills relating to a body of knowledge and practice to analyse and synthesize complex information and problems.</li> </ul>
LO 3	Application of knowledge and skills	<ul style="list-style-type: none"> <li>• apply the acquired advanced theoretical and/or technical knowledge about professional practice and a range of cognitive and practical skills to identify and analyse problems and issues, including real-life problems, associated with the biochemistry</li> </ul>
LO 4	Generic learning outcomes	<ul style="list-style-type: none"> <li>• listen carefully, read texts and research papers analytically and present complex information in a clear and concise manner to different groups/audiences,</li> <li>• communicate, in a well-structured manner, technical information and explanations, and the findings/ results of the</li> </ul>

		<p>research studies,</p> <ul style="list-style-type: none"> <li>• meet one's own learning needs relating to the chosen fields of learning, work/vocation, and an area of professional practice,</li> <li>• pursue self-paced and self-directed learning to upgrade knowledge and skills, including research-related skills, required to pursue higher level of education and research.</li> </ul>
LO 5	Constitutional, humanistic, ethical and moral values	<ul style="list-style-type: none"> <li>• embrace and practice constitutional, humanistic, ethical and moral values in one's life,</li> <li>• adopt objective and unbiased actions in all aspects of work and professional practice,</li> <li>• participate in actions to address environmental protection and sustainable development issues,</li> </ul>
LO 6	Employment ready skills, and entrepreneurship skills and mindset	<ul style="list-style-type: none"> <li>• adapting to the future of work and responding to the demands of the fast pace of technological developments and innovations that drive shift in employers' demands for skills, particularly with respect to transition towards more technology-assisted work involving the creation of new forms of work and rapidly changing work and production processes.</li> <li>• exercising full personal responsibility for output of own work as well as for group/ team outputs and for managing work that are complex and unpredictable requiring new strategic approaches.</li> </ul>

## 2.5 Instructional Design

### 2.5.1 2-year M.Sc.- Biochemistry Programme Structure

The University follows the credit system in all its programmes. One credit is equal to 30 hours of learner's study time which is equivalent to 15 lectures in conventional system. To earn a Master's Degree, a learner has to earn 80 credits in minimum four semesters (two years) with 20 credits per semester. For earning 80 credits, a learner has to go through the following Programme Structure:

#### Programme Structure of M.Sc.- Biochemistry under NHEQF

Level	Year	Sem	Core Course 1	Core Course 2	Core Course 3	Research component	Practical Lab/ Dissertation with viva voce	Total credit
8	1	1 <sup>st</sup>	4	4	4	4	4	20
		2 <sup>nd</sup>	4	4	4	4	4	20
9	2	3 <sup>rd</sup>	4	4	4	4	4	20
		4 <sup>th</sup>	4	4	4	4	4	20
<b>Total credit</b>								<b>80</b>

#### Explanation of terms used for categorization of courses:

- Course 1 to 3:** A course, which should compulsorily be studied by a learner as a core requirement is termed as a Core course.
- Research Component:** The components included in this category are Basics in Research (PGBR-01), Mini Project (PGMP-02), Basic Research Tools (PGRT-03).
- Practical Lab:** Lab based on courses discussed in theory papers.
- Industrial Training/ Survey/ Research Project/ Field Work/Apprenticeship/ Dissertation/ Internship:** A course designed to acquire special/advanced knowledge,

such as supplement study/support study to a project work, and a learner studies such a course on his own with an advisory support by a counsellor/faculty member.

**2.5.2 Course curriculum:** The details of syllabus is given in Appendix-I

**2.5.3 Language of Instruction:** SLM is provided in English. However, learner can write assignment and give Term End Examination (TEE) either in Hindi or English.

**2.5.4 Duration of the Programme**

Minimum duration in years: 02

Maximum duration in years: 04

**2.5.5 Faculty & Support Staff**

Professor (2), Assistant Professor (5) and support staff (3)

## **2.6 Instructional Delivery Mechanisms**

The Open University system is more learner-oriented, and the student is an active participant in the teaching-learning process. Most of the instructions are imparted through distance rather than face-to-face communication.

The University follows a multi-media approach for instruction. It comprises of:

- self-instructional printed material (Self Learning Material)
- audio and video lectures
- face-to-face counselling
- assignments
- laboratory work
- Project work in some courses
- teleconference/web conference
- Web Enabled Academic Support Portal
- e-GYANSANGAM (Open Educational Repository):  
<http://gyansangam.uprtou.ac.in>
- e-GYANARJAN: Its a Learning Management System based on Moodle (<http://gyanarjan.uprtou.ac.in>) to aid the learner through web conferencing, sharing of learning resources, counselling classes etc.

### **2.6.1 Self-Learning Material**

The Self Learning Material (SLMs) are prepared in line with the UGC guidelines on preparation of SLMs. The prepared study materials are self-instructional in nature.

The course material is divided into blocks. Each block contains a few units. Lessons, which are called Units, are structured to facilitate self-study. The units of a block have similar nature of contents. The first page of each block indicates the numbers and titles of the units comprising the block. In the first block of each course, we start with course introduction. This is followed by a brief introduction to the block. After the block introduction, emphasis is given on contribution of ancient Indian knowledge into that specific course. Next, each unit begins with an introduction to talk about the contents of the unit. The list of objectives are outlined to expect the learning based outcome after working through the unit. This

is followed by the main body of the unit, which is divided into various sections and sub-sections. Each unit is summarized with the main highlights of the contents.

Each unit have several “Check Your Progress” Questions and Terminal Questions /exercises. These questions help the learner to assess his/her understanding of the subject contents. At the end of units, additional references/books/suggested online weblink for MOOCs/Open Educational Resources for additional reading are suggested.

### **2.6.2 Audio and Video lectures**

Apart from SLM, audio and video lectures have been prepared for some courses. The audio-video material is supplementary to print material. The video lectures are available at YouTube channel of university([https://www.youtube.com/channel/UCj2XTEB6iCZwwIqmKw\\_jzYg](https://www.youtube.com/channel/UCj2XTEB6iCZwwIqmKw_jzYg)).

### **2.6.3 Counselling Classes**

The face to face (F2F) counselling classes are conducted at head quarter and study centers. The purpose of such a contact class is to answer some of questions and clarify the doubts of learner which may not be possible through any other means of communication. Well experienced counsellors at study centers provide counselling and guidance to the learner in the courses that (s)he has chosen for study. The counselling sessions for each of the courses will be held at suitable intervals throughout the whole academic session. The time table for counselling classes are displayed at head quarter as well as by the coordinator of study center, however, attending counselling sessions is not compulsory. It is noted that to attend the counselling sessions, learner has to go through the course materials and note down the points to be discussed as it is not a regular class or lectures.

### **2.6.4 Assignments**

The purpose of assignments is to test the comprehension of the learning material that learner receives and also help to get through the courses by providing self-feedback to the learner. The course content given in the SLM will be sufficient for answering the assignments.

Assignments constitute the continuous evaluation component of a course. The assignments are available at the SLM section of the home page of university website. In any case, learner has to submit assignment before appearing in the examination for any course. The assignments of a course carry 30% weightage while 70% weightage is given to the term-end examination (TEE). The marks obtained by learner in the assignments will be counted in the final result. Therefore, It is advised to take assignments seriously. However, there will be no written assignments for Lab courses.

### **2.6.5 Laboratory Work**

Laboratory courses are an integral component of the M.Sc. programme. While designing the curricula for laboratory courses, particular care has been taken to weed out experiments not significant to the present-day state of the discipline. Importance has been given to the utility of an experiment with respect to real life experience, development of experimental skills, and industrial applications. It is

planned to phase the laboratory courses during suitable periods (such as summer or autumn vacations) so that in-service persons can take them without difficulty. Laboratory courses worth 2 credits will require full-time presence of the student at the Study Centre for one week continuously. During this time a student has to work for around 60 hours. Around 40 hours would be spent on experimental work and the remaining time will be used for doing calculations, preparations of records, viewing or listening to the video/audio programmes.

#### **2.6.6 Teleconference/Web conference**

Teleconference/web conference, using done through ZOOM/webex in form of online special counselling sessions is another medium to impart instruction to and facilitate learning for a distance learner. The students concerned would be informed about the teleconferencing schedule and the place where it is to be conducted by sending bulk SMS.

#### **2.6.7 Web Enabled Academic Support Portal**

The University also provide Web Enabled Academic Support Portal to access the course materials, assignments, and other learning resources.

#### **2.6.8 e-GYANSANGAM**

The e-GYAMSANGAM (UPRTOU-OER REPOSITORY) is an open access platform for educational resources that rely on the concept of 5Rs namely; Reuse, Revise, Remix, Retain and Redistribute. Uttar Pradesh Rajarshi Tandon Open University in support with Commonwealth Educational Media Centre for Asia initiated the implementation of philosophy behind the NEP-2020 to provide equitable use of technology to support learners (SDG4). This not only ensure inclusive and equitable quality education opportunities but also provide faculty to repurpose high quality open educational resources (OER) such that innovative, interactive and collaborative learning environment is built. UPRTOU believes the philosophy of Antyoday (reaching to last person of the society) and facilitate the learner by providing Self Learning Materials, Lecture Notes, Audio/video Lectures, Assignments, Course materials etc. through face-to-face mode as well as distance mode. This e-GYANSANGAM depository will fulfill the educational facilities through equitable use of technology to the learners.

#### **Objectives**

- To provide low-cost access model for learners. To foster the policy of reaching to unreached.
- To break down barriers of affordability and accessibility of educational resources.
- To give faculty the ability to customize course materials for learners.
- To provide equal access to affordable technical, vocational and higher education resources (SDG 4.3).
- To provide ubiquitous access to anyone. This will facilitate the quick availability of educational resources and reduces time.
- To supplement Self Learning Material (SLM).
- To reduce the mentor-mentee gap as depository provide access to number of local access as well as global access to educational resources.

**2.6.9 e-GYANARJAN:** It's a Learning Management System based on Moodle (<http://gyanarjan.uprtou.ac.in>) to aid the learner through web conferencing, sharing of learning resources, counselling classes etc.

## 2.6.10 Learner Support Service Systems

### (a) Study Centre

A Study Centre has following major functions:

- (i) **Counselling:** Counselling is an important aspect of Open University System. Face to face contact-cum-counselling classes for the courses will be provided at the Study Centre. The detailed programme of the contact-cum-counselling sessions will be sent to the learner by the Coordinator of the Study Centre. In these sessions learner will get an opportunity to discuss with the Counsellors his/her problems pertaining to the courses of study.
- (ii) **Evaluation of Assignments:** The evaluation of Tutor Marked Assignments (TMA) will be done by the Counsellors at the Study Centre. The evaluated assignments will be returned to the learner by the Coordinator of Study Centre with tutor comments and marks obtained in TMAs. These comments will help the learner in his/her studies.
- (iii) **Library:** Every Study Centre will have a library having relevant course materials, reference books suggested for supplementary reading prepared for the course(s).
- (iv) **Information and Advice:** The learner will be given relevant information about the courses offered by the University. Facilities are also provided to give him/her guidance in choosing courses.
- (v) **Interaction with fellow-students:** In the Study Centre learner will have an opportunity to interact with fellow students. This may lead to the formation of self-help groups.

### (b) Learner Support Services (LSS)

The University has formed an LSS cell at the head quarter. The LSS cell coordinate with the Study Centre to get rid of any problem faced by the learner.

## 2.7 Procedure for admissions, curriculum transaction and evaluation

### 2.7.1 Admission Procedure

- (a) The detailed information regarding admission will be given on the UPRTOU website and on the admission portal. Learners seeking admission shall apply online.
- (b) Direct admission to 2-year M.Sc. (**Biochemistry**) program is offered to the interested candidates.

#### **Entry Eligibility:**

**Level 8:** Bachelor degree in concern subject (B.Sc. (Bio)/B.Sc. (Honors) with chemistry as one of the subject) OR Biochemistry/Microbiology/Biotechnology/ at B.Sc. Level OR Any 4 year Graduate Degree in Medical Sciences/Science.

**Level 9:** Students who successfully completed the Bachelors degree (Research) or PG Diploma in Biochemistry at level 8 will get admission in 2<sup>nd</sup> year of M.Sc. (Biochemistry) program in accordance with NEP-2020.

- (c) **Programme Fee: Rs. 12000 / year.** The fee is deposited through online admission portal only.

## 2.7.2 Evaluation

The evaluation consists of two components: (1) continuous evaluation through assignments, and (2) term-end examination. Learner must pass both in continuous evaluation as well as in the term-end examination of a course to earn the credits assigned to that course. For each course there shall be one written Terminal Examination. The evaluation of every course shall be in two parts that is 30% internal weightage through assignments and 70% external weightage through terminal exams.

<b>(a) Theory course</b>	<b>Max. Marks</b>
Terminal Examination	70
Assignment	30
<b>Total</b>	<b>100</b>

<b>(b) Practical course:</b>	<b>Max. Marks</b>
Terminal Practical Examination	100

Marks of Terminal Practical Examination shall be awarded as per following scheme:

i.	Write up /theory work	30	
ii.	Viva-voce	30	
iii.	Execution/Performance/Demonstration	20	
iv.	Lab Record	20	

The following 10-Point Grading System for evaluating learners' achievement is used for CBCS programmes:

### 10-Point Grading System in the light of UGC-CBCS Guidelines

Letter Grade	Grade Point	% Range
O (Outstanding)	10	91-100
A+ (Excellent)	9	81-90
A (Very Good)	8	71-80
B+ (Good)	7	61-70
B (Above Average)	6	51-60
C (Average)	5	41-50
P (Pass)	4	36-40
NC (Not Completed)	0	0-35
Ab (Absent)	0	
Q	Qualified	Applicable only for Non-Credit courses
NQ	Not Qualified	

Learner is required to score at least a 'P' grade (36% marks) in both the continuous evaluation (assignments) as well as the term-end examination. In the overall computation also, learner must get at least a 'P' grade in each course to be eligible for the M. Sc. degree.

## Computation of CGPA and SGPA

(a) Following formula shall be used for calculation of CGPA and SGPA

For jth semester $SGPA (S_j) = \frac{\sum (C_i * G_i)}{\sum C_i}$	where, $C_i$ = number of credits of the $i$ th course in $j$ th semester $G_i$ = grade point scored by the learner in the $i$ th course in $j$ th semester.
$CGPA = \frac{\sum (C_j * S_j)}{\sum C_j}$	where, $S_j$ = SGPA of the $j$ th semester $C_j$ = total number of credits in the $j$ th semester

The CGPA and SGPA shall be rounded off up to the two decimal points. (For e.g., if a learner obtained 7.2345, then it will be written as 7.23 or if s(he) obtained 7.23675 then it will be written as 7.24)

CGPA will be converted into percentage according to the following formula:

$$\text{Equivalent Percentage} = \text{CGPA} * 9.5$$

(b) Award of Division

The learner will be awarded division according to the following table:

Division	Classification
1 <sup>st</sup> Division	6.31 or more and less than 10 CGPA
2 <sup>nd</sup> Division	4.73 or more and less than 6.31 CGPA
3 <sup>rd</sup> Division	3.78 or more and less than 4.73 CGPA

### 2.7.3 Multiple Entry and Multiple Exit options

The 2-year M.Sc. programme is an Outcome-Based Education (OBE) for qualifications of different types. The qualification types and examples of title/nomenclature for qualifications within each type are indicated in Table 1.

Level	Qualification title	Programme duration	Entry Option	Exit option
8	B.Sc. (Research) OR PG Diploma in Biochemistry	Programme duration: First year (first two semesters) of the M.Sc. programme	Bachelor degree in concern subject (B.Sc. (Bio)/B.Sc. (Honors) with chemistry as one of the subject) OR Biochemistry/ Microbiology/ Biotechnology/ at B.Sc. Level OR Any 4 year Graduate Degree in Medical Sciences	<b>Exit</b> Awarded with Bachelor' Degree (Research) for 4 year programme OR PG Diploma in Biochemistry
9	Master in (Biochemistry)	Programme duration: First two years (first four semesters) of the of the M.Sc. programme	Level 8 Bachelor' Degree (Research) for 4 year programme OR PG Diploma in Biochemistry	<b>Exit</b> awarded with Master's in (Biochemistry)

## 2.8 Requirement of the laboratory support and Library Resources

The practical sessions are held in the science laboratories of the Study Centre. In these labs, the learner will have the facility to use the equipment and consumables relevant to the syllabus. The SLM, supplementary text audio and video material of the various courses of the program is available through the online study portal of the University. The University also has a subscription of National Digital Library to provide the learners with the ability to enhance access to information and knowledge of various courses of the programme.

## 2.9 Cost estimate of the programme and the provisions

2-year M.Sc. programme consists of 15 theory courses, 4 laboratory courses and research activities. One course is of 4 credits which consist of approx. 6 units. The total approximated expenditure on the development of 15 courses is:

S. No.	Item	Cost per Unit & (writing editing)	Total cost (Rs.)
1	Total no. of units in 12 courses = $15 \times 12 = 90$	7500	675000
2	BOS Meetings etc.	100000	100000
<b>Total</b>			<b>775000</b>

## 2.10 Quality assurance mechanism and expected programme outcomes

(a) **Quality assurance mechanism:** The program structure is developed under the guidance of the Board of studies comprising external expert members of the concerned subjects followed by the School board. The program structure and syllabus is approved by the Academic Council of the University. The course structure and syllabus is reviewed time to time according to the feedback received from the stakeholders and societal needs.

The Centre for Internal Quality Assurance will monitor, improve and enhance effectiveness of the program through the following:

- ✓ Annual academic audit
- ✓ Feedback analysis for quality improvement
- ✓ Regular faculty development programs
- ✓ Standardization of learning resources
- ✓ Periodic revision of program depending upon the changing trends by communicating to the concerned school

### (b) Expected programme outcomes (POs)

Knowledge and understanding	<b>PO1</b>	To grasp the ability of biochemical process and functioning of living being systems in concern to their structure and functions.
Skills related to specialization	<b>PO 2</b>	To adapt the skills and understanding of the concepts of enzyme kinetics, their behaviour & mechanism, molecular mapping, gene expression and control of DNA transcription in living beings.
Application of knowledge and skills	<b>PO 3</b>	To conceptualize and analyze the principle of different biochemical changes of various biomolecules with their chemistry in living system

	<b>PO 4</b>	To apply clinical and experimental knowledge for the diagnoses of different kinds of diseases.
Generic learning outcomes	<b>PO 5</b>	Learner will be able to get the job in various fields related to medical professions, pharmaceutical industry, biotechnological industry and community health centre.
	<b>PO 6</b>	Learner will also be able to improve the quality of life for the human welfare by understanding the principle of living organisms at the molecular level.

<b>Newly Introduced programme : Yes</b>	
Programme:	<b>Master in Science</b>
Year: NA	First Introduction year: <b>2023</b>
Programme prerequisites: Bachelor degree in concern subject (B.Sc. (Bio)/B.Sc. (Honors) with chemistry as one of the subject) OR Biochemistry/Microbiology/Biotechnology/ at B.Sc. Level OR Any 4 year Graduate Degree in Medical Sciences/Science.	

**APPENDIX-I**

**Academic Year 2023-24**  
**Detailed Programme Structure & Syllabus**  
**M.Sc. Biochemistry Programme Structure**

Semester I	Course Code	Title of papers	Credit	Max. Marks	
1 <sup>st</sup> SEM	PGBCH -101	Cell Biology and Biomolecules	4	100	
	PGBCH -102	Analytical Biochemistry	4	100	
	PGBCH -103	Bioenergetics and Metabolism	4	100	
	PGBCH -104N(P)	Practical's based on PGBCH 101,102 and 103	4	100	
	PGBR-01N	Basics in Research	4	100	
<b>Credit I semester</b>			<b>20</b>	<b>500</b>	
2 <sup>nd</sup> SEM	PGBCH -106	Nutrition and Physiology	4	100	
	PGBCH -107	Bio Statistics	4	100	
	PGBCH -108	Clinical biochemistry	4	100	
	PGBCH -109N(P)	Practical's based on PGBCH 105,106 and 107	4	100	
	PGMP-02N	Mini Project	4	100	
<b>Credit II semester</b>			<b>20</b>	<b>500</b>	
3 <sup>rd</sup> SEM	PGBCH -111	Enzymology and enzyme technology	4	100	
	PGBCH -112	Immunology	4	100	
	PGBCH -113	Basic Biotechnology	4	100	
	PGBCH -114N(P)	Practical's based on PGBCH 109,110 and 111	4	100	
	PGRT -03N	Research Tools and Practices	4	100	
<b>Credit III semester</b>			<b>20</b>	<b>500</b>	
	<b>Select any one group</b>				
4 <sup>th</sup> SEM	<b>Group A</b>	PGBCH – 116N	Bio-safety and IPR	4	100
		PGBCH -117N/ PGEVS-120N	Environmental Toxicology and Occupational Health Hazardous	4	100
		PGBCH-118N /PGZY-121N	Genetic Engineering	4	100
		PGBCH-119N(P)	Practical's based on PGBCH 114N and 115N	4	100
	<b>OR</b>				
	<b>Group B</b>	PGBCH -120N	Microbiology and Toxicology	4	100
		PGBCH -121N	Industrial biotechnology	4	100
		PGBCH -122N	Bioinformatics	4	100
PGBCH-123 N (P)		Practical's based on PGBCH 114N and 115N	4	100	
	<b>Compulsory paper</b>				
	<b>PGBCH-124 (D)N</b>	Dissertation/Industrial training/Internship with Viva Voce	4	100	
<b>Credit IV semester</b>			<b>20</b>	<b>500</b>	
<b>Total credit/Max. Marks</b>			<b>80</b>	<b>2000</b>	

Programme: <b>M.Sc.</b>	Year: 2023	Semester: <b>I</b>
<b>Subject: Biochemistry</b>		
Course Code: <b>PGBCH-101N</b>	Course Title: <b>Cell Biology and Biomolecules</b>	
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>➤ To discuss the basics of outline of biochemistry</li> <li>➤ To discuss the structures of prokaryotic and eukaryotic cells</li> <li>➤ To discuss the basic concept of cell organelles and its role in biochemical functions</li> <li>➤ To discuss about cell and different organelles</li> </ul>		
<b>Course Outcomes:</b> CO 1: Able to understanding the history and scope of Biochemistry in brief. CO 2: Able to understanding of water properties and its role in living systems. CO 3: Learn the conceptualize the cell structure and its functions CO 4: Know the structure and functions of various cell organelles. CO 5: Also know the structure and classification of amino acids		
Credits: <b>4</b>	Type of Course: <b>Core</b>	
Max. Marks: <b>100</b>	Min. Passing Marks: <b>36</b>	
<b>Block 1</b>	<b>Cell and Cell Organelles</b>	
Unit I	<b>Introduction to cell:</b> Cell biology and cell organelles: History of biochemistry, biochemical organization, architecture of cells, structure of prokaryotic and eukaryotic cell, structure of cell wall and cell membrane.	
Unit II	<b>Cell organelles:</b> Structure and function of different cell organelles mitochondria, nucleus, endoplasmic reticulum, chloroplast, Golgi apparatus, ribosomes, lysosomes, centrioles cytoskeleton.	
<b>Block 2</b>	<b>Block-II: Biomolecules Part I</b>	
Unit V	<b>Carbohydrates:</b> Introduction to carbohydrates, monosaccharides-structure, properties and their derivatives, aldose and ketose, stereoisomerism of monosaccharides, acid and base reaction in monosaccharides, structure of disaccharides and oligosaccharides, types of polysaccharides, function of complex carbohydrate, glycosidic bonds, polysaccharides as energy storage.	
Unit VI	<b>Proteins:</b> Introduction to protein, amino acids, primary, secondary, tertiary and quaternary structures of protein, structure of hemoglobin, proteinprotein interaction, protein interaction with nucleic acid, function of protein and malfunction of protein.	
<b>Block 3</b>	<b>Block-III: Biomolecules Part II</b>	
Unit V	<b>Lipids:</b> Introduction to lipids, types, structure and function of lipids, essential fatty and saturated fatty acid, wax, phospholipids, glycerophospholipidssphingophospholipids, glycolipids, glyceroglycolipids, sphingo-glycolipids, simple lipids, lipid bilayer structure, biological membrane: components and structure.	
Unit VI	<b>Nucleic acids:</b> Introduction to nucleic acid, structure and components of nucleotides, nitrogen bases in nucleotide and nucleosides, nucleic acids, structures and types of RNA, double helix of DNA, Central Dogma, denauration of DNA, nucleic acid	

sequencing, biological function of nucleotides.

**Suggested Text Book Readings:**

1. David L. Nelson and Michael Cox, "Lehninger Principles of Biochemistry" International Edition-2021.
2. Dr J L Jain, "Fundamentals of Biochemistry" S. Chand and Company-2020.
3. P S Verma and V K Agarwal, "Cell Biology (Cytology, Biomolecule and Molecular Biology" S. Chand Publication-2016.
4. Talwar and Srivastava, "Textbook of Biochemistry and Human Biology" Eastern Economy Edition, Prentice Hall, India-2002.
5. Satyanarayana U., "Biochemistry" Elsevier India,2021

**Suggested online links:**

1. Cell Biology and Bio-molecule: [Microprocessor and Its Applications \(uprtou.ac.in\)](http://uprtou.ac.in)
2. Introduction to cell biology: [me339\\_s02.pdf \(stanford.edu\)](http://me339_s02.pdf(stanford.edu))
3. Carbohydrates: [Notes-C18-121.pdf \(latech.edu\)](http://Notes-C18-121.pdf(latech.edu))
4. Structure of Proteins: [Structure and functions of Amino Acids and Proteins \(aiimsrishikesh.edu.in\)](http://Structure and functions of Amino Acids and Proteins(aiimsrishikesh.edu.in))
5. Nucleic Acid: [Biochemistry.pdf \(sscasc.in\)](http://Biochemistry.pdf(sscasc.in))

**This course can be opted as an elective by the students of following subjects: M.Sc. (Botany), M.Sc. (Zoology)**

**Suggested equivalent online courses (MOOCs) for credit transfer:**

Biochemistry of Biomolecules: [Biochemistry of Biomolecules - Course \(swayam2.ac.in\)](http://Biochemistry of Biomolecules - Course (swayam2.ac.in))

Programme: <b>M.Sc.</b>	Year: 2023	Semester: <b>I</b>
Subject: <b>Biochemistry</b>		
Course Code: <b>PGBCH-102N</b>	Course Title: <b>Analytical Biochemistry</b>	
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>➤ To discuss the basics understanding of spectroscopy</li> <li>➤ To discuss the role of electrophoreses in biochemical analysis</li> <li>➤ To discuss the instrumentation and application of microscopy</li> <li>➤ To discuss the basic principal of XRD</li> </ul>		
<b>Course Outcomes:</b> CO 1: Able to understand the instrumentation and principal of uv-visible spectroscopy CO 2: know the instrumentation and application of chromatography CO 3: Learn about electrophoreses principle and application in biochemistry CO 4: Able to know microscopy and its functions CO 5: Also able to know the instrumentation and application of NMR and XRD		
Credits: <b>4</b>	Type of Course: <b>Core</b>	
Max. Marks: <b>100</b>	Min. Passing Marks: <b>36</b>	
<b>Block 1</b>	<b>Spectroscopy and Chromatography</b>	
Unit-I	<b>Spectroscopy:</b> Origin of spectra and electronic transition, Visible and UV Spectroscopy-tools and techniques and applications, atomic adsorption, spectroscopy- tools and techniques and applications.	
Unit-II	<b>Chromatography</b> Principle, thin layer, ion exchange, affinity, hydrophobic exchange and gel filtration chromatography, principle and instrumentation of high performance liquid chromatography (HPLC).	
<b>Block- II:</b>	<b>Centrifugation and Electrophoresis</b>	
Unit-III	<b>Centrifugation</b> Principles of centrifugation, types of centrifuges, differential centrifugation, density gradient, and ultracentrifugation.	
Unit-IV	<b>Electrophoretic techniques:</b> General principles, electrophoresis of proteins, native-PAGE and SDS-PAGE, agarose gel electrophoresis for DNA, isoelectric- focusing, 2D gel electrophoresis.	
<b>Block- III:</b>	<b>Microscopy, X-ray diffraction and NMR</b>	
Unit-V	<b>Microscopy:</b> Basic principles and instrumentation of scanning electron microscopy (SEM) and transmission electron microscopy (TEM), scanning tunneling microscopy, specific staining of biological materials	
Unit-VI	<b>Instrumentation:</b> X-ray diffraction and NMR principle, instrumentation and applications.	
<b>Suggested Text Book Readings:</b> <ol style="list-style-type: none"> <li>1. Principal and Techniques Of Biochemistry and Molecular Biology, Wilson and Walker, Seven Editor, Cambridge Press.</li> <li>2. Analytical Clinical Biochemistry, Kaushik Basu Et Al., Techno World Publisher,</li> <li>3. Analytical Biochemistry, Mohammad Raies Et. Al., Book Enclave, Publisher</li> </ol>		

4. S.M. Khopkar, Basic Concepts of Analytical Chemistry, New Age International Pvt Ltd Publishers, 2018
5. Y R Sharma, Elementary organic spectroscopy; S Chand publication, Fifth edition 2013.
6. Pavia donald, Introduction to spectroscopy, 5th edition.

**Suggested online links:**

1. Introduction To Spectroscopy: [Introduction To Spectroscopy.Pdf \(Su.Se\)](#)
2. Principles Of Spectroscopy: [Microsoft Powerpoint - Spectroscopy-Chem6230 \(Ugpti.Org\)](#)
3. Introduction, Chromatography Theory, and Instrument Calibration: [Microsoft Word - Ch 1 2017.Doc \(Whitman.Edu\)](#)
4. Techniques in Techniques in Molecular Biology: [Microsoft Word - Bbyet-141 Vol. 1, Credit Page, Bi, Ci 28-7-2021 \(Egyankosh.Ac.In\)](#)

**This course can be opted as an elective by the students of following subjects:** M.Sc. (Botany), M.Sc. (Zoology)

**Suggested equivalent online courses (MOOCs) for credit transfer:**

Biochemistry of Biomolecules: [Biochemistry of Biomolecules - Course \(swayam2.ac.in\)](#)

Programme: <b>M.Sc.</b>	Year: 2023	Semester: <b>I</b>
Subject: <b>Biochemistry</b>		
Course Code: <b>PGBCH-103N</b>	Course Title: <b>Bioenergetics and Metabolism</b>	
<b>Course Objectives:</b>		
<ul style="list-style-type: none"> <li>➤ To discuss the process of metabolism</li> <li>➤ To discuss the bioenergetics process</li> <li>➤ To discuss the carbohydrate metabolism</li> <li>➤ To discuss the metabolism of nitrogenous compounds</li> </ul>		
<b>Course Outcomes:</b>		
CO 1: Able to know the energy production for metabolism.		
CO 2: Learn about oxidation potential and energy production		
CO 3: Learn about metabolism of carbohydrate metabolism		
CO 4: Able to understand the metabolism of amino acid		
CO 5: Also able to know the urea cycle and its regulation		
Credits: <b>4</b>	Type of Course: <b>Core</b>	
Max. Marks: <b>100</b>	Min. Passing Marks: <b>36</b>	
<b>Block 1</b>	<b>Bioenergetics</b>	
Unit I	<b>Bioenergetics-I:</b> Concept of free energy, standard free energy, determination of $\Delta G$ for a reaction, relationship between equilibrium constant and standard free energy change, biological standard state and standard free energy, change in coupled reactions.	
Unit II	<b>Bioenergetics-II:</b> Redox potentials, high energy phosphate compounds-ATP, phosphate group transfer, photosynthetic light reactions.	
<b>Block 2</b>	<b>Coenzyme sand Carbohydrate Metabolism</b>	
Unit III	Coenzymes and cofactors: Prosthetic group, coenzymes involved in different metabolic pathways, classification of coenzymes, isozymes, abzymes, synzyme, pyridoxal phosphate and B12 coenzymes.	
Unit IV	Carbohydrate Metabolism: Glycolysis, fermentation, TCA cycle, electron transport chain, oxidative phosphorylation, gluconeogenesis, glycogenesis, energetic can dregulation of metabolic cycles, metabolism of disaccharides, hormonal regulation of carbohydrate metabolism.	
<b>Block 3</b>	<b>Metabolism of Amino acids and Nitrogen compounds</b>	
Unit VI	<b>Amino acids:</b> General reactions of amino acid metabolism-transamination, decarboxylation , oxidative and non-oxidative deamination of aminoacids. Specialmetabolism of methionine, histidine, phenylalanine, tyrosine, tryptophan, lysine, valine, leucine, isoleucine and polyamines.	
Unit V	<b>Metabolism of nitrogen compounds:</b> Metabolism and regulation, decarboxylation, transamination, deamination, metabolism and regulation of urea, Urea cycle and its regulation.	
<b>Suggested Text Book Readings:</b>		
1. Bioenergetics, David Nicholls, Academic Press ISBN: 9780123884251 4th Edition		
2. Bioenergetics, Alexander Lowen Penguin Books, ISBN13: 9780140194715		

3. Principles of Biochemistry: Lehninger, Nelson and Cox. Student Edition, CBS 1439 Publishers and Distributors, Delhi.

4. Fundamentals of Biochemistry: Dr J L Jain, S. Chand and Company

**Suggested online links:**

1. Bioenergetics: [\(Pdf\) Bioenergetics \(Researchgate.Net\)](#)
2. Metabolism of Amino Acids —General Aspects: [Bch103-7.Pdf \(Davuniversity.Org\)](#)
3. Carbohydrates Metabolism: [Slide 1 \(Mgcub.Ac.In\)](#)
4. Glycolysis- [glycolysis \(ttuhsc.edu\)](#)
5. Introduction to Nitrogen Metabolism: [Nitrogen Metabolism.pdf \(slideshare.net\)](#)

**This course can be opted as an elective by the students of following subjects: NA**

**Suggested equivalent online courses (MOOCs) for credit transfer: NA**

Programme: M.Sc.	Year: 2023-24	Semester: I
<b>Subject: Biochemistry</b>		
Course Code: <b>PGBR-01N</b>	Course Title: <b>Basics in Research</b>	
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>➤ To discuss the Sources of information</li> <li>➤ To discuss about journal abbreviations</li> <li>➤ To discuss the monographs, dictionaries, text books etc.</li> </ul>		
<b>Course Outcomes:</b> CO 1: Able to learn about how to get information of research. CO 2: Learn about journal and article and research manuals CO 3: Able to know the role of primary, secondary and tertiary sources of information. CO 4: Gain knowledge about abstract and citation index. CO 5: Also know about digital web resources		
Credits: 4	<b>Type of Course:</b> Core	
Max. Marks: 100	Min. Passing Marks: 36	
<b>Topic 1</b>	<b>Literature Survey</b> Introductions: Sources of information, need for reviewing literature, primary-secondary and tertiary sources, journals, journal abbreviations, abstracts, current titles, reviews, monographs, dictionaries, text books, current contents, patents. Introduction to chemical abstracts and beilstein, subject index, substance index, author index, formula index and other indices with examples. Digital: Web resources, E-journals, journal access, TOC alerts. Hot articles: Citation index, UGC infonet, E-books, Impact Factors, Search engines- Google scholar, chemical industry, Wiki-databases, chemSpider, Science Direct, SciFinder, Scopus	
<b>Topic 2</b>	<b>Ethics and IPR</b> Regulatory bodies, practices and compliances, Good Laboratory Practices (GLP), Research Ethics & Misconduct, Patents, Copyrights, GI and Trademarks, Product and process patent, Patent Treaties and Convention, process of filing patent, database of patent, search and retrieval.	
<b>Suggested Text Book Readings:</b> <ol style="list-style-type: none"> <li>1. Use different searching engine to get relevant information (Google scholar, chemical industry, Wiki-databases, chem Spider, Science Direct, SciFinder, Scopus.</li> <li>2. Access to different online research library and research portal (Web resources, E-journals, journal access, TOC alerts)</li> </ol>		
<b>Suggested online link:</b> <ol style="list-style-type: none"> <li>1. You tube</li> <li>2. Web resources</li> <li>3. Hot articles</li> <li>4. Science Direct</li> <li>5. SciFinder, Scopus</li> </ol> <p style="padding-left: 40px;">Google scholar</p>		
This course can be opted as an elective by the students of following subjects: NA		

Suggested equivalent online courses (MOOCs) for credit transfer:

- 1. Research Ethics, Shri. Manoj Kumar K, INFLIBNET,  
[https://onlinecourses.swayam2.ac.in/cec22\\_ge28/preview](https://onlinecourses.swayam2.ac.in/cec22_ge28/preview)**

**Note:-** In this paper, learner itself study the objectives and prepare a report. The report will be submitted along with assignment to respective study center for evaluation. The maximum marks for evaluation are 100.

Programme: <b>M.Sc.</b>	Year: 2023	Semester: <b>II</b>
<b>Subject: Biochemistry</b>		
Course Code: <b>PGBCH-106N</b>	Course Title: <b>Nutrition and Physiology</b>	
<b>Course Objectives:</b>		
<ul style="list-style-type: none"> <li>➤ To discuss the nutrition and physiology of human</li> <li>➤ To discuss the element of human nutrition</li> <li>➤ To discuss the protein that is the building block of living being</li> <li>➤ To discuss the digestive system and respiration</li> </ul>		
<b>Course Outcomes:</b>		
CO 1: Able to understand the role of nutrition in physiology		
CO 2: Learn the Basal metabolic rates (BMR)		
CO 3: Able to describe the dietary resource and metabolic functions of nutrients		
CO 4: Able to know the blood composition		
CO 5: Also able to know the respiratory system and ATP		
Credits: <b>4</b>	Type of Course: <b>Core</b>	
Max. Marks: <b>100</b>	Min. Passing Marks: <b>36</b>	
<b>Block 1</b>	<b>Nutrition and Nutritional Elements</b>	
Unit I	<b>Basic Concepts of nutrition:</b> Function of nutrients, measurement of caloric value of food, basal metabolic rate (BMR); factors affecting BMR, recommended dietary allowances, dietary recommendations human nutritional needs, malnutrition.	
Unit II	<b>Elements of nutrition:</b> Dietary requirement of carbohydrates, lipids and proteins; concepts of protein quality, micronutrients and macronutrients, essential amino acids, essential fatty acids and their physiological function, deficiency and toxicity of nutrients.	
<b>Block 2</b>	<b>Vitamins, Minerals and Physiology</b>	
Unit III	<b>Vitamins and minerals:</b> Dietary sources, biochemical functions, water soluble and fat soluble vitamins, requirements and deficiency diseases associated with vitamins, role of minerals in metabolism	
Unit IV	<b>Introduction to physiology:</b> Blood-composition and functions of plasma, erythrocytes, leucocytes and thrombocytes, blood coagulation, types of blood groups, antigen and antibodies, blood transfusion.	
<b>Block 3</b>	<b>Digestive system and Respiration</b>	
Unit V	<b>Digestive system:</b> Compositions, parts of alimentary canal, functions and regulation of saliva, gastric, pancreatic, intestinal and bile secretions, role of enzymes in digestive system.	
Unit VI	<b>Respiration:</b> Inspiration and expiration, types of respiration, lungs structure, mechanism of breathing and Its regulation,	
<b>Suggested Text Book Readings:</b>		

1. David L. Nelson and Michael Cox, “Lehninger Principles of Biochemistry” International Edition-2021.
2. Dr J L Jain, “Fundamentals of Biochemistry” S. Chand and Company-2020.
3. Nutritional Biochemistry, DC Sharma, CBS Nursing publication
4. Nutritional Biochemistry, Tom Brody, Academic Press publication
5. Satyanarayana U., “Biochemistry” Elsevier India,2021

**Suggested online links:**

1. Food, Nutrition, Health and Fitness: [kehe103.pdf \(ncert.nic.in\)](#)
2. Human Vitamin and Mineral Requirements: [Foreword \(fao.org\)](#)
3. Vitamins: [Vitamins & Minerals \(austincc.edu\)](#)
4. The Digestive System: <https://www.uc.edu/content/dam/uc/ce/docs/OLLI/PageContent/OLLI - The Digestive System.pdf>

**This course can be opted as an elective by the students of following subjects: M.Sc. (Zoology) M.Sc. (Nutrition and Home Science)**

**Suggested equivalent online courses (MOOCs) for credit transfer: NA**

Programme: <b>M.Sc.</b>	Year: 2023	Semester: <b>II</b>
<b>Subject: Biochemistry</b>		
Course Code: <b>PGBCH-107N</b>	Course Title: <b>Bio-Statistics</b>	
<b>Course Objectives:</b>		
<ul style="list-style-type: none"> <li>➤ To discuss the history and scope of bio-statistics</li> <li>➤ To discuss the different statistical techniques used in biochemistry</li> <li>➤ To discuss the bio chemical data analysis using statistical methods</li> <li>➤ To discuss the research methodology and hypothesis</li> </ul>		
<b>Course Outcomes:</b>		
CO 1: Able to understanding of history and scope of bio-statistics		
CO 2: Able to know the role of mode, median and mode in data analysis.		
CO 3: To learn about sampling and sampling analysis		
CO 4: Able to know the process of analysis of variance		
CO 5: also able to hypothesis analysis and implementation		
Credits: <b>4</b>	Type of Course: <b>Core</b>	
Max. Marks: <b>100</b>	Min. Passing Marks: <b>36</b>	
<b>Block 1</b>		
Unit I	Meaning and Types of Research, Significance of Research, About Research Problem and its Selection, Measures of Central Tendency, Measures of Dispersion, Measures of Asymmetry.	
Unit II	Measures of Relationship, Regression Analysis Association of Attributes, 3-Sigma Limits.About Sampling, Different Types of Sampling Designs, Simple Random Sampling, Stratified Sampling, Cluster Sampling.	
<b>Block 2</b>	<b>Vitamins, Minerals and Physiology</b>	
Unit III	Basic Concepts of Probability, Definitions of Probability, Additive and Multiplicative law of Probability, Conditional Probability, Bayes' Theorem. Random Variable and its types, Probability Mass Function, Probability Density Functions	
Unit IV	Source of Vital Statistics and Demographic Data, Rates, ratio, proportion, Measures of Fertility, measures of mortality, measures of morbidity, Migration. Probability Distributions, Binomial Distribution, Poisson distribution, Geometric Distribution, Normal Distribution, Exponential Distribution	
<b>Block 3</b>	<b>Digestive system and Respiration</b>	
Unit V	About Hypothesis and its Types, Level of Significance, Critical Region, P Value, Types of errors, Chi-Square Tests, t-tests, z-tests.	
Unit VI	<b>Respiration:</b> Analysis of Variance and Co-Variance, Basic Principles of ANOVA and ANCOVA. (One Way, Two Way and Three Way Analysis)	
<b>Suggested Text Book Readings:</b>		
<ol style="list-style-type: none"> <li>1. Introduction to Statistics, David Lane, Rice University</li> <li>2. Basic Statistics, B.L. Agrawal, New Age International Private Limited</li> <li>3. Basic Statistics, Thomas Higher Education Textbooks</li> <li>4. Computer Fundamentals : Concepts, Systems &amp; Application, Priti Sinha, Pradeep K., Sinha , BPB Publications</li> </ol>		

**Suggested online links:**

1. Introduction to Descriptive Statistics: [introduction-to-descriptive-statistics.pdf](#)
2. Descriptive Statistics: [Slide 1 \(incois.gov.in\)](#)
3. Basic Probability Theory: [46628-0 Ash 1 \(illinois.edu\)](#)

**This course can be opted as an elective by the students of following subjects: NA**

**Suggested equivalent online courses (MOOCs) for credit transfer:**

1. Introduction to Biostatistics: [Introduction to Biostatistics - Course \(nptel.ac.in\)](#)

Programme: <b>M.Sc.</b>	Year: 2023	Semester: <b>II</b>
<b>Subject: Biochemistry</b>		
Course Code: <b>PGBCH-108N</b>	Course Title: <b>Clinical Biochemistry</b>	
<b>Course Objectives:</b>		
<ul style="list-style-type: none"> <li>➤ To discuss the clinical process and chemical control</li> <li>➤ To discuss the genetic and chemical control</li> <li>➤ To discuss nutrition, drugs and digestion</li> </ul>		
<b>Course Outcomes:</b>		
CO 1: Able to understand the role of clinical biochemistry in laboratory		
CO 2: Able to know the composition of body fluids and macro and micronutrient		
CO 3: Know genetic damage by ionization radiation		
CO 4: Able to know the control of water and electrolyte metabolism		
CO 5: Also able to know inborn errors of metabolism		
Credits: <b>4</b>	Type of Course: <b>Core</b>	
Max. Marks: <b>100</b>	Min. Passing Marks: <b>36</b>	
<b>Block 1</b>	<b>Clinical process and chemical control</b>	
Unit I	<b>Basic in clinical chemistry:</b> Role of clinical biochemistry in laboratory, clinical utility, blood samples, respiratory and metabolic control of pH, disorder of acid base balance, blood gases and its measurement, anion gap.	
Unit II	<b>Genetic and chemical control:</b> DNA and genetic information, genetic damage by ionization radiation, mutation and carcinogens, cancer and tumors marker, transport, action and measurement of hormones, endocrine disorder, investigation of endocrine diseases.	
<b>Block 2</b>	<b>Nutrition, drug and digestion</b>	
Unit III	<b>Nutrition and drug:</b> Composition of body fluids, macro and micronutrient, assessment of nutritional status, therapeutic drugs monitoring, drugs overdose.	
Unit IV	<b>Digestion:</b> Digestive process, gut hormones and clinical disorder, disorder of acid base balance anion gap.	
<b>Block 3</b>	<b>Electrolyte transport and inborn errors of metabolism</b>	
Unit V	<b>Control of water and electrolyte metabolism:</b> Water balance, osmolarity of sodium disorder, balance of water, electrolyte and potassium, measurement of sodium and potassium, control of calcium, disorders related to calcium metabolism.	
Unit VI	Transport and Storage: plasma proteins, protein groups, measurement of plasma protein, lipids transport and lipids disorders, atherosclerosis, and specific proteins, lipoproteins.	
Unit VII	<b>Inborn errors of metabolism:</b> Inheritance, Investigation of IBEM, Investigation of suspected IBEM, Parental diagnosis, Phenylketonuria, Cystic fibrosis.	
<b>Suggested Text Book Readings:</b>		
1. Clinical Biochemistry: Metabolic and Clinical Aspects: William J. Marshall, Elsevier		
2. Practical Clinical Biochemistry Methods And Interpretations: Ranjna Chawla		
3. Early Clinical Exposure: A Case Based Approach in Clinical Biochemistry: Anita Chalak,		

Jaypee Brothers Medical Publishers.

4. Clinical Biochemistry, Richard Luxton, Viva Books publisher

**Suggested online links:**

1. DNA: The Genetic Material: [Ch10-1 Gen material.pdf \(csun.edu\)](#)
2. Pathophysiology of Water and Electrolyte Metabolism: [PowerPoint Presentation \(bns-hungary.hu\)](#)
3. Inborn errors of metabolism: [INBORN ERRORS of METABOLISM, Part 1 \(ufl.edu\)](#)
4. Digestive System: [PowerPoint Presentation \(uc.edu\)](#)

**This course can be opted as an elective by the students of following subjects: NA**

**Suggested equivalent online courses (MOOCs) for credit transfer: NA**

Programme: M.Sc.	Year: 2023-24	Semester: II
Subject: <b>Biochemistry</b>		
Course Code: <b>PGMP-02N</b>	Course Title: <b>Mini Project</b>	
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>➤ To discuss to project</li> <li>➤ To discuss how to select the topic of project</li> <li>➤ To know how writing the projects</li> <li>➤ To discuss about needs of information for project</li> </ul>		
<b>Course Outcomes:</b> CO 1: Able to learn about how to get information of project. CO 2: Learn about journal and article and research manuals CO 3: Able to know the role of primary, secondary and tertiary sources of project work. CO 4: Also know how to use digital web resources for project work CO 5: learn about writing of project		
Credits: 4	<b>Type of Course:</b> Core	
Max. Marks: 100	Min. Passing Marks: 36	
<b>Topic</b>	Students shall make mini project on selected topic of their own choice (with or without any, Supervisor) and prepare the report and submit it to the University Examination Department and School of Science of the University for evaluation.	
<b>Suggested Text Book Readings:</b> <ol style="list-style-type: none"> <li>1. Use different searching engine to get relevant information (Google scholar, chemical industry, Wiki-databases, chem Spider, Science Direct, SciFinder, Scopus.</li> <li>2. Access to different online research library and research portal (Web resources, E-journals, journal access, TOC alerts)</li> </ol> <b>Suggested online link:</b> <ol style="list-style-type: none"> <li>1. You tube</li> <li>2. Web resources</li> <li>3. Hot articles</li> <li>4. Science Direct</li> <li>5. SciFinder, Scopus</li> </ol> Google scholar		
<b>Note:</b> Students shall make mini project on selected topic of their own choice studied so far (with or without any, Supervisor) and prepare the report. The report will be submitted along with assignment to respective study center for evaluation. The maximum marks for evaluation are 100.		

Programme: <b>M.Sc.</b>	Year: 2023	Semester: <b>III</b>
Subject: <b>Biochemistry</b>		
Course Code: <b>PGBCH-111N</b>	Course Title: <b>Enzymology and Enzyme Technology</b>	
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>➤ To discuss the nomenclature and classification of enzymes</li> <li>➤ To discuss the mechanical action of enzymes</li> <li>➤ To discuss the enzyme kinetics and regulation</li> </ul>		
<b>Course Outcomes:</b> <p>CO 1: Able to understand the enzymes action and properties</p> <p>CO 2: Able to know mechanism of enzyme action and regulation.</p> <p>CO 3: Know the isolation and purification of enzymes</p> <p>CO 4: Able to know the purification and large scale production of enzymes</p> <p>CO 5: Also able to know the multi-enzymes complexes</p>		
Credits: <b>4</b>	Type of Course: <b>Core</b>	
Max. Marks: <b>100</b>	Min. Passing Marks: <b>36</b>	
<b>Block 1</b>	<b>Enzymes nomenclature and multi-enzymes complexes</b>	
Unit I	<b>Introduction to enzymes:</b> Nomenclature and classification of enzymes, general properties of enzymes, cofactors and specificity, Criteria for enzyme homogeneity, bioenergetics of enzymes reactions, catalytic antibodies	
Unit II	<b>Multi-enzymes complexes:</b> Isozymes, Coenzyme, artificial enzymes, catalytic antibodies, Enzyme engineering-strategies, directed evolution, degradation of unnatural substrates. Protein mediated transport, enzyme inhibition, determination of KI, suicide inhibitors.	
<b>Block 2</b>	<b>Enzyme kinetics and regulation</b>	
Unit III	<b>Enzyme kinetics:</b> Active sites, Enzyme specificity, Enzyme unit, Enzyme velocity, Activation energy and transition state enzymatic reaction mechanisms, Michaelis- Menten equation, Effect of substrate, pH, temperature and inhibitors on enzyme activity.	
Unit IV	<b>Mechanism of enzyme action and regulation:</b> Active and regulatory sites, chemical modification, feedback inhibition, positive and negative cooperativity, allosteric enzymes, marker enzymes, enzyme region and stererio specificity.	
<b>Block 3</b>	<b>Industrial enzymes and purification</b>	
Unit V	<b>Industrial enzymes:</b> In detergent, food, leather, dairy, medicines and chemical industries. Enzyme immobilization: Introduction, methods, applications and limitations.	
Unit VI	<b>Isolation and purification of enzymes:</b> Isolation, purification and large scale production of enzymes with principles and applications of the involved techniques, viz gel filtration, ion exchange and affinity chromatography, centrifugation and electrophoretic techniques	
<b>Suggested Text Book Readings:</b> <ol style="list-style-type: none"> <li>1. David L. Nelson and Michael Cox, "Lehninger Principles of Biochemistry" International</li> </ol>		

Edition-2021.

2. Dr J L Jain, "Fundamentals of Biochemistry" S. Chand and Company-2020.
3. P S Verma and V K Agarwal, "Cell Biology (Cytology, Biomolecule and Molecular Biology" S. Chand Publication-2016.
4. Talwar and Srivastava, "Textbook of Biochemistry and Human Biology" Eastern Economy Edition, Prentice Hall, India-2002.
5. Satyanarayana U., "Biochemistry" Elsevier India,2021

**Suggested online links:**

1. Enzyme Kinetics: [Enzyme Kinetics \(columbia.edu\)](http://columbia.edu)
2. Nomenclature and Classification of Enzymes: [Enzymes Nomenclature and Classification \(amu.ac.in\)](http://amu.ac.in)
3. Mechanism of Enzyme Action: [Mechanism of enzyme action \(jrc.ac.in\)](http://jrc.ac.in)
4. Applications of Enzyme: [45 Enzymes - Applications.pdf \(du.ac.in\)](http://du.ac.in)

**This course can be opted as an elective by the students of following subjects: M.Sc. (Zoology) M.Sc. (Biotechnology)**

**Suggested equivalent online courses (MOOCs) for credit transfer: NA**

Programme: <b>M.Sc.</b>	Year: 2023	Semester: <b>III</b>
<b>Subject: Biochemistry</b>		
Course Code: <b>PGBCH-112N</b>	Course Title: <b>Immunology</b>	
<b>Course Objectives:</b>		
<ul style="list-style-type: none"> <li>➤ To discuss the immunology and immune system</li> <li>➤ To discuss the elements of immune system</li> <li>➤ To discuss infectious diseases and immunology</li> </ul>		
<b>Course Outcomes:</b>		
CO 1: Able to understand the architecture of immune system		
CO 2: Able to know the role of T cells and stem cell.		
CO 3: Know the antigens processing and presentation.		
CO 4: Able to Understand the primary and secondary response,		
CO 5: Also able to know the signal transduction properties		
Credits: <b>4</b>	Type of Course: <b>Core</b>	
Max. Marks: <b>100</b>	Min. Passing Marks: <b>36</b>	
<b>Block 1</b>	<b>Immune system</b>	
Unit I	<b>Introduction to immunology</b> Introduction to immunology, architecture of immune system, primary and secondary lymphoid organism, maturation and selection of T cells, types of immunoglobulin's, immunization, stem cell, immune technology, clonal selection theory.	
Unit II	<b>Immunity:</b> Types of immunity-innate, acquired, adaptive and cellular immunity, immune response, inflammatory barrier, hormonal influence, peptide binding by class I and class II major histocompatibility complex.	
<b>Block 2</b>	<b>Elements of Immune System</b>	
Unit III	Cells and Organs of immune System, B-cells maturation, activation and differentiation, t-cell maturation, activation and differentiation, t-cells and bcellsreports, macrophages, dendrites cells, natural killer cells (NKcells), organization and expression of immunoglobulin genes.	
Unit IV	Antigens processing and presentation, effector responses of cell-mediated and humoral immunity, cytokines, complement system, classification of common vaccines for humans, vaccines (hepatitis, influenza, measles), blood groups and Rh factor.	
<b>Block 3</b>	<b>Infection diseases and immunology</b>	
Unit V	<b>Immune response to infection diseases:</b> Lymphocytes, primary and secondary response, signal transduction properties, antibody receptor structure, hypersensitivity.	
Unit VI	Transplantation immunology, immunologic tolerance, immunology of tumors, cancer and AIDS.	
<b>Suggested Text Book Readings:</b>		
1. A Textbook Of Immunology: Latha P. Madhavee, S Chand & Company, publication		
2. Immunology, Dulsy Fatima, Saras Publication		
3. Basics Of Immunology, Preeti Sharma, IP Innovative Publication		
4. Immunology, David Male, Elsevier publication		

**Suggested online links:**

1. Introduction to Immunology: [Immunology.pdf \(hmmcollege.ac.in\)](http://hmmcollege.ac.in)
2. Components of Immune system: [components of immune system \(dHINGCOLLEGEONLINE.CO.IN\)](http://dHINGCOLLEGEONLINE.CO.IN)
3. Immune System: [Immune System Handout \(Soinc.Org\)](http://SOINC.ORG)

**This course can be opted as an elective by the students of following subjects: NA**

**Suggested equivalent online courses (MOOCs) for credit transfer:**

Biochemistry of Biomolecules: [Biochemistry of Biomolecules - Course \(swayam2.ac.in\)](http://swayam2.ac.in)

Programme: <b>M.Sc.</b>	Year: 2023	Semester: <b>III</b>
<b>Subject: Biochemistry</b>		
Course Code: <b>PGBCH-113N</b>	Course Title: <b>Basic Biotechnology</b>	
<b>Course Objectives:</b>		
<ul style="list-style-type: none"> <li>➤ To discuss the basic history and scope of biotechnology.</li> <li>➤ To discuss the molecular biology and recombinant DNA technology.</li> <li>➤ To discuss the medical biotechnology</li> <li>➤ To discuss the agriculture and food biotechnology</li> </ul>		
<b>Course Outcomes:</b>		
CO 1: Able to understand the role of biotechnology in medical		
CO 2: Able to understand the role of biotechnology in agriculture and food biotechnology		
CO 3: To know about cell molecular biology		
CO 4: Learn about plant and animal biotechnology.		
CO 5: Also able to know the recombinant DNA technology		
Credits: <b>4</b>	Type of Course: <b>Core</b>	
Max. Marks: <b>100</b>	Min. Passing Marks: <b>36</b>	
<b>Block 1</b>	<b>Biotechnology and molecular biology</b>	
Unit I	<b>Biotechnology:</b> An overview-definition, scope and importance of Biotechnology, useful products of biotechnology, A brief account of microbes in industry and agriculture, Fermented and Probiotic foods, Food spoilage and preservation, Metabolic engineering for over production of metabolites, Biotransformation.	
Unit II	<b>Molecular Biology &amp; Recombinant DNA Technology:</b> Concept of Recombinant DNA Technology and Gene Cloning, advance methods of molecular biology, Vectors, Vector engineering, Enzymes involved in RDT, Recombinant gene construction, Gene Transfer methods, Gene expression studies, Polymerase Chain Reaction (PCR).	
<b>Block II</b>	<b>Agricultural Biotechnology and Animal &amp; Plant Biotechnology</b>	
Unit III	<b>Agriculture, Food and Environmental Biotechnology:</b> Role of biotechnology to Improve yield and nutritional values of crop, GM Foods, Labeling of GM Foods, Risks (Health, Environment etc) associated with GM Foods, Biobusiness, Biosafety, Role of Biotechnology in pollutants remediation (air, water and soil) and energy productions, Bioremediation, Restoration of degraded lands and Conservation of biodiversity.	
Unit: IV	<b>Plant and Animal Biotechnology:</b> Introduction to plant tissue culture and its applications, Gene transfer methods in plants, transgenic plants, In-vitro fertilization and embryo transfer in humans and livestock, Transfection techniques and transgenic animals, Animal Cloning.	
<b>Block 3</b>	<b>Block–III: Biotechnology and Molecular biology</b>	
Unit V	<b>Medical Biotechnology:</b> Biotechnology in medicine, Vaccines, Diagnostic, Forensic, Gene therapy, Nano Medicine & Drug Delivery Cell & Tissue Engineering, Genetic disorders, Molecular methods of disease diagnosis	
Unit VI	Hybridoma technology, Gene therapy, Stem cell for treatment of diseases,	

Therapeutic molecule, Immunological techniques. Different types of culture media.

**Suggested Text Book Readings:**

1. Advanced Biotechnology, Dubey R.C. S Chand & Company publisher
2. Biotechnology: A Problem Approach, Biotechnology: A Problem Approach, Pathfinder Publication
3. Basic Biotechnology, Ratledge Colin, ambridge University Press
4. Plant biotechnology, Adrain Slater et al., South Asia Edition.

**Suggested online links:**

1. Biotechnology history: [Biotechnology all lecture notes - Lecture 1- Biotechnology history](#)  
[Biotechnology definition- any - Studocu](#)
2. Introduction to biotechnology, history and concepts definition: [fsba-module-2-unit-1-notes-english.pdf \(rug.nl\)](#)
3. Recombinant DNA Technology: [Chapter14.pdf \(richmond.edu\)](#)
4. Animal Biotechnology: [1589512953\\_Z\(H\)-VI-Biotech-4.pdf \(deshbandhucollege.ac.in\)](#)
5. Medical biotechnology: [Medical Biotechnology \(vu.edu.pk\)](#)

**This course can be opted as an elective by the students of following subjects: NA**

**Suggested equivalent online courses (MOOCs) for credit transfer: NA**

Programme: M.Sc.	Year: 2023-24	Semester: III
Subject: <b>Biochemistry</b>		
Course Code: <b>PGRT-03N</b>	Course Title: <b>Basics in Research Tools</b>	
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>➤ To discuss the application of MS office</li> <li>➤ To discuss different research tools for research work.</li> <li>➤ To discuss application of software's.</li> <li>➤ To discuss about reference management tools</li> </ul>		
<b>Course Outcomes:</b> CO 1: Able to learn about basic computer application of research work. CO 2: Learn about Latex tools with MS-XL CO 3: Able to know the role of Chem-Draw, Origin, SPSS, R-software, Octave, Matlab CO 4: Gain knowledge about application of Mendeley-software. CO 5: Also know about RefWorks and Zotero, etc		
Credits: <b>4</b>	<b>Type of Course:</b> Core	
Max. Marks: <b>100</b>	Min. Passing Marks: <b>36</b>	
<b>Topic 1</b>	<b>Application of MS Office/Latex in research</b> Uses and application of MS Office/ Latex Tools with MS-XL, Power point Presentation.	
<b>Topic 2</b>	<b>Application of Software's</b> Uses and application of Softwares such as plagiarism software, Chem-Draw, Origin, SPSS, R-software, Octave, Matlab, Mercury, etc.	
<b>Topic 2</b>	<b>Reference management tools</b> Uses and application of Mendeley-software, EndNote, RefWorks and Zotero, etc.	
<b>Suggested Text Book Readings:</b> <ol style="list-style-type: none"> <li>1. Microsoft office: <u>Microsoft Office Essentials - IT Essentials: a Practical Guide - Subject Guides at University of York</u></li> <li>2. How to Convert an Excel Table to a Latex table: <u>How to Convert an Excel Table to a Latex table - YouTube</u></li> <li>3. SPSS – What Is It: <u>SPSS - Quick Overview &amp; Beginners Introduction (spss-tutorials.com)</u></li> <li>4. Video Processing in MATLAB: <u>Video Processing in MATLAB - Video - MATLAB &amp; Simulink (mathworks.com)</u></li> <li>5. ChemDraw Tutorial: <u>ChemDraw Tutorial - YouTube</u></li> </ol>		
<b>Note:-</b> In this paper, learner itself study the objectives and prepare a report. The report will be submitted along with assignment to respective study center for evaluation. The maximum marks for evaluation are 100.		

Programme: <b>M.Sc.</b>	Year: 2023	Semester: <b>IV</b>
Subject: <b>Biochemistry</b>		
Course Code: <b>PGBCH-116N</b>	Course Title: <b>Biosafety and IPR</b>	
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>➤ To discuss the history and process of biosafety</li> <li>➤ To discuss the patent and convention process</li> <li>➤ To discuss the Gene and GMO</li> <li>➤ To discuss the patents and agreement</li> </ul>		
<b>Course Outcomes:</b> <p>CO 1: Able to understand the biosafety and risk assessment.</p> <p>CO 2: Able to know the role of WTO and international agreement</p> <p>CO 3: To know about laboratory and environment biosafety</p> <p>CO 4: Able to know the ecological aspects of GMOs and impact on biodiversity</p> <p>CO 5: Learn to know the risk management and intellectual properties right</p>		
Credits: <b>4</b>	Type of Course: <b>Core</b>	
Max. Marks: <b>100</b>	Min. Passing Marks: <b>36</b>	
<b>Block 1</b>	<b>Biosafety and convention</b>	
Unit I	Bio-safety and risk assessment tissues, regulatory framework, National biosafety Policies and law, The Cartagena protocol on biosafety.	
Unit II	<b>WTO and Agreement:</b> WTO and other international agreements related to biosafety; Cross border Movement of germplasm; Risk management issues containment. The WTO and other international agreements; Intellectual properties, copyrights, trademarks, trade secret, patents, geographical indications, etc.	
<b>Block 2</b>	<b>GENE AND GMO</b>	
Unit III	General principles for the laboratory and environmental biosafety; healthy aspects; toxicology, allergenicity, antibiotic resistance etc. Impact on environment	
Unit IV	<b>Gene flow:</b> Gene flow in natural and artificial ecologies; Sources of gene escape, tolerance of Target organisms, creation of super-weeds/super viruses etc.	
<b>Block III</b>	<b>Patent and agreements</b>	
Unit V	<b>Ecological aspects:</b> Ecological aspects of GMOs and impact on biodiversity; Monitoring strategies and methods for detecting transgenics; Radiation safety and non-isotopic procedures; Benefits of transgenics to human health, society and the environment.	
<b>Suggested Text Book Readings:</b> <ol style="list-style-type: none"> <li>1. IPR, Biosafety and Bioethics: Deepa Goel, Shomini Parashar; Pearson, 2013</li> <li>2. Bioethics and Biosafety: M.K. Sateesh, I. K. International Pvt Ltd, 2013</li> <li>3. Plant Biotechnology: Principles and Applications, Malik Zainul Abdin, Usha Kiran, Kamaluddin, Athar Ali, Springer, 2017</li> <li>4. General Biochemistry: J.H.Weil., Wiley Eastern, Limited, 1990</li> <li>5. An Introduction to Ethical, Safety and Intellectual Property Rights Issues in biotechnology: Padma Nambisan, Academic press 20107.</li> </ol>		

**Suggested online links:**

1. Cartagena Protocol on Biosafety: Biosafety: [1527 CBD 40pgs-layout](#)
2. Text of the Convention: [Text of the Convention \(cbd.int\)](#)
3. WTO Agreements: [WTO Agreements, an overview of WTO agreements, TRIPS, TRIMS, AOA, GATS, international business ugc - YouTube](#)
4. Environmental Aspects: [Environmental Aspects \(usda.gov\)](#)

**This course can be opted as an elective by the students of following subjects: NA****Suggested equivalent online courses (MOOCs) for credit transfer: NA**

Programme: M.Sc.	Year: 2023	Semester: IV
Subject: <b>Environmental Science</b>		
Course Code: <b>PGBCH-117N/PGEVS 120N</b>	Course Title: <b>Environmental Toxicology &amp; Occupational Health Hazards</b>	
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• To discuss about environmental toxicity and toxicant</li> <li>• To discuss about rout of environmental toxicant of human beings</li> <li>• To discuss about occupational toxicology and its effects on human health</li> <li>• To discuss the transformation of toxicant and systematic toxicity</li> </ul>		
<b>Course Outcomes:</b> CO 1: Able to know the toxicity of environment and its effect CO 2: Learn the duration and exposure of toxicant. CO 3: Able to know the distribution, binding and storage, and excretion of toxicant. CO 4: Know the different types of systematic toxicity. CO 5: Also learn the occupational toxicant exposure and limits		
Credits: 4	<b>Type of Course:</b> Core	
Max. Marks: 100	Min. Passing Marks: 36	
<b>Block 1</b>	<b>Toxicity and Toxicants</b>	
Unit I	<b>Introduction to Toxicology:</b> Definition, history and scope of toxicology, toxicant, types of toxicant, toxicity and toxic agent, factor effects toxicants, target and non organ toxicity, dose effects and dose response relationship.	
Unit II	<b>Toxicants:</b> Classification of toxic agents, natural toxins, animal toxins, plant toxins, food toxins, genetic poisons and chemical toxins.	
Unit III	<b>Duration and exposure of toxicant:</b> Acute exposure, chronic exposure, types of human exposure- internal exposure, occupational exposure, environmental exposure, accidental poisoning and internal poisoning	
<b>Block 2</b>	<b>Toxicity and Public Health</b>	
Unit IV	<b>Fate of toxicant in human body:</b> Toxicant absorption, distribution, binding and storage, and excretion, active and passive transport of toxicant.	
Unit V	<b>Chemical toxicity in human:</b> Alcohol toxicity, toxicity of ketones, minerals toxicity-sodium, potassium, iodine, iron, nitrogen, calcium, zinc, copper, selenium and manganese toxicity, toxicity of dioxins.	
Unit VI	<b>Public Health:</b> Toxicologists and public health, laws and regulations governing toxicants, epidemiological approaches to toxicants, Blacklisted toxic chemicals, pesticide, automobile emission.	
<b>Block 3</b>	<b>Systematic Toxicity</b>	
Unit VII	<b>Renal toxicity</b> Renal toxicity- Renal structure and functions, susceptibility of kidney to toxic insult, chemically induced renal injury.	
Unit VIII	<b>Cutaneous toxicology:</b>	

	Dermatological effects of toxic agents, Allergic contact dermatitis, Cutaneous carcinogenesis
Unit IX	<b>Pulmonary and Hepatic toxicity:</b> Toxicant causing respiratory dysfunction, mechanism of entry of toxicant into the lungs, Systematic lung toxins, Actions of toxins on the liver, Chronic liver injury.
	<b>Carcinogenesis and Testing methods</b>
Unit X	<b>Carcinogenesis and mutagenicity:</b> Carcinogens and carcinogenesis, types of carcinogens, mechanism of carcinogenesis, Mutation and mutagenicity, types of mutation, mechanism of mutagenesis
Unit XI	<b>Transformation of toxicants:</b> Bioaccumulation, biomagnifications, biotransformation, types of biotransformation, biotransformation of DDT, toxic material in environment.
Unit XI	<b>Occupational toxicology:</b> Occupational toxicants, exposure limits, Risks associated with hazardous substances, Risk assessment and management guidelines, Occupational/Industrial hygiene, Hazard control.

### **Suggested Text Book Readings:**

1. Environmental Toxicology, Kees van Gestel, Vrije University, Amsterdam, [Environmental Toxicology](#)
2. Environmental Toxicology, Third Edition, Sigmund F. Zakrzewski, oxford university press
3. A Textbook of Modern Toxicology: Ernest Hodgson A John Wiley & Sons, Inc., Publication
4. Principles of Environmental Toxicology, I. Shaw, J. Chadwick, CRC Press
5. Occupational Toxicology, Chris Winder, Neill H. Stacey, CRC Press

### **Suggested online link:**

1. Introduction to Toxicology Introduction to Toxicology: [Introduction to toxicology \(europa.eu\)](http://europa.eu)
2. Introduction to Toxicology: [Introduction to Toxicology | Part 1 | Complete Toxicology | NEET PG 2021 | Dr. Ambuj Mittal - YouTube](#)
3. Chemical toxicology: [chemical toxicology part 2 || effects of heavy metals like arsenic | mercury,chromium,cadmium lead - youtube](#)
4. Drug-induced nephrotoxicity: <https://www.scielo.br/j/ramb/a/TC7wp7jkjgSjPMZ9ZNnqdMF/?lang=en&format=pdf>
5. Toxicology in Occupational and Environmental Setting: [c01 \(wiley-vch.de\)](http://c01.wiley-vch.de)

This course can be opted as an elective by the students of following subjects: M.Sc. (Zoology) M.Sc. (Environmental Science)

Suggested equivalent online courses (MOOCs) for credit transfer: NA

Programme: <b>M.Sc.</b>	Year: 2023	Semester: <b>IV</b>
<b>Subject: Biochemistry</b>		
Course Code: <b>PGBCH-118N/ PGZY 121N</b>	Course Title: <b>Genetic Engineering</b>	
<b>Course Objectives:</b>		
<ul style="list-style-type: none"> <li>➤ To discuss the basics of genetic engineering</li> <li>➤ To discuss the nucleic acids, enzymes and cloning vectors</li> <li>➤ To discuss the PCR, DNA finger printing and recombinant DNA technology (RDT)</li> <li>➤ To discuss the Immunotechnology, blotting techniques and transgenic animals</li> </ul>		
<b>Course Outcomes:</b>		
CO 1: Able to understand the basics of molecular biology and its applications		
CO 2: Able to understand the genes expression, nucleic acids and their applications		
CO3: Able to understand the cloning vectors, blotting techniques and RDT		
CO3: Also able to understand isolation of nucleic acids, DNA finger printing and Immuno technology		
Credits: <b>4</b>	Type of Course: <b>Core</b>	
Max. Marks: <b>100</b>	Min. Passing Marks: <b>36</b>	
<b>Block I</b>	<b>Material and Tools- I</b>	
Unit I	<b>History of genetics:</b> Basic molecular biology- gene expression in prokaryotes and eukaryotes	
Unit II	<b>Working with nucleic acids:</b> Isolation of DNA and RNA, Radiolabelling of nucleic acids- end labeling, nick translation, by primer extension, Principle of nucleic acid hybridization, DNA sequencing methods- Maxam-Gilbert and Sanger-Coulson sequencing.	
Unit III	<b>Enzymes as tools:</b> Restriction enzymes- Type II, uses and restriction mapping, DNA modifying enzymes- Nucleases, Polymerases, and end-modifying enzymes, DNA ligases	
<b>Block II</b>	<b>Genetic Engineering- I</b>	
Unit IV	<b>Cloning vectors:</b> Plasmids- pBR322, pUC8, Lambda ( $\lambda$ )-phage vector, M13 Phage, Cosmids, Phasmids, Shuttle vector, Bacterial artificial chromosome (BAC), Yeast artificial chromosome (YAC), Mammalian artificial chromosome (MAC)	
Unit V	<b>cDNA and its applications:</b> Synthesis of cDNA from mRNA, Cloning cDNA in plasmid and bacteriophage vectors, Expression of cloned cDNA molecules, cDNA library	
<b>Block II</b>	<b>Genetic Engineering- II</b>	
Unit VI	<b>Cloning from genomic DNA:</b> Genomic DNA and library, Preparation of DNA fragment for cloning, Ligation, packaging and amplification of libraries	
Unit VII	<b>Polymerase chain reaction (PCR):</b> Basic PCR, RT (reverse transcribed)- PCR, Real Time PCR, Applications of PCR in genetic engineering	
Unit VIII	<b>DNA Finger printing:</b> History, DNA markers, Minisatellites, Microsatellites, Methods and applications	
Unit IX	<b>Screening and analysis of recombinants:</b> Use of chromogenic substrates, Genetic selection methods, Nucleic acid probes- Chromosome walking and jumping, Screening cloned banks, Immunological	

	screening for expressed genes, Blotting techniques
<b>Block IV</b>	<b>Genetic Engineering-II</b>
X	<b>Genetic engineering in action:</b> Analysis of gene structure and function, Techniques- Gel retardation, DNA foot printing, DNA finger printing, Primer, extension, S <sub>1</sub> mapping, and Dot-blot analysis.
XI	<b>Immuno-technology:</b> Hybridoma technology, Monoclonal antibodies and its production, Antibody engineering, Uses of monoclonal antibodies
XII	<b>Transgenic animals</b> Transgenic animals Vs cloned animals, Producing transgenic animals, Applications of transgenic animals
<b>Suggested Text Book Readings:</b>	
<ol style="list-style-type: none"> <li>1. Karp's Cell and Molecular Biology, 9th Edition, by Gerald Karp, Wiley publication.</li> <li>2. Principles of Molecular Biology, Rastogi, scientific international</li> <li>3. Genetic Engineering and Biotechnology by Tourte, Taylor &amp; Francis</li> <li>4. David L. Nelson and Michael Cox, "Lehninger Principles of Biochemistry" International Edition-2021.</li> <li>5. Biotechnology , by B.D. Singh, Kalyani publishers</li> </ol>	
<b>Suggested online links:</b>	
<ol style="list-style-type: none"> <li>1. History of Genetics: <a href="#">History of Genetics.pdf (colorado.edu)</a></li> <li>2. Enzymes used in Genetic Engineering: <a href="#">lec20.pdf (eagri.org)</a></li> <li>3. DNA Fingerprinting: <a href="#">100004146.pdf (amu.ac.in)</a></li> <li>4. Immunological methods and applications: <a href="#">Online Chapter.pdf (roitt.com)</a></li> <li>5. DNA cloning: <a href="#">Chapter14.pdf (blackwellpublishing.com)</a></li> <li>6. Gene Cloning: <a href="#">e200402-301.pdf (cheric.org)</a></li> </ol>	
<b>This course can be opted as an elective by the students of following subjects: M.Sc. (Zoology) M.Sc. (Boyany)</b>	
<b>Suggested equivalent online courses (MOOCs) for credit transfer: NA</b>	

Programme: <b>M.Sc.</b>	Year: 2023	Semester: <b>IV</b>
Subject: <b>Biochemistry</b>		
Course Code: <b>PGBCH-120N</b>	Course Title: <b>Microbiology and Toxicology</b>	
<b>Course Objectives:</b>		
<ul style="list-style-type: none"> <li>➤ To discuss the microbial diversity and culture</li> <li>➤ To discuss the methods in microbiology</li> <li>➤ To discuss the nutritional microbiology and chemotherapy</li> <li>➤ To discuss the role of microbes in agriculture and environment</li> </ul>		
<b>Course Outcomes:</b>		
CO 1: Able to understanding of history and scope of microbes		
CO 2: Abe to understand the microbial diversity and its growth		
CO 3: Able to learn the methods of microbial culture and techniques		
CO 4: know the role of microbes in agriculture		
CO 5: Also able to discuss the environmental microbiology and its toxicity		
Credits: <b>4</b>	Type of Course: <b>Core</b>	
Max. Marks: <b>100</b>	Min. Passing Marks: <b>36</b>	
<b>Block 1</b>	<b>Microbial diversity and culture</b>	
Unit I	<b>Microbial diversity and systematic:</b> Modern approaches to bacterial taxonomy, polyphasic classification, General characteristics of primary domains and of Taxonomic groups belonging to Bacteria, Archaea and Eukarya, Nomenclature and outline of bacterial classification as per Bergey's Manual, Accessing microbial diversity using molecular methods such as Denaturing Gradient Gel Electrophoresis (DGGE)	
Unit II	<b>Methods in Microbiology:</b> Theory and practice of sterilization, Pure culture techniques, Principles of microbial nutrition, Construction of culture media, Enrichment culture techniques, Isolation and culture of aerobic and anaerobic bacteria, Culture collection, preservation and maintenance of microbial cultures.	
<b>Block II</b>	<b>Microbial Nutrition and Chemotherapy</b>	
Unit III	<b>Metabolic Diversity among Microorganism:</b> Microbial Nutrition, nutritional types and modes of nutrition in bacteria, Extremophiles. Microbial growth: The definition of growth, mathematical expression of growth, growth curve, measurement of growth and growth yields; Synchronous growth and Continuous culture.	
Unit IV	<b>Chemotherapy/Antibiotics Antimicrobialagents;</b> Antibiotics: Penicillins and Cephalosporins and Broad-spectrum antibiotics, sulfa drugs, Antifungal antibiotics, Mode of action, Molecular mechanism of drug resistance. Bacterial Genetic System: Transformation, Conjugation, Transduction, Recombination, Bacterial genetic map with reference to Ecoli.	
<b>Block III</b>	<b>Microbial diseases and Environmental Toxicology</b>	
Unit V	Microbial diseases: Bacterial and virus diseases with reference to tuberculosis, Cholera, AIDS, Rabies, food born diseases.	

Unit VI	Introduction to Environmental Toxicology, Bioconcentration, Bioaccumulation, and Biomagnification, Toxicokinetics, Xenobiotics Compounds, Biotransformation of Xenobiotics, Environmental Xenobiotic.
<p><b>Suggested Text Book Readings:</b></p> <ol style="list-style-type: none"> <li>1. Prescott' microbiology, eighth edition by By Joanne Willey and Kathleen Sandman and Dorothy Wood.</li> <li>2. A textbook of Microbiology, R.C. Dubey and D.K. Maheshwari,, S Chand &amp; Company P Ltd, New Delhi</li> <li>3. Text book of microbiology by Ananthanarayan and paniker's, Seventh edition, Orient longman private limited.</li> <li>4. Foundations in Microbiology, By Kathleen Park Talaro and Barry Chess, 10 edition</li> <li>5. Microbiology: An Introduction, 13th Edition by Gerard J. Tortora, Berdell R. Funke and Christine L. Case.</li> </ol> <p><b>Suggested online links:</b></p> <ol style="list-style-type: none"> <li>1. Microbial diversity and systematic: <a href="#">1075X_CH03_025.qxd (jblearning.com)</a></li> <li>2. Microbiological Laboratory Techniques: <a href="#">Microbiological Laboratory Techniques (mowr.gov.in)</a></li> <li>3. Antibiotics and chemotherapeutic agents: <a href="#">Micro 260 Antibiotic agents and Modes of Action.pdf (spokane.edu)</a></li> <li>4. Environmental Toxicology: <a href="#">Environmental Toxicology 3rd edition.pdf (unp.ac.id)</a></li> <li>5. Introduction to environmental toxicology: <a href="#">Introduction to Environmental Toxicology: Molecular Substructures to Ecological Landscapes (routledge.com)</a></li> </ol>	
<p><b>This course can be opted as an elective by the students of following subjects: NA</b></p>	
<p><b>Suggested equivalent online courses (MOOCs) for credit transfer: NA</b></p>	

Programme: <b>M.Sc.</b>	Year: 2023	Semester: <b>IV</b>
Subject: <b>Biochemistry</b>		
Course Code: <b>PGBCH-121N</b>	Course Title: <b>Industrial Biotechnology</b>	
<b>Course Objectives:</b>		
<ul style="list-style-type: none"> <li>➤ To discuss the process and fermentation</li> <li>➤ To discuss the process of industrial production</li> <li>➤ To discuss the food technology and isolation process</li> <li>➤ To discuss the isolation process</li> </ul>		
<b>Course Outcomes:</b>		
CO 1: Able to understand the bioprocess technology.		
CO 2: Able to understanding fermentation process.		
CO 3: To the process of bioreactor and stability of microbial reactions.		
CO 4: Able to understand the downstream process.		
CO 5: Learn the sterilization and pasteurization process of food.		
Credits: <b>4</b>	Type of Course: <b>Core</b>	
Max. Marks: <b>100</b>	Min. Passing Marks: <b>36</b>	
<b>Block 1</b>	<b>Bioprocess and fermentation</b>	
Unit I	Introduction to bioprocess technology, bioreactors, Isolation, preservation and maintenance of industrial microorganisms, kinetics of microbial growth and death, media for industrial fermentation, air and media sterilization.	
Unit II	<b>Types of fermentation processes:</b> Analysis of batch, fed-batch, and continuous bioreactors, stability of microbial reactors, analysis of mixed microbial populations, specialized bioreactors (pulsed, photo bioreactors etc.) measurement and control of bioprocess parameters.	
<b>Block II</b>	<b>Processing and industrial production</b>	
Unit III	<b>Downstream processing:</b> Introduction, removal of microbial cells and solid matter, foam separation, precipitation, filtration, centrifugation, cell disruptions, liquid-liquid extraction, chromatography, Membrane process, Drying and crystallization, Whole cell immobilization and its industrial applications.	
<b>Unit IV</b>	<b>Industrial production of chemicals:</b> Alcohol (ethanol), acids (citric, acetic and gluconic), Solvents (glycerol, acetone, butanol), Antibiotics (penicillin, streptomycin, tetracycline).	
<b>Block III</b>	<b>Food technology and isolation process</b>	
Unit V	<b>Introduction to food technology:</b> Elementary idea of canning and packing, Sterilization and pasteurization of food products, Technology of typical food/food products (bread, cheese, idli).	
Unit VI	<b>Isolation process:</b> Isolation and screening of industrially important microorganism, different Processes of biofuels production, petroleum microbiology.	
<b>Suggested Text Book Readings:</b>		
1. Industrial Biotechnology, Wim Soetaert and Erick J. Vandamme, Wiley-VCH publication.		

2. Modern industrial microbiology and biotechnology, Nduka Okafor, Science Publishers
3. Industrial Biotechnology, Varun Shastri, Disha Books
4. Industrial Biotechnology, Kavita, A.I.T.B.S. Publishers, India
5. Cruegers Biotechnology: A Textbook of Industrial Microbiology, Wulf Crueger, Medtech.

**Suggested online links:**

1. Bioprocess/Fermentation Technology: [Bioprocess/Fermentation Technology \(Chapter 4\) - Biotechnology \(Cambridge.Org\)](#)
2. Downstream Processing: [Validation \(Biomufacturing.Org\)](#)
3. Biotechnology for Clean Industrial Products and Processes: [931998031 \(Page 1\) \(Oecd.Org\)](#)
4. Isolation, Screening and Strain Improvement: [isolation, screening and strain improvement \(ub.ac.id\)](#)
5. Introduction to Food Technology, General Aspect of Food Industry: [microsoft word - 1. introduction to food technology, general aspect of food industry.doc.docx \(nptel.ac.in\)](#)

**This course can be opted as an elective by the students of following subjects: NA**

**Suggested equivalent online courses (MOOCs) for credit transfer: NA**

Programme: <b>M.Sc.</b>	Year: 2023	Semester: <b>IV</b>
Subject: <b>Biochemistry</b>		
Course Code: <b>PGBCH-122N</b>	Course Title: <b>Bioinformatics</b>	
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>➤ To discuss the history and scope of bio information.</li> <li>➤ To discuss the molecular phylogeny</li> <li>➤ To discuss the 3D protein structure and classification of database</li> <li>➤ To discuss the data base management</li> </ul>		
<b>Course Outcomes:</b> <p>CO 1: Able to understand the role of bioinformatics in biochemistry.</p> <p>CO 2: Able to understand Simulation and drug designing</p> <p>CO 3: To know about protein data base</p> <p>CO 4: Able to known the role of national center for biotechnology information</p> <p>CO 5: Learn the process of protein data base bank management</p>		
Credits: <b>4</b>	Type of Course: <b>Core</b>	
Max. Marks: <b>100</b>	Min. Passing Marks: <b>36</b>	
<b>Block 1</b>	<b>Bioinformatics and Biological data bases</b>	
Unit I	<b>Introduction to bioinformatics:</b> Introduction of bioinformatics, Aim, scope, and research are as of bioinformatics, use of internet and search engines (WWW, HTML, URLs, Netscape, Explorer, Google, PUBMED) database Management system, database browsing	
Unit II	Biological databases-Sequence and molecular file formats, introduction, Sequence file formats, sequence conversion tools, molecular file formats, Molecular file format conversion sequence alignments, scoring matrices, PAM, BLOSUM, alignment of pairs of sequences, multiple sequence Alignment (MSA).	
<b>Block II</b>	<b>Phylogeny and sequence databases</b>	
<b>Unit III</b>	<b>Molecular phylogeny:</b> Introduction of phenotypic, phylogeny and molecular phylogeny, representation of phylogeny, molecular clocks, methods of phylogeny, statistical evaluation of the obtained phylogenetic.	
Unit IV	<b>Biological sequence databases:</b> Biological databases, classification scheme of biological databases, biological database retrieval systems, national center for biotechnology information (NCBI), tool and databases of NCBI, data base retrieval tool, sequence submission to NCBI,	
<b>Block III</b>	<b>Protein database, Simulation and drug designing</b>	
Unit V	Blast, PSO-blast, nucleotide database, protein database, gene expression database, structural database, chemical database, other database, Molecular Simulation and drug designing.	
Unit VI	Protein 3D structure and classification database, protein data base bank, Harnessing data from PDB, data deposition tools, PDB Data, RCSB PDB	

Structural genomics in formation portal, retrieval of structural data base from MMDB, converted domain database (CDD).
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**Suggested Text Book Readings:**

1. Bioinformatics, Principal and Application: Ghosh and Malik, Oxford University Press publication
2. Bioinformatics, Principal and Application: Harshwardhan P. Bal, Oxford University Press publication
3. Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery, S. C. Rastogi, PHI Publication
4. Bioinformatics Sequence and Genome Analysis 2ed: Mount D. W , CBS Publisher
5. Introduction to Bioinformatics, Lesk, Oxford University Press publication

**Suggested online links:**

1. Introduction to bioinformatics: [bioinformatics \(mgcub.ac.in\)](http://mgcub.ac.in)
2. Molecular phylogeny and evolution: [PowerPoint Presentation \(fh-muenster.de\)](http://fh-muenster.de)
3. Biological Databases: [Biological databases: why? \(rlacollege.edu.in\)](http://rlacollege.edu.in)
4. Protein databases: [Microsoft PowerPoint - Protein databases .ppt \(amherst.edu\)](http://amherst.edu)

<b>This course can be opted as an elective by the students of following subjects: NA</b>
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### Practical work

PGBCH -104 N(P)	Practical's based on PGBCH-101N,102N and 103N
PGBCH -109N(P)	Practical's based on PGBCH-106N,107N and 108N
PGBCH -114N(P)	Practical's based on PGBCH-111N,112N and 113N
PGBCH-119N(P)	Practical's based on PGBCH-116N, 117N and 118N
PGBCH-123N(P)	Practical's based on PGBCH-120N, 121N and 122N
<b>Note:</b> The topic of practical will be selected from relevant theory paper as per suggestion of relevant faculty members of study centre.	

<b>PGBCH-124(D)N</b>
Dissertation/Industrial training/Internship with Viva Voce
<b>Course Objective:</b>
<b>Project and Dissertation</b> In second year (fourth semester) of Masters the main objective of the exposure of students' dissertation/Industrial training/ Internship is to elevate their understanding into the practical and experimental aspects of some targeted areas of Biochemistry. This course will develop their analytical ability and it will provide them an apt exposure to work in any research group and will motivate them to execute research in the area of their interest in Bio-chemical sciences.
<b>Course Outcome:</b>
<b>CO-1.</b> Students will be able to plan and strategize a scientific problem, and implement it within a reasonable time frame.
<b>CO-2.</b> It is expected that after completing this project dissertation, students will learn to work independently and how to keep accurate/readable record of assigned project.
<b>CO-3.</b> In addition, students will be able to know biochemical data analysis and their interpretation that will be very helpful for biochemical/biotechnological and pharmaceutical research work.
<b>CO-4.</b> Also, students will be able to become as expert in field of clinical biochemistry, biotechnology, bioinformatics and genetic engineering.
<b>CO-5.</b> Subsequently, the students should be able to critically examine research articles, and improve their scientific writing/communication skills and power point presentation.
For project work and dissertation, the area of the work would be to be decided by the advisor/mentor.
On completion of the project work, students have to submit the work in the form of a dissertation followed by oral presentation in the presence of faculty members.

## APPENDIX-II

**Guidelines for preparing Research Project/Dissertation is available at link:**

[http://14.139.237.190/upload\\_pdf/01\\_02\\_2023\\_Guidelines\\_fo\\_Project\\_Lit\\_Survey\\_Dissertation.pdf](http://14.139.237.190/upload_pdf/01_02_2023_Guidelines_fo_Project_Lit_Survey_Dissertation.pdf)