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No. HEC/CD/NCRC/BIOCHEMISTRY/2024/6836

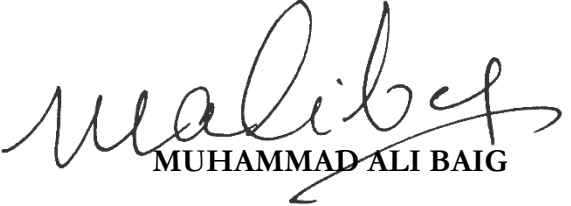
November 28, 2024

SUBJECT: REVISED CURRICULUM FOR DEGREE PROGRAMS IN BIOCHEMISTRY

The Higher Education Commission (HEC) of Pakistan, as mandated by its law, provides guidance to Higher Education Institutions (HEIs) on curricula for tertiary education levels in alignment with the National Qualifications Framework (NQF). To address evolving academic trends and market demands, HEC, in collaboration with the Pakistan Academy of Sciences (PAS), has revised the curricular standards for Biochemistry degree programs at NQF levels 6 and 7. These updated standards are intricately aligned with HEC's Undergraduate Education Policy V 1.1 (2023) and Graduate Education Policy (2023), ensuring coherence with national priorities and adherence to international benchmarks.

02. The revised curricula for Biochemistry degree programs (enclosed) are hereby notified and that the universities offering these programs are advised to structure their Biochemistry programs to meet these revised standards as the minimum requirement at their **earliest**. An electronic copy of the document is available on HEC's official website.

03. Through effective implementation of these standards, HEC envisions a future where Pakistani graduates in Biochemistry excel in scientific discovery and technological innovation, making substantial contributions to societal progress both nationally and globally.


MUHAMMAD ALI BAIG

Vice Chancellors/Rectors/Heads

All Public/Private Sector Universities/DAIs

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- ii. ES to Chairman, Higher Education Commission, Islamabad
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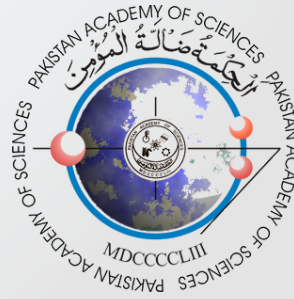


CURRICULUM FOR BIOCHEMISTRY

BACHELOR OF SCIENCE
MASTER OF SCIENCE

2024

A COLLABORATIVE VENTURE OF
HIGHER EDUCATION COMMISSION & PAKISTAN ACADEMY OF SCIENCES
GOVERNMENT OF PAKISTAN



CURRICULUM FOR
BIOCHEMISTRY
DEGREE PROGRAMS

2024

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Preface

The curriculum serves as a comprehensive blueprint for the teaching-learning process that students must navigate to achieve specific academic objectives. This encompasses clearly defined prior learning requirements, program objectives, scheme of studies, and course learning outcomes. As knowledge rapidly evolves and new fields emerge, it is crucial to continually develop and revise curricula to ensure they remain current, relevant, and impactful.

As mandated by its law through Clause 10-1 (a), (l), (s), and (v), the Higher Education Commission (HEC) of Pakistan has been developing and periodically updating curricula through its National Curriculum Revision Committees (NCRCs). These committees are generally composed of subject matter experts, researchers, and representatives from accreditation bodies, professional councils, and industry stakeholders. In response to the evolving needs, HEC, in collaboration with Pakistan Academy of Sciences (PAS), has undertaken the task to develop robust standards for the curricula of degree programs in Biochemistry at levels 6 and 7 of the National Qualifications Framework. These standards are meticulously structured in accordance with the HEC's Undergraduate Education Policy V 1.1 (2023) and Graduate Education Policy (2023), ensuring alignment with both national priorities and international educational standards.

The degree programs in Biochemistry are designed to equip students with cutting-edge knowledge and practical skills, fostering innovation and research to address the emerging and unique challenges in the field of Biochemistry. It is hoped that these curricular standards, prescribed by subject experts from across the country, will not only contribute towards meeting the national educational and economic requirements but will also elevate the competency levels of our graduates in the field of Biochemistry.

With the support of universities in implementing these standards, HEC envisions a future where Pakistani graduates in Biochemistry are at the forefront of scientific discovery and technological innovation, driving progress and contributing to the betterment of society both nationally and internationally.

Dr. Amjad Hussain

Director General
Academics Division

Guiding Principles

MINIMUM STANDARDS

The curricular standards and guidelines prescribed in this policy are mandatory at minimum level only. Universities or the concerned departments may however set higher standards provided that the standards prescribed herein are not reduced or compromised.

COURSE SEQUENCE, TITLES & CREDITS

For Bachelor of Science (BS) and Master of Science (MS) in Biochemistry, the sequence of courses prescribed in this policy is logically arranged and is suggestive only. The concerned department may rearrange the sequence and alter the course titles and credits provided that the essence of the courses prescribed in this policy remains intact. The department may add more courses as and when required in accordance with HEC guidelines and subject to approval of university's relevant statutory body.

COURSE LEARNING OUTCOMES

Course learning outcomes (CLOs) are the bare minimum standards of learning that students must achieve upon completing a specific course, ensuring consistency in the quality of education across institutions. The CLOs prescribed in this policy represent the minimum level of competency and understanding expected from students. While these standards must not be compromised, departments are encouraged to enhance the rigor of the CLOs by incorporating additional learning outcomes, provided these do not alter the essence of the prescribed standards. In this policy, CLOs are exclusively developed for major and interdisciplinary courses. CLOs for elective courses are not prescribed here, as these are advanced or specialized courses. The development of CLOs for electives is the responsibility of the concerned department, taking into account the course's advanced nature and relevance to the program. For general education courses as required under the HEC Undergraduate Education Policy V 1.1. including the course of Pakistan Studies, departments may adopt the CLOs prescribed in the HEC-developed model courses, as available on its website.

COURSE SYLLABUS

This document serves as a comprehensive guideline delineating the CLOs for each course offered in the Bachelor of Science (BS) and Master of Science (MS) in Biochemistry as minimum standards. The concerned department may prepare, modify, and tailor the syllabus of each course, ensuring alignment with the given learning outcomes in this policy. It is in this regard imperative that the department utilizes instructional, reference, and reading materials that it deems appropriate to effectively meet the learning outcomes.

GENERAL EDUCATION

For Bachelor of Science (BS) in Biochemistry, the courses for General Education component must mandatorily be offered with the same titles and credits as prescribed in the HEC Undergraduate Education Policy V 1.1. including the course of Pakistan Studies. The concerned department may adopt and follow the learning outcomes and study contents developed by HEC for these courses as available on its website. The requirement of general education is not applicable for Master of Science (MS) in Biochemistry.

REQUIREMENT OF INTERNSHIP

It is a mandatory degree award requirement of three (03) credit hours for Bachelor of Science (BS) in Biochemistry. Internship of six (06) to eight (08) weeks (preferably undertaken during semester or summer break) must be graded by a faculty member in collaboration with the supervisor in the field. This requirement cannot be substituted with additional course work, capstone or project work.

REQUIREMENT OF CAPSTONE PROJECT

It is a mandatory degree award requirement of three (03) credit hours for Bachelor of Science (BS) in Biochemistry. A capstone project is multifaceted body of work that serves as a culminating academic and intellectual experience for students. The capstone project must be supervised and graded by a faculty member as per the protocols prescribed by the concerned department. This requirement cannot be substituted with additional course work or internship.

ASSOCIATE DEGREE IN BIOCHEMISTRY

The specialized nature of Biochemistry requires advanced qualifications for meaningful employment. In view of the existing market conditions and recruitment rules of the relevant employers in academia and industry, the Associate Degree in Biochemistry falls short of the qualifications necessary for most biochemistry-related positions. Therefore, and in the best interest of students and the discipline, the National Curriculum Review Committee (NCRC) has decided to not recommend launch of Associate Degree in Biochemistry.

LABORATORY REQUIREMENTS

Universities / departments offering degree programs in the discipline of Biochemistry are required to adhere to the requirements specified for Biochemistry laboratories in this policy, as minimum standards in true spirit. Universities / departments are expected to enhance the laboratory standards as and when required and maintain / upgrade the same to ensure quality education and research in the field of Biochemistry.

ENTRY & EXIT PROVISIONS

Pathway for Graduates with Associate Degree

- a) Students having completed Associate Degree in any discipline related to the field of Biochemistry shall be required to complete deficiency courses up-to a maximum of eighteen (18) credit hours as determined by the admitting university / department. Relevance of the prior qualification in this regard will also be determined by the concerned department.
- b) In case where the deficiency courses are more than eighteen (18) credit hours, the university may decide not to offer admission in accordance with the screening, admission and merit calculation criteria approved by its statutory bodies.
- c) The minimum eligibility for admission in the fifth semester in the above case is 2.00/4.00 CGPA in the prior qualification i.e., Associate Degree. The admitting university may, however, set higher eligibility criteria for admission in the fifth semester of Bachelor of Science (BS) in Biochemistry.

Pathway for Graduates with Conventional BSc/Equivalent Degree Programs

- a) Students having completed two-year conventional BSc/equivalent degree programs are allowed admission in the fifth semester of Bachelor of Science (BS) in Biochemistry in which case, the students shall be required to complete deficiency courses up-to a maximum of twenty-one (21) credit hours as determined by the admitting university.
- b) In case where the deficiency courses are more than twenty-one (21) credit hours, the university may decide not to offer admission, in accordance with the screening, admission and merit calculation criteria approved by its statutory bodies.
- c) The minimum eligibility for admission in the fifth semester in the above case is 45% cumulative score in the prior qualification i.e., two-year conventional BSc/equivalent degree programs. The admitting university may however set higher eligibility criteria for admission in the fifth semester of Bachelor of Science (BS) in Biochemistry.

Exiting from Bachelor of Science (BS) in Biochemistry with the Associate Degree

Offering of Associate Degree in Biochemistry is not recommended. However, exit from Bachelor of Science (BS) in Biochemistry with Associate Degree is allowed in accordance with the provisions of HEC Undergraduate Education Policy V 1.1. and only in such circumstances where no other remedy is available to safeguard the academic career of the student.

**CURRICULUM FOR
BACHELOR OF SCIENCE (BS)
BIOCHEMISTRY**

BS Biochemistry

PROGRAM DESCRIPTION

The Bachelor of Science (BS) in Biochemistry program is designed in accordance with the provisions of the HEC Undergraduate Education Policy V 1.1. to provide students with a robust understanding of biochemical sciences. The program integrates molecular, cellular, organismal, and biochemical pathways to equip students with the skills necessary for research, industry, and further academic pursuits in biochemistry and related fields. Spanning eight semesters, the curriculum offers a balanced and progressive learning experience. Throughout the course of this degree program, students will gain hands-on experience with modern laboratory techniques and computational tools essential for biochemical research and practice. Through this program, students will learn to effectively convey scientific knowledge and research findings, preparing them for careers in academia, research institutions, healthcare, pharmaceutical industries, and biotechnology both within Pakistan and internationally.

STANDARD NOMENCLATURE

For the purpose of standardization, the recommended nomenclature for the four-year degree program in Biochemistry is “**Bachelor of Science in Biochemistry**”.

PROGRAM LEARNING OUTCOMES

By the completion of BS in Biochemistry, the graduates will be able to:

- Demonstrate a comprehensive understanding of fundamental concepts in biochemistry, integrating knowledge across molecular, cellular, organismal and biochemical pathways.
- Effectively use methods and techniques as applied in the field of biochemistry, including analytical, molecular, computational and structural approaches.
- Communicate scientific knowledge and research findings in biochemistry while demonstrating a commitment to continuous learning and professional development in the field.

ELIGIBILITY & ADMISSION CRITERIA

Higher Secondary School Certificate (involving 12 years of schooling) or an IBCC equivalent qualification in any science group with a subject of Biology or General Biology is the basic eligibility requirement for admission in the BS in Biochemistry. The admitting university may set minimum eligibility scores and may conduct entry / admission test through its own testing body / system or an external testing services provider of repute as per the screening, admission and merit calculation criteria approved by its statutory bodies.

PROGRAM STRUCTURE

The BS in Biochemistry is structured in accordance with the provisions of the HEC Undergraduate Education Policy V 1.1. and comprises of one-hundred and thirty-two (132) credit hours spread over eight (08) regular semesters, at minimum. Universities may offer courses up to maximum of one-hundred and forty-four (144) credit hours provided that the total number of credit hours are reasonably set to effectively achieve the Program Learning Objectives (PLOs) without putting undue burden on students.

Minimum Credit Hours	132
General Education	32 credit hours (13 courses)
Discipline Related Courses / Major	73 credit hours (25 courses)
Interdisciplinary / Allied Courses	21 credit hours (7 courses)
Internship	3 credit hours
Capstone Project	3 credit hours
Program Duration	Minimum: 4 years (8 regular semesters) Maximum: 6 years (12 regular semesters) The maximum limit is further extendable to another year in accordance with HEC semester rules.
Semester Duration	16-18 weeks for regular semesters (1-2 weeks for examination) 8-9 weeks for summer semesters (1 week for examination)
Course Load (per semester)	15-18 credit hours for regular semesters Up-to 8 credit hours for summer semesters (for remedial/deficiency/failure/repetition courses only)
3 Credit Hours (Theory)	3 classes (1 hour each) OR 2 classes (1.5 hour each) OR 1 class (3 hours) per week throughout the semester.
1 Credit Hours (Lab / Field Work)	1 credit hour in laboratory or practical work / project requires lab contact of three hours per week throughout the semester.

The standard scheme of studies for BS in Biochemistry is given below:

SEMESTER 1			
S.N.	Course	Credits	Category
1	Introductory Biochemistry	3 (2-1)	Major

2	Inorganic Chemistry	3 (2-1)	Interdisciplinary
3	Quantitative Reasoning – I *	3 (3-0)	General Education
4	Natural Science **	3 (2-1)	General Education
5	Functional English *	3 (3-0)	General Education
6	Applications of Information & Communication Technologies (ICT) *	3 (2-1)	General Education
TOTAL CREDITS: 18			

SEMESTER 2			
S.N.	Course	Credits	Category
1	Cell Biology	3 (2-1)	Major
2	Fundamentals of Microbiology	3 (2-1)	Interdisciplinary
3	Organic Chemistry	3 (2-1)	Interdisciplinary
4	Quantitative Reasoning – II *	3 (3-0)	General Education
5	Social Science ***	2 (2-0)	General Education
6	Expository Writing *	3 (3-0)	General Education
TOTAL CREDITS: 17			

SEMESTER 3			
S.N.	Course	Credits	Category
1	Carbohydrates & Lipids	3 (2-1)	Major
2	Human Physiology	3 (2-1)	Major
3	Principles of Genetics	3 (3-0)	Interdisciplinary

4	Arts & Humanities ****	2 (2-0)	General Education
5	Islamic Studies * (Religious Ed / Ethics for non-Muslim students)	2 (2-0)	General Education
6	Pakistan Studies *	2 (2-0)	General Education
7	Entrepreneurship *	2 (2-0)	General Education
TOTAL CREDITS: 17			

SEMESTER 4			
S.N.	Course	Credits	Category
1	Proteins & Nucleic Acids	3 (2-1)	Major
2	Fundamentals of Molecular Biology	3 (3-0)	Major
3	Nutritional Biochemistry	3 (2-1)	Major
4	Physical Chemistry	3 (2-1)	Interdisciplinary
5	Civics & Community Engagement *	2 (2-0)	General Education
6	Ideology & Constitution of Pakistan *	2 (2-0)	General Education
TOTAL CREDITS: 16			

SEMESTER 5			
S.N.	Course	Credits	Category
1	Metabolism of Carbohydrates & Lipids	3 (3-0)	Major
2	Plant Biochemistry	3 (2-1)	Major
3	Immunology	3 (2-1)	Major

4	Enzymology	3 (2-1)	Major
5	Introduction to Biotechnology	3 (2-1)	Interdisciplinary
TOTAL CREDITS: 15			

SEMESTER 6			
S.N.	Course	Credits	Category
1	Metabolism of Proteins & Nucleic Acids	3 (3-0)	Major
2	Cancer Biology	3 (3-0)	Major
3	Environmental Biochemistry	3 (2-1)	Major
4	Elective – I *****	3	Major
5	Biostatistics	3 (2-1)	Interdisciplinary
TOTAL CREDITS: 15			

SEMESTER 7			
S.N.	Course	Credits	Category
1	Computational Biology	3 (2-1)	Major
2	Clinical Biochemistry	3 (2-1)	Major
3	Analytical Techniques in Biochemistry	3 (1-2)	Major
4	Scientific Inquiry & Research Methods	2 (2-0)	Major
5	Biosafety & Bioethics	2 (2-0)	Major
6	Elective – II *****	3	Major
TOTAL CREDITS: 16			

SEMESTER 8			
S.N.	Course	Credits	Category
1	Industrial Biochemistry	3 (3-0)	Major
2	Genomics, Transcriptomics & Proteomics	3 (3-0)	Major
3	Elective – III ****	3	Major
4	Elective – IV ****	3	Major
5	Capstone	3	Capstone
TOTAL CREDITS: 15			

* HEC designed model courses may be adopted.

** The university / concerned department may offer any course in the broader category of **“Natural Science”** which should have relevance to the nature of the degree program.

*** The university / concerned department may offer any course in the broader category of **“Social Science”** including but not limited to a course of Psychology, Sociology, Anthropology etc.

**** The university / concerned department may offer any course in the broader category of **“Arts & Humanities”** including but not limited to a course of regional or international language such as Chinese, Arabic, French, Spanish etc. or any other course such as Philosophy, History etc.

***** The university / concerned department may offer any advanced course in the field of Biochemistry as an **elective**, where required in the above scheme as per available academic and faculty resources. **Credit combination** (reflecting balance of theory and lab / field work) must be arranged in accordance with the nature of the course.

DEGREE AWARD REQUIREMENTS

The following minimum requirements are prescribed for award of BS in Biochemistry:

- All courses in the General Education category with titles and credit hours as prescribed in HEC Undergraduate Education Policy V 1.1. including the course of Pakistan Studies must be completed.
- Minimum of 132 credit hours as prescribed in the above scheme must be completed.
- Capstone project of three (03) credit hours must be completed in accordance with the HEC Undergraduate Education Policy V 1.1. This requirement cannot be substituted with additional coursework or internship.
- Internship of three (03) credit hours must be completed in accordance with the HEC Undergraduate Education Policy V 1.1. This requirement cannot be substituted with additional coursework, capstone, research or project work.

- e) CGPA must not be below 2.00/4.00 at the time of completion of the degree program. The university may however set higher standard in this regard.
- f) The minimum duration to complete the degree program is eight (08) regular semesters and the maximum duration is twelve (12) regular semesters. The maximum duration may further be extended to two (02) more semesters in accordance with HEC semester rules. Summer semester is not considered as a regular semester.

**CURRICULUM FOR
MASTER OF SCIENCE (MS)
BIOCHEMISTRY**

MS Biochemistry

PROGRAM DESCRIPTION

The Master of Science (MS) in Biochemistry is designed in alignment with the HEC Graduate Education Policy 2023, aiming to provide students with a comprehensive and advanced understanding of biochemical sciences. The program is designed to deepen students' knowledge of molecular processes, focusing on the latest research, technologies, and trends in the field of biochemistry. Through this program, the students will be equipped to conduct independent research, addressing complex biochemical challenges such as enzyme mechanisms, metabolic regulation, and biomolecular interactions. Advanced courses in Biochemistry as electives are incorporated in the scheme of studies with discretion of varsities to allow students to specialize in cutting-edge areas of biochemistry, enabling them to tailor their education to their career goals. Upon completion, the graduates will be well-prepared to contribute to the advancement of biochemical sciences and develop innovative solutions to critical challenges related to the field of biochemistry.

STANDARD NOMENCLATURE

For the purpose of standardization, the recommended nomenclature for all graduate degree programs (NQF-7) in Biochemistry is “**Master of Science in Biochemistry**”.

PROGRAM LEARNING OUTCOMES

By the completion of MS in Biochemistry, the graduates will be able to:

- Analyze and synthesize advanced concepts and current research in various fields of biochemistry.
- Apply advanced experimental techniques to conduct independent research and solve complex biochemical problems, with a focus on innovation and practical applications.
- Demonstrate the ability to effectively communicate scientific findings and theoretical concepts in biochemistry to both specialized and general audiences, ensuring clarity and scientific rigor.

ELIGIBILITY & ADMISSION CRITERIA

- a) An undergraduate degree (involving 16 years of education) in the field of Biochemistry is the basic eligibility requirement for admission in the Master of Science (MS) in Biochemistry.
- b) Candidates having undergraduate degrees (involving 16 years of education) in any discipline other than but relevant to the field of Biochemistry are also eligible for admission to the program subject to completion of deficiency courses up to a maximum of fifteen (15) credit hours to be determined by the concerned department. Relevance of the prior qualification in this regard will also be determined by the concerned department. In case where the deficiency is determined for more than fifteen (15) credit hours, the university may decide not to offer admission in accordance with the screening, admission and merit calculation criteria approved by its statutory bodies.

- c) In addition to the basic eligibility, the admitting university is further required to conduct a rigorous admission (biochemistry related) test for admission to the program, with a passing score of 50% (OR) accept the GRE/HAT General/equivalent tests, with a passing score of 50%. The university may also set minimum eligibility scores (above 50%) as per the screening, admission and merit calculation criteria approved by its statutory bodies.

PROGRAM STRUCTURE

The standard program structure for MS in Biochemistry is as under:

Minimum Credit Hours	30
Minimum Coursework Requirement	24 credit hours (8 courses)
Minimum Research Requirement	6 credit hours
Program Duration	<p>Minimum: 2 years (4 regular semesters) Maximum: 4 years (8 regular semesters)</p> <p>Note: In accordance with the HEC Graduate Education Policy (2023), in case where a student is unable to secure the degree within the prescribed timeframe and claims for extension in duration, the university may constitute an appropriate authority and determine the causes of delay. In the event of force majeure (i.e., delay on account of circumstance beyond the control of student), the university may grant an extension in the period of award of degree in accordance with the duration limiting factor(s) and also take corrective measures in case the delay is caused by process or administrative reasons.</p>
Semester Duration	<p>16-18 weeks for regular semesters (1-2 weeks for examination)</p> <p>8-9 weeks for summer semesters (1 week for examination)</p>
Course Load (per semester)	<p>09-12 credit hours for regular semesters Up-to 8 credit hours for summer semesters (for remedial / deficiency / failure / repetition courses only)</p>
3 Credit Hours (Theory)	<p>3 classes (1 hour each) OR 2 classes (1.5 hour each) OR 1 class (3 hours)</p>

1 Credit Hours (Lab / Field Work)	1 credit hour in laboratory or practical work requires lab / field contact of three hours per week throughout the semester.
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The standard scheme of studies for MS in Biochemistry is given below:

SEMESTER 1			
S.N.	Course	Credits	Category
1	Advanced Biochemical Techniques *	3 (3-0)	Core
2	Elective – I **	3	Elective
3	Elective – II **	3	Elective
4	Elective – III **	3	Elective
TOTAL CREDITS: 12			

SEMESTER 2			
S.N.	Course	Credits	Category
1	Research Methodologies in Biochemistry *	3 (3-0)	Core
2	Elective – IV **	3	Elective
3	Elective – V **	3	Elective
4	Elective – VI **	3	Elective
TOTAL CREDITS: 12			

SEMESTER 3			
S.N.	Course	Credits	Category
1	Thesis ***	6	Research

SEMESTER 4			
S.N.	Course	Credits	Category
	Thesis ***	Continued	Research

* These are the **mandatory courses** for the program.

** The university / concerned department may offer any advanced course in the field of Biochemistry as an **elective**, where required in the above scheme as per available academic and faculty resources. **Credit combination** (reflecting balance of theory and lab / field work) must be arranged in accordance with the nature of the course.

*** Research work for **thesis** must be performed by students individually as per university's policy on the same including but not limited to the protocols for topic selection, allocation of supervisor and co-supervisor (where required), thesis submission, defense and evaluation as approved through its statutory bodies.

DEGREE AWARD REQUIREMENTS

The following minimum requirements are prescribed for award of MS in Biochemistry:

- a) Minimum of twenty-four (24) credit hours including six (6) credit hours for core courses and eighteen (18) credit hours for electives as prescribed in this policy must be completed.
- b) In addition to coursework of twenty-four (24) credit hours, research work / thesis of minimum six (06) credit hours must also be completed individually as partial fulfilment of the degree program. Requirement of research work / thesis cannot be substituted with additional course work. Credit hours for research work / thesis may be increased above six (06) credit hours subject to approval of the university's relevant statutory body.
- c) CGPA must not be below 2.50/4.00 at the time of completion of the degree program. The university may however set higher standard in this regard.
- d) The minimum duration required to complete the degree is four (04) regular semesters which may be extended up to a maximum of eight (08) regular semesters. Summer semester is not considered as a regular semester.

COURSE LEARNING OUTCOMES FOR BS & MS BIOCHEMISTRY

Arranged in Alphabetical Order

Course Learning Outcomes

(Arranged in Alphabetical Order)

ADVANCED BIOCHEMICAL TECHNIQUES

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

- Demonstrate proficiency in using advanced biochemical techniques and tools for the detection, quantification, and analysis of biomolecules.
- Evaluate the strengths, limitations, and applications of various biochemical techniques in research and diagnostics.
- Apply and practically validate the concepts of the course through lab work.

ANALYTICAL TECHNIQUES IN BIOCHEMISTRY

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

- Understand the principles and applications of various analytical techniques used in biochemistry.
- Apply chromatographic and spectroscopic methods for the separation and analysis of biomolecules.
- Interpret experimental data to evaluate quantitative and qualitative parameters of biochemical substances.

BIOSAFETY & BIOETHICS

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

- Understand the principles and practices of biosafety in laboratory settings.
- Explain the ethical considerations in biological research and applications.
- Apply guidelines for responsible conduct of research involving biological materials.

BIOSTATISTICS

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

- Understand the basic statistical concepts and their application in biological research.
- Analyze biological data using appropriate statistical methods and software.
- Interpret statistical results to make informed decisions in scientific studies.

CANCER BIOLOGY

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

- Understand the molecular and cellular basis of cancer development and progression.
- Explain the role of oncogenes, tumor suppressors, and signaling pathways in cancer.
- Analyze current therapeutic approaches and challenges in cancer diagnosis and treatment.

CARBOHYDRATES & LIPIDS

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

- Understand the structure, function and classification of carbohydrates and lipids.
- Use different methods for qualitative and quantitative analysis of carbohydrates and lipids.
- Analyze the role of carbohydrates and lipids in a living system.

CELL BIOLOGY

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

- Understand the structure, function, and molecular organization of cells and cell organelles.
- Describe the processes of cell division, signaling, and communication.
- Use microscopy and other techniques to study cellular processes.

CLINICAL BIOCHEMISTRY

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

- Understand the biochemical basis of human diseases and diagnostic methods.
- Explain the principles of clinical assays for disease diagnosis.
- Interpret clinical laboratory results to assess health status and disease progression.

COMPUTATIONAL BIOLOGY

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

- Understand the concepts and tools used for analyzing biological data.
- Apply bioinformatics techniques to study nucleic acids and protein sequences and structures.
- Interpret computational models and simulations to predict biological functions.

ENVIRONMENTAL BIOCHEMISTRY

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

- Understand the interactions between biochemical and environmental factors.
- Describe the impact of pollutants on biochemical pathways and bioremediation strategies.
- Analyze environmental pollutants in ecosystems.

ENZYMOLOGY

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

- Understand the classification, kinetics, mechanisms and regulation of enzymes.
- Describe the role of enzymes in metabolic pathways related to health and diseases.
- Analyze enzyme activity and inhibition using experimental techniques.

FUNDAMENTALS OF MICROBIOLOGY

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

- Understand the diversity, structure, and function of microorganisms.
- Describe the roles of microorganisms in health, disease, and the environment.
- Apply microbiological techniques for the identification and study of microorganisms.

FUNDAMENTALS OF MOLECULAR BIOLOGY

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

- Understand the molecular mechanisms of gene expression.
- Describe the processes of DNA replication, transcription, and translation.
- Analyze gene function by using molecular techniques.

GENOMICS, TRANSCRIPTOMICS & PROTEOMICS

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

- Understand the principles of genomics, transcriptomics, and proteomics.
- Describe the applications of high-throughput technologies in studying biological systems.
- Interpret data from omics studies to gain insights into gene function.

HUMAN PHYSIOLOGY

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

- Understand the function of the human body systems.
- Describe the physiological processes that regulate homeostasis and organ function.
- Analyze the effects of diseases and disorders on physiological functions.

IMMUNOLOGY

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

- Understand the basic concepts of the immune system and its components.
- Describe the mechanisms of autoimmunity and immune responses against pathogens, vaccines and foreign substances.
- Apply immunochemical techniques to understand immune system related disorders.

INDUSTRIAL BIOCHEMISTRY

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

- Understand the applications of biological products in industry.
- Describe the production and purification of biochemicals in industrial settings.
- Analyze the role of biochemistry in the development of industrial processes.

INORGANIC CHEMISTRY

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

- Understand the principles of inorganic chemistry, types of bonds and coordination chemistry.
- Describe the structure and reactivity of inorganic compounds.
- Apply inorganic chemistry concepts to study the biomolecules.

INTRODUCTION TO BIOTECHNOLOGY

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

- Understand the fundamental concepts and applications of biotechnology.
- Describe the use of biotechnological techniques in different industries.
- Analyze ethical and societal implications of biotechnological advancements.

INTRODUCTORY BIOCHEMISTRY

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

- Understand the basic concepts of biochemistry, structure and function of biomolecules.
- Describe the role of biomolecules in living systems.
- Determine biomolecules using basic biochemical techniques.

METABOLISM OF CARBOHYDRATES & LIPIDS

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

- Understand the biochemical pathways involved in the metabolism of carbohydrates and lipids.
- Describe the regulation and integration of metabolic pathways.
- Analyze the interconnections between metabolic pathways in different physiological states.

METABOLISM OF PROTEINS & NUCLEIC ACIDS

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

- Understand the biochemical pathways involved in the metabolism of proteins and nucleic acids.
- Describe the regulation of amino acid and nucleotide metabolism.

- Analyze the interconnections between metabolic pathways in different physiological states.

NUTRITIONAL BIOCHEMISTRY

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

- Understand the biochemical basis of nutrition and the role of nutrients in health.
- Describe the metabolism of macronutrients and micronutrients.
- Analyze the impact of nutritional deficiencies and imbalances on health.

ORGANIC CHEMISTRY

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

- Understand the principles of organic chemistry.
- Describe the synthesis and properties of organic compounds.
- Apply concepts of organic chemistry to study biomolecules and biochemical reactions.

PHYSICAL CHEMISTRY

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

- Understand the principles of physical chemistry.
- Describe the physical properties of molecules and their interactions.
- Apply the concepts of physical chemistry to study biochemical processes.

PLANT BIOCHEMISTRY

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

- Understand the biochemical processes involved in plant growth and development.
- Describe the role of photosynthesis, respiration and secondary metabolites in plants.
- Analyze the impact of environmental factors on plant biochemical pathways.

PRINCIPLES OF GENETICS

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

- Understand the principles of inheritance and genetic variation.
- Describe the processes involved in the inheritance of characters.
- Analyze genetic crosses and predict inheritance patterns using Mendelian principles.

PROTEINS & NUCLEIC ACIDS

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

- Understand the classification, structure and function of amino acids, proteins and nucleic acids.
- Use different methods for qualitative and quantitative analysis of proteins and nucleic acids.
- Analyze the role of proteins and nucleic acids in the living system.

RESEARCH METHODOLOGIES IN BIOCHEMISTRY

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

- Demonstrate proficiency in employing advanced research methodologies relevant to biochemical studies, including experimental design and data analysis.
- Evaluate the strengths, limitations, and appropriate applications of different research methodologies in biochemistry.
- Integrate advanced research methodologies to design and execute complex research projects, critically analyze data, and formulate evidence-based conclusions in biochemical research.

SCIENTIFIC INQUIRY & RESEARCH METHODS

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

- Understand the principles of scientific inquiry and experimental design.
- Describe the methodologies used in conducting research in biochemistry.
- Apply research techniques to investigate biochemical questions, analyze data and report writing.

LABORATORY REQUIREMENTS FOR BS & MS BIOCHEMISTRY

List of Essential and Desirable Equipment and Apparatus

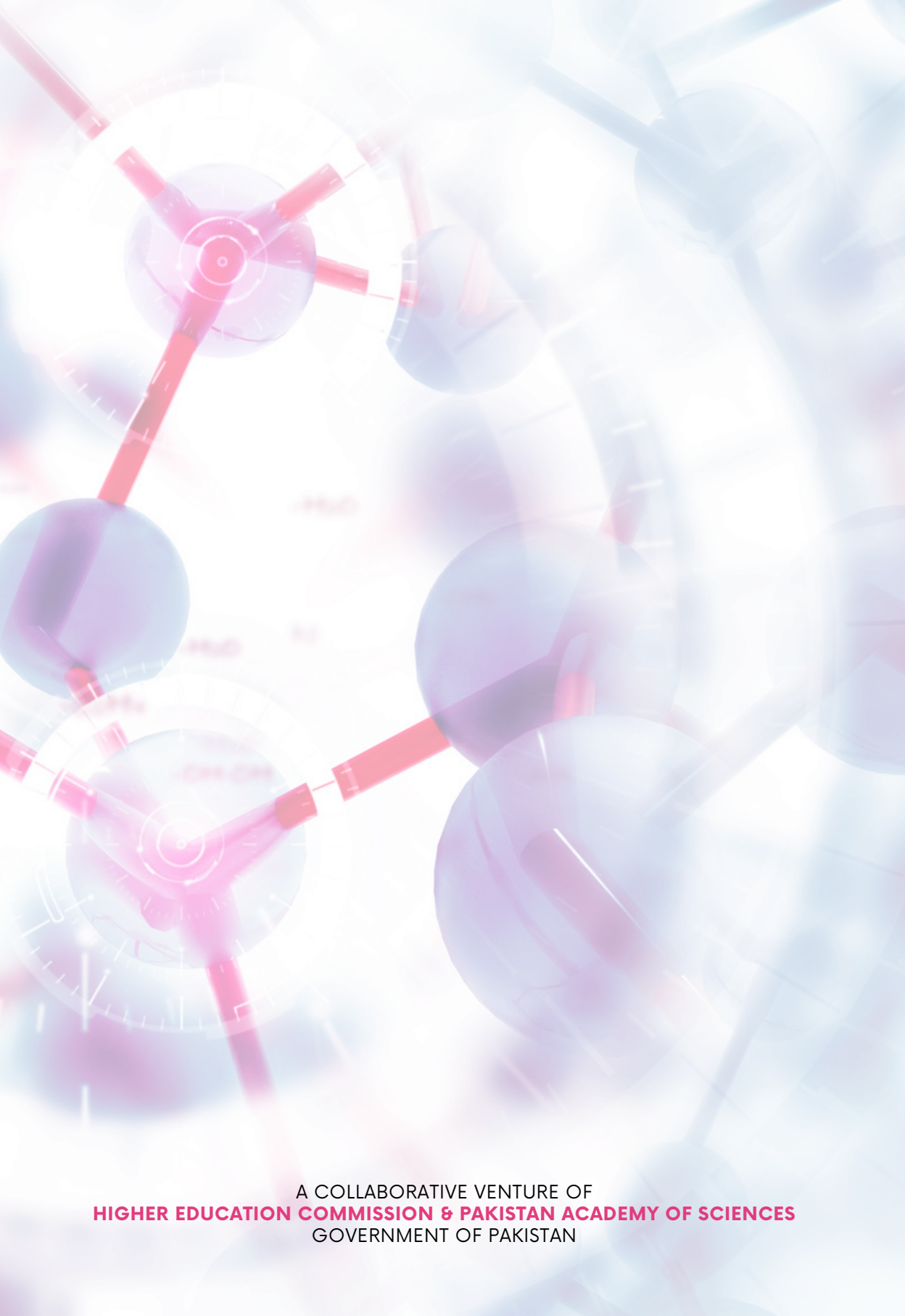
Laboratory Requirements

ESSENTIAL EQUIPMENT / APPARATUS

- Autoclave
- Computer workstations
- Distillation unit
- ELISA Reader
- Freezer
- Fume-hood
- Gel documentation system
- Gel electrophoresis with power supply (horizontal)
- Gel electrophoresis with power supply (vertical)
- Homogenizer
- Hot plate with stirrer
- Incubator
- Kjeldahl apparatus
- Microcentrifuge machine
- Microscope
- Oven
- PCR machine
- pH meter
- Refrigerator
- Rotary evaporator
- Set of micropipettes
- Shaker
- Soxhlet Apparatus
- Transilluminator
- UV-Vis spectrophotometer
- Vortex
- Water bath
- Weighing balance

DESIRABLE EQUIPMENT / APPARATUS

- Chemistry analyzer
- CO₂ incubator
- Cooling water bath
- Deionizer
- Flame photometer
- Gas chromatograph
- Hematology analyzer
- HPLC
- Ice machine
- Laminar flow
- Liquid nitrogen container
- Low temperature microcentrifuge machine
- Nanodrop spectrophotometer
- Polarimeter
- Real time PCR
- Refractometer
- Spectro fluorometer
- Thermos-blocks
- Ultra centrifuge
- Western blot



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