



BAHRIA UNIVERSITY COLLEGE OF ALLIED HEALTH SCIENCES KARACHI

**Prospectus
Fall 2026**



Table of Contents

<u>Chancellor Bahria Univeristy</u>	1
<u>Message of Pro Chancellor</u>	3
<u>Rector’s Message</u>	5
<u>Bahria University</u>	6
<u>Discovering Knowledge</u>	7
<u>Mission and Vision of Bahria University</u>	8
<u>Strategic Goals</u>	9
<u>Why BU</u>	11
<u>Bahria University Health Sciences Campus Karachi</u>	15
<u>Message from the Desk of Director General</u>	16
<u>Scholarships/Fee Concessions/ Waivers/Student Loans</u>	18
<u>Bahria University College of Allied Health Sciences</u>	23
<u>Message from the Desk of Dean Health Sciences</u>	24
<u>Message from the Desk of Principal</u>	25
<u>Bahria University College of Allied Health Sciences</u>	25
<u>Bahria University College of Allied Health Sciences (BUCAHS) at a Glance</u>	26
<u>Learning & Teaching Methods</u>	28
<u>Career Office</u>	29
<u>Adding Values</u>	30
<u>The BU Experience</u>	33
<u>Sports at BU</u>	34
<u>Music at Bu</u>	36
<u>Dramatics at Bahria University</u>	37
<u>Bahria University Psychological Services Centers</u>	38
<u>Student Support Centre (SSC)</u>	39
<u>International Linkages</u>	40
<u>Research at Bahria University</u>	42
<u>Multidisciplinary Research Lab</u>	44
<u>Libraries</u>	45
<u>Programs Offered</u>	46
<u>BUCAHS Aim</u>	47
<u>Objectives of BUCAHS</u>	48

<u>BS Biotechnology</u>	50
<u>Biotechnology Program Mission:</u>	51
<u>Program Educational Objectives:</u>	51
<u>Program Learning Outcomes (Plos)</u>	51
<u>Future Carrer Prospectus</u>	52
<u>Bs Biotechnology Road Map Aligned with HEC UEP Policy</u>	53
<u>Detailed Course Contents of Semester I</u>	55
<u>Detailed Course Contents of Semester II</u>	59
<u>Detailed Course Contents of Semester III</u>	65
<u>Detailed Course Contents Of Semester IV</u>	70
<u>Detailed Course Contents Of Semester V</u>	75
<u>Detailed Course Contents Of Semester VI</u>	79
<u>Detailed Course Contents of Semester VII</u>	83
<u>Detailed Course Contents of Semester VIII</u>	86
<u>Detailed Course Contents of Electives</u>	89
<u>BS-MLT</u>	98
<u>PROGRAM EDUCATIONAL OBJECTIVES:</u>	99
<u>PROGRAM LEARNING OUTCOMES (PLOs)</u>	99
<u>FUTURE CARRER PROSPECTUS</u>	101
<u>BS MLT Road Map Aligned with HEC UEP Policy</u>	103
<u>Detailed Course Contents of Semester I</u>	105
<u>Detailed Course Contents of Semester II</u>	110
<u>Detailed Course Contents of Semester III</u>	115
<u>Detailed Course Contents of Semester IV</u>	120
<u>Detailed Course Contents of Semester V</u>	125
<u>Detailed Course Contents of Semester VI</u>	129
<u>Detailed Course Contents of Semester VII</u>	134
<u>Detailed Course Contents of Semester VIII</u>	137
<u>Detailed Course Contents of Electives</u>	Error! Bookmark not defined.



ASIF ALI ZARDARI
CHANCELLOR BAHRIA
UNIVERISTY





MESSAGE OF PRO CHANCELLOR

Bahria University is a flagship project of Pakistan Navy envisioned to promote the indispensable cause of quality and multidisciplinary Higher Education in country. The University has embarked on a remarkable journey from its inception. Just over the span of two decades, it stands among the reputable universities of Pakistan. It is heartening to note that the university has become a center of excellence for knowledge and research in multiple academic disciplines. The University has kept its custom of taking lead in adoption of modern teaching pedagogies and investing in facilities featuring dedicated modern infrastructure, equipped with cutting edge technologies to ensure conducive environment with the aim to become the benchmark of academic excellence. Pakistan Navy acknowledges the support of all stakeholders and I am delighted to share that Pakistan Navy is focused on building the future of motherland and will continue with high spirits.

The founding father of Pakistan – Muhammad Ali Jinnah (RA) considered youth as the greatest asset of nation and relentlessly emphasized on the education and development of youth for a promising future. To achieve Quaid's objective, Bahria University must focus on wholesome grooming of its students through personal and professional development along with delivery of quality education. The University Alumni's are distinguished with characteristics of Competency, Ethics, Morality and Subject Knowledge.

I would encourage the Youth of Pakistan to enroll for Higher Education to be a complete person, a responsible citizen and a valuable asset for the country.

Admiral
Naveed Ashraf
NI (M), Tbt Pro -
Chancellor Bahria
University Chief
of the Naval
Staff



Vice Admiral Abid Hameed HI(M)
Rector Bahria University



RECTOR'S MESSAGE

Over the history of mankind, universities have contributed to the development of humans and societies in making them more civil, social, and bringing a continuous ease in lives through knowledge creation and advancement in natural and social sciences. At Bahria University, we are keenly focused on larger goals of development and advancement of society with an aim to contribute towards a promising and prosperous global future.

I am pleased to share that the profound dedication of our faculty and management has helped us achieve significant milestones. Over a short span of time since its inception, Bahria University has emerged from a small institute to a federally chartered public sector university ranked as 2nd best in Pakistan and among 601 – 800 Universities worldwide by Times Higher Education World (THE) University Ranking 2022. The University has evolved into a comprehensive higher education institute offering over 80 degree programmes in 13 academic disciplines. All degree programmes of the university are recognized by local and international accreditation bodies. Likewise, the University is member of prominent global and regional Higher Education networks including Association of Commonwealth Universities, International Association of Universities, China Pakistan Economic Corridor Consortium of Universities and has working relations with over 45 International Universities.

At Bahria University, we continuously work towards the development of curriculum at par with international standards and ensure to incorporate right blend of academic and practical knowledge. Our student centric policies in combination with State-of-the Art facilities provide a conducive environment for learning and research thus enabling our scholars to get hold of subject knowledge and relevant expertise. We extensively strive towards inculcating and infusing values, ethos, honesty and building of strong character apart from learning & developing skills amongst students. Alhamdulillah, it is due to our dedication and measures that our graduate placement ratio is amongst highest in the country.

We look forward to grow further and keep contributing towards betterment of our homeland and globe at large. I welcome all our stakeholders to join hands with us in achieving our vision and mission of championing the larger cause of a promising global future.

BAHRIA UNIVERSITY

Bahria University is a Federally Chartered Public Sector University which was established on 7th February 2000 through a Presidential Ordinance. It is a multi-campus institution of higher education, which is committed to attain the highest standards in teaching, learning and research, compatible with global requirements of practicing different professions. The University is widely recognized for preparing professionals, to assume roles as future leaders and to become good executives/managers through development of their physical, mental, moral and professional competence. The enrollment of students has crossed 19,000+ in the campuses located in Islamabad, Karachi and Lahore.



**MULTIDISCIPLINARY
RESEARCH LAB**



**DISCOVERINGKNO
WLEDGE**



MISSION

To ensure academic excellence through deliverance of quality education and applied research in a collegiate environment having strong linkages with industry and international community to meet the societal challenges.



VISION

To become a knowledge and creativity driven international university that contributes towards development of society



CORE VALUES

Integrity

Creativity

Excellence

- Humility

- Self-Discipline



STRATEGIC GOALS

Excellence in Education	The aim is to offer students a transformational educational experience, encompassing both the academic and the co-curricular activities, which provides them with the opportunity to fulfill their potential as successful professionals in life.
Excellence in Research	The aim is to develop and sustain an environment where research is viewed and practiced as a primary function that will subsequently contribute towards the vitalization of teaching, by discovery of new knowledge, and improving people's life in our country and abroad.
Excellence in Global Reach	The aim is to thrive for a global presence by equipping students, staff and faculty with the global knowledge and expertise to become a world renowned university.
Engaging with Business/ Industry	The aim is to maximize the impact of our excellence in education and research by engaging effectively with business/ industry in a way that benefits staff, students, faculty and alumni to provide sustainable growth in our income from government and non-government sources.
Excellence in Social Integration	The aim is to commit our self towards development of our local communities, and foster an environment where the staff, students and faculty see themselves as part of the larger, global community.
Improving & Ensuring the University's Financial Security	The aim is to enhance existing income streams and develop diversified means of income generation for the financial sustainability of the university.

Why BU

Highly Qualified &
Experienced Faculty

Strong Industrial &
International Academia Linkages

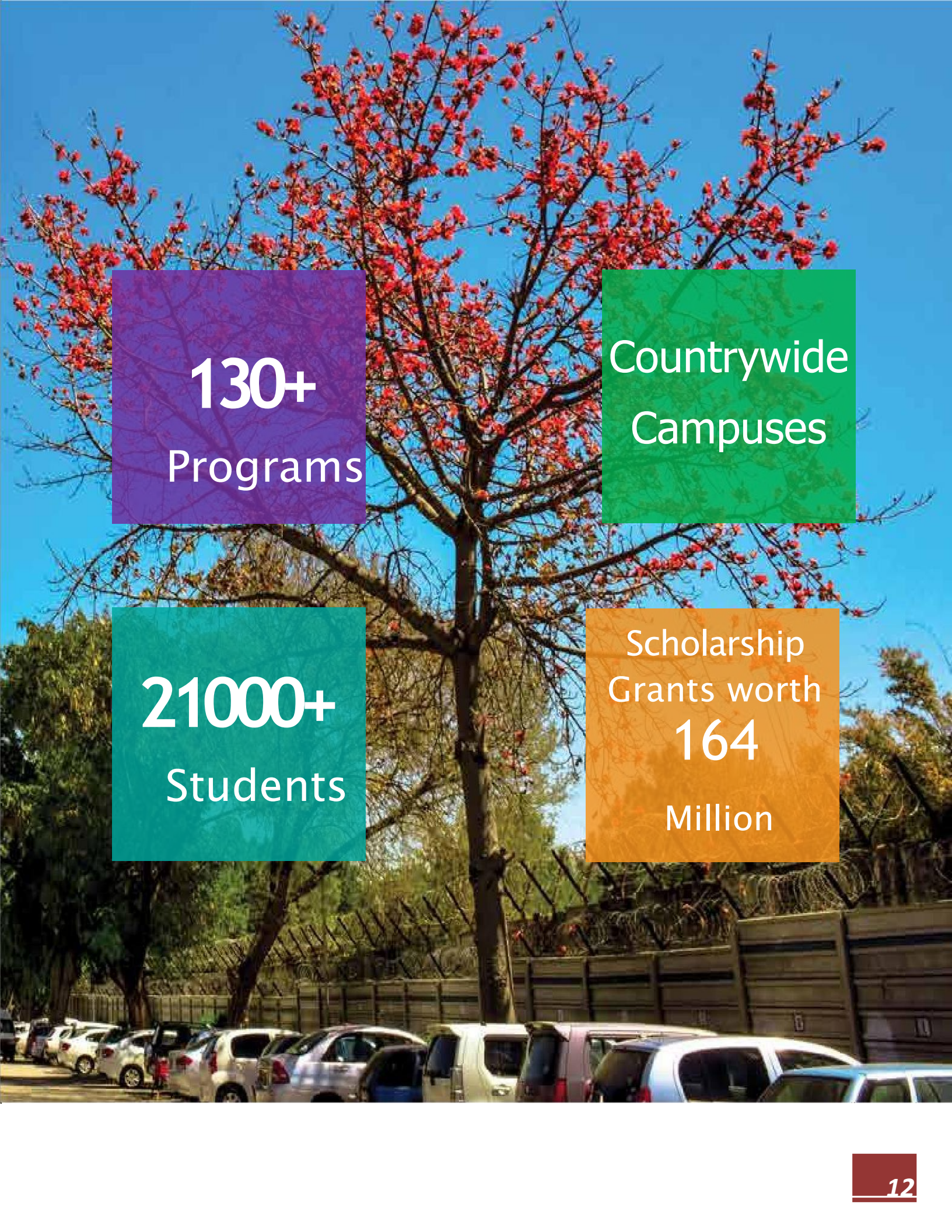
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International Linkages

Research Funding Over

PKR 240

Million



130+
Programs

Countrywide
Campuses

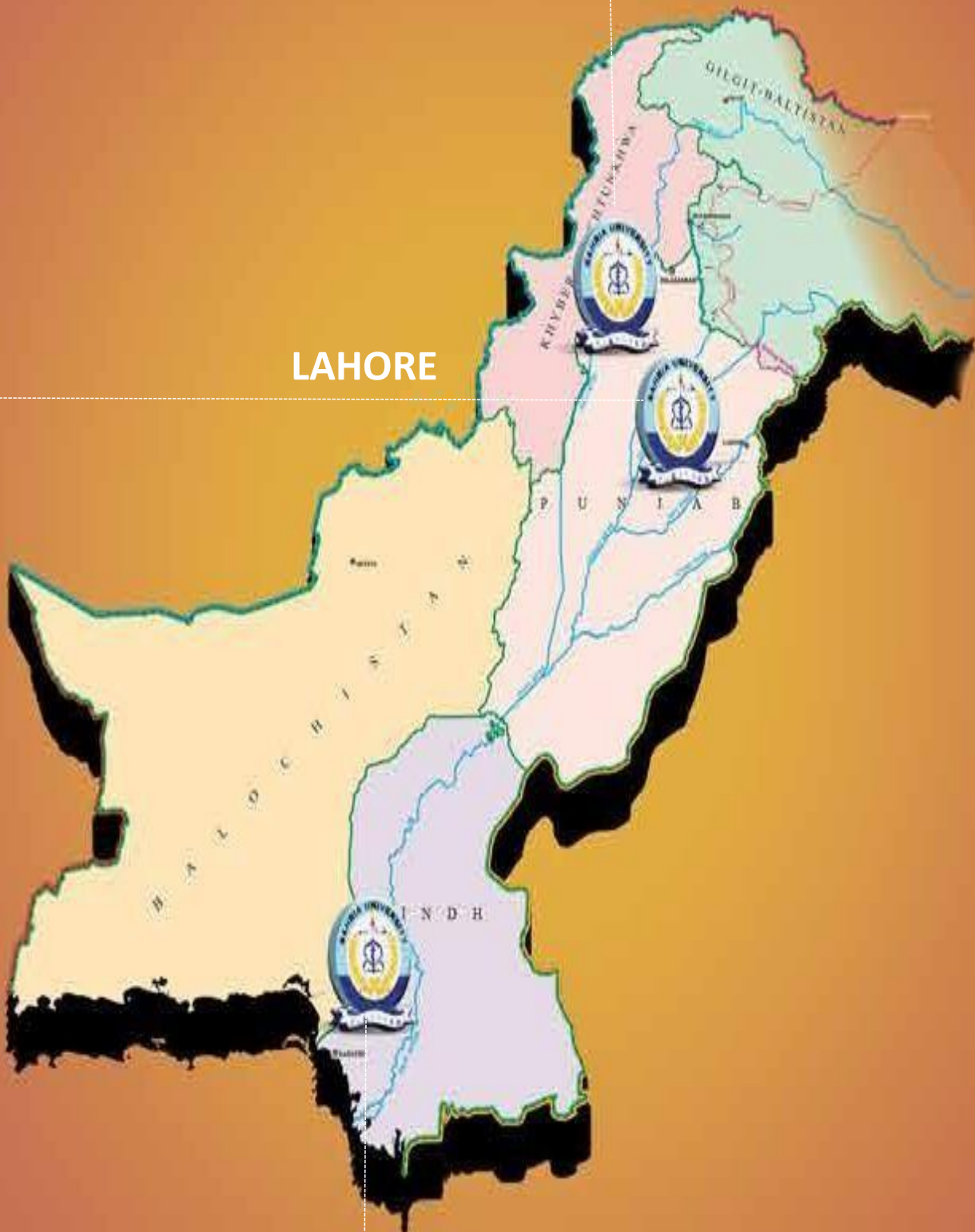
21000+
Students

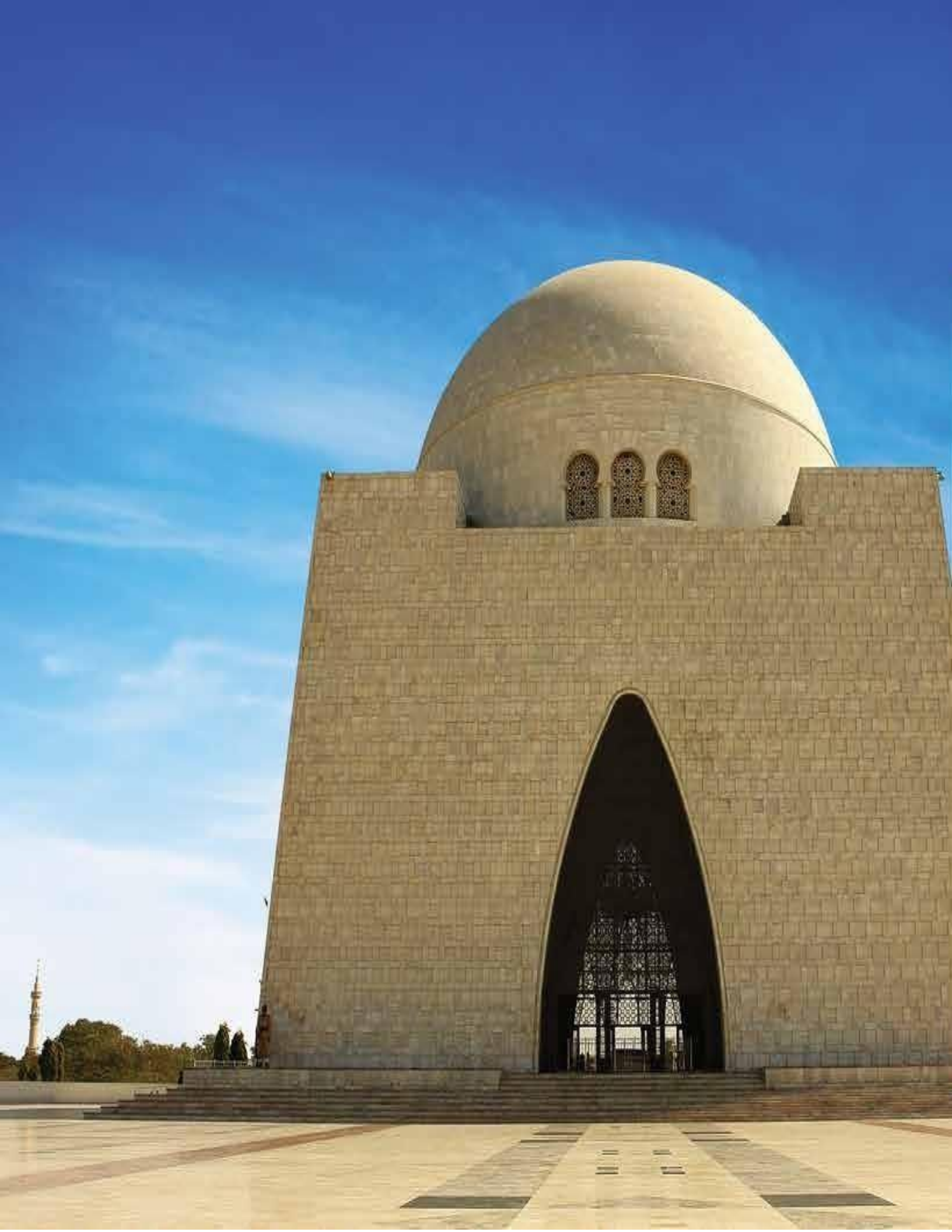
Scholarship
Grants worth
164
Million

ISLAMABAD

LAHORE

KARACHI





BAHRIA UNIVERSITY HEALTH SCIENCES CAMPUS KARACHI CAMPUS



The Bahria University Health Sciences Campus Karachi (BUHSCK), established in 2009 as a constituent campus of Bahria University, is a leading center for healthcare education and training in Pakistan. Strategically located adjacent to PNS Shifa Hospital in DHA Phase II, Karachi, the campus provides students with direct exposure to a modern clinical environment and hands-on learning opportunities. BUHSCK offers a diverse portfolio of programs including MBBS, BDS, Doctor of Physical Therapy (DPT), BS Nursing (BSN), BS Medical Laboratory Technology (BS-MLT), BS Biotechnology, as well as MS, MPhil and PhD programs in various health sciences disciplines. The curriculum emphasizes interactive learning, medical ethics, and problem-based modular instruction, ensuring students are well-prepared for the dynamic healthcare landscape.

BUHSCK is supported by highly qualified faculty, advanced teaching facilities such as simulation labs and research-equipped laboratories, and a well-stocked library. Its affiliation with PNS Shifa, a recognized teaching hospital, allows comprehensive clinical training across a range of specialties, while strong research culture and participation in national conferences promote scholarly growth and innovation. Accredited by PMDC, HEC, PNC, and PPTA, and offering merit- and need-based scholarships, BUHSCK continues to produce compassionate, skilled, and globally competitive healthcare professionals.

Message from the Desk of Director General

Health Sciences Campus Karachi



VICE ADMIRAL (R)
ATHAR MUKHTAR HI (M)

I am truly honored and delighted to have the opportunity to be a part of Bahria University (BU) that is endowed with a Strategic Vision of promoting Higher Education through Quality Research, and an underlying Mission of serving Pakistan by nurturing its human capital.

The vision of BU is 'to become an internationally recognized university that contributes towards development of nation through excellence in education and research'. BU is ranked as the fifth top university among all universities in Pakistan and holds the second position among federally chartered universities. BUHSC-K, a part of BU, embarked on its academic venture in 2008 solely with BU Medical College (BUMC). Over time, BUHSC (K) made remarkable progress and established five additional colleges within its premises, namely BU Dental College (BUDC) in 2012, Pakistan Navy Nursing College as a subunit of BU in 2017, BU College of Physical Therapy (BUCPT) in 2017, BU College of Allied Health Sciences (BUAHS) in 2018, and BU Post-graduate College in 2022. The transformation of BU Medical College into Bahria University Health Sciences within a span of just 10 years would have seemed implausible without the unwavering efforts, support, and dedication of its staff, students, and faculty.

BUHSC(K) fosters the growth of a conducive and disciplined learning environment, which in turn leads to an increased number of high-quality healthcare professionals. The institution also actively promotes the development of healthcare facilities and offers comprehensive training programs that encompass multiple disciplines, thereby enhancing the capabilities of both graduates and postgraduates. Our undergraduate and graduate programs have been meticulously designed to offer comprehensive training in cutting-edge research methodologies and emerging fields of interest within the health sciences. Students from Pakistan and various parts of the globe choose to pursue their studies in our programs, aiming to become trailblazers in health sciences research. PNS SHIFA, our affiliated hospital, is a prestigious 1000-bed facility. Established in 1953, it holds the distinction of being the oldest hospital of the Pakistan Navy in Pakistan. The hospital serves as a training ground for various healthcare disciplines, with a dedicated and highly competent faculty overseeing the process. The environment at PNS SHIFA fosters conducive learning, providing students with hands-on medical and paramedical skills training. This comprehensive approach equips students with the confidence to effectively collaborate within a multidisciplinary healthcare team.

Our primary objective is to enhance access to essential healthcare services by producing skilled and proficient healthcare professionals. Additionally, we strive to connect global and diverse community groups, without any form of discrimination, to the resources provided by Bahria University through its various health professions training programs. We appreciate your visit to our website and assure you that our team of highly accomplished faculty and administrative staff are readily available to address any queries or concerns regarding the programs outlined here. We value your feedback and suggestions, and look forward to hearing from you.



SCHOLARSHIPS/FEE CONCESSIONS/WAIVERS/STUDENT LOANS

Scholarships for students with an aim to encourage excellence in studies through rewarding high academic achievers through various types of Advance Merit /Merit scholarships and also to support less privileged student(s) to attain their goals/target by offering purely Need Based Scholarships. BU believes that no one should be deprived of getting education merely on the grounds of inability to pay.

Objectives

BU scholarships are offered with an objective to;

- a. Provide financial support to academically talented and less privileged students with an objective to empower them to acquire quality education at Higher Education level.
- b. Elevate the socio-economic status of the students by enabling them to get the modern education and career opportunities for their brighter future.
- c. To improve access to higher education, especially for those belonging from far flung areas of Pakistan

Types of Scholarships Offered and their Eligibility Criteria

The eligibility criteria for different types of scholarships are as under:

1. **Advance Merit Scholarships – Types;**
The Scholarships in the following five categories, in order to encourage and ensure that the most talented students join Bahria University.
 - i. Advanced Merit Scholarship for Board Toppers;
 - ii. Advanced Merit Scholarship for Top Rankers in University Merit Lists;

- iii. Advanced Merit Scholarship for Outstanding Performers in A-Levels;
- iv. Exemption of admission fee to Bahria University graduates/alumni for MBA/MS/MPhil/PhD program at Bahria University
- v. Incentive to attract High Achieving Candidates into PG Programs.

Advanced Merit Scholarship for Board Toppers (for undergraduate programs)

Bahria University shall offer 100% total fee waiver/concession (including all other charges) for the first semester, to top three toppers of all Boards of Intermediate and Secondary Education (BISE).

Note: However, its continuation during the subsequent semesters will be subject to the condition that awardee must maintain his/her minimum GPA/CGPA of 3.50

1. Advanced Merit Scholarship for Top Rankers in University Merit Lists

Top merit position holders in Bahria University admission merit list according to their respective University generally award Advanced Merit discipline will be awarded scholarships/fee waiveas per following criteria:

a. Undergraduate Programs; Top three student scoring at least 70% in the merit lists for Management and Business Studies (considered together), Engineering (all Engineering programmes considered together) and Computer

Sciences, shall be eligible for award of scholarship in the form of Tuition Fee

waiver as follows:

- **1st Position Holder** **75%**
Tuition Fee waiver
- **2nd Position Holder** **50%**
Tuition Fee waiver
- **3rd Position Holder** **30%**
Tuition Fee waiver

Note: The top-ranking student scoring at least 70% in the merit lists for Law, Earth & Environment Sciences, Media Studies, Humanities & Social Sciences and Psychology, shall be eligible for award of scholarship in the form of 75% Tuition Fee waiver.

b. Post-Graduate Programs; The top-ranking student scoring at least 70% in the merit list of MBA, MS, MPhil, or equivalent at each CU shall be eligible for award of 50% tuition fee waiver.

Note: For continuation of the scholarship in the subsequent semesters for the above categories the students will be required to achieve a GPA/CGPA of at least 3.50.

Advanced Merit Scholarship for Outstanding Performers in A-Levels

Bahria University shall award scholarship 75% waiver/concession in tuition fee, to all students who have achieved minimum 03 A's in A Levels. Eligible students shall have to produce equivalence certificate issued from the Inter Board Committee of Chairmen (IBCC).

For continuation of scholarship in the subsequent semesters the students will be required to achieve a GPA/CGPA of at least 3.50

Exemption of Admission Fee to Bahria University Graduates/ Alumni for MBA/MS/MPhil/PhD Programs at Bahria University

Bahria University Graduate/Alumni shall be given 100% Admission fee waiver for admission in MBA/MS/MPhil and PhD Programs.

Incentives to attract High Achieving Candidates into PG Programs

The incentives to attract High Achieving Candidates into PG Programs will be as following:

a. From Non-Engineering background; Candidates for PG programs (MBA/MS/MPhil/PhD) with 95% marks (in case of annual examination) or CGPA 3.75 from

non-engineering programs in last degree from HEC recognized National & International Universities shall be offered 50% waiver in tuition fee.

b. From Engineering background; Candidates for PG programs (MBA/MS/MPhil/PhD) with 80 % marks (in case of Annual examination) CGPA 3.50 from engineering programs (in semester system), in last degree from HEC recognized National & International Universities shall be offered 50% waiver in tuition fee.

For continuation of scholarship in the subsequent semesters, the students will be required to achieve GPA/CGPA of at least 3.50 for Engineering and GPA/CGPA 3.75 for

Non-Engineering program.

2. Merit Scholarships for Batch Toppers (For all semester based programs)

The merit Scholarships for Batch Toppers for all semester based programs will be as following:

SCHOLARSHIPS/FEE CONCESSIONS/ WAIVERS/STUDENT LOANS

be awarded Merit Scholarship as per following;

- 1st position Holder 70%
- 2nd Position Holder 40%
- 3rd Position Holder 30%

a. For Post-Graduate Programs (MBA/MS/MPhil/ PhD or Equivalent); Top scorer students from each batch, achieving first two (02) position in their Semester Examination shall be awarded Merit Scholarship as per following;

- **1st position Holder 70%**
- **2nd Position Holder 40%**

Eligibility Criteria; The criteria to qualify for the Merit Scholarship will be as following;

- The students of all programs are eligible for Merit Scholarship.
- The Merit scholarship shall be offered to students on the basis of GPA of their previous semester & tuition fee of their current semester.
- The students must achieve minimum GPA ≥ 3.75 in order to qualify for the award of Merit Scholarship for non-engineering program(s), in case of engineering & computing programs, student has to achieve minimum GPA ≥ 3.60 as per details mentioned above.
- In case of a tie, the student with the higher percentage will get the Scholarship. In case of a double tie, all students will be awarded the Scholarship.
- The student(s) have to follow the academic road map with regular course load for all type of Merit Based Scholarships.
- Student availing naval fee concession will also be eligible for Merit scholarship as per policy, however they can only avail one benefit at a time (i.e. fee reduction or merit scholarship).
- BU Faculty and administrative staff qualify for Merit scholarship shall not be considered for award of scholarship if availing already any fee concession.
- Merit Scholarship shall not be provided for the Summer Semester, final semester (Graduating Batch).

i. A student in receipt of more than one scholarship/waiver shall be eligible to avail one scholarship as per student(s) discretion.

j. For MS/MPhil only for 02 years of program, for the purpose of award of Merit Scholarship, the GPA of course work shall only be considered in the 3rd semester.

3. Financial Assistance Scholarship (FAS)

Financial Assistance Scholarship shall be offered to the needy and financially weak students in order to partially or fully support them. New intake after becoming bona-fide students and already enrolled students can apply subject to fulfilling the eligibility criteria. The scholarship once granted in this category remains available to the students for the entire degree program provided their performance shall not fall below GPA/CGPA 2.50.

Eligibility criteria for award of Financial Assistance scholarships; Following shall be the eligibility criteria to apply for Financial Assistance Scholarship Program:

- Financial Assistance Scholarship shall mainly focus on to support students from low-income background.
- Students of all programs are eligible for Financial Assistance Scholarship subject to the condition he/she finds financial constraints to cope with educational expenses.
- For fresh intake, results of their Matric, FA/FSc., O & A levels or equivalent be considered for award of scholarship
- For the students enrolled in 2nd semester onwards shall be eligible to apply if he/she has a minimum 2.50 GPA/CGPA in the previous semester and for continuation at least 2.50 GPA/CGPA has to be maintained in the subsequent semesters. If the students fail to maintain 2.50 GPA/CGPA in the previous semester, then their scholarship shall be withheld

till the time he/she improves academic grades to

- e. 2.50 GPA/CGPA.
- f. Students with any physical disability shall be preferred
- g. Students belonging to less developed areas (as identified by GoP) shall be preferred if fall under FAS eligibility criteria.
- h. Students mentioning income and expenditure details has to justify with supporting documents.

4. Merit Scholarships at BUMDC (For Annual based Examinations)

For MBBS & BDS programs, merit scholarships for batch toppers shall be awarded on the basis of the result of annual examination except the final professional examination. The award shall be a lump sum amount for the year following the annual examination, as follows:

A. MBBS Students

Merit in Annual Exam	Scholarship Amount
1st	Rs 100,000
2nd	Rs 75,000
3rd	Rs 50,000

B. BDS Students

Merit in Annual Exam	Scholarship Amount
1st	Rs 100,000
2nd	Rs 75,000

For all semester-based programs at BUMDC, general scholarship policy of BU shall be implemented i.e. Merit & Need based both (except Advance merit categories)

5. Study Loan/ Revolving Fund

A newly inducted student whose academic progress is impeded by the lack of financial resources to pay the fee(s), shall be eligible for financial support through the Study Loan. The loan will be interest-free and available to the students of all degree programs except MBBS and BDS, though the preference shall be given to UG students.

To apply for the loan, a student shall first secure admission and get the fee voucher. A student (only 1st semester intake) can request for the loan against the total 1st semester fee. The loan shall be processed through the Central Scholarship Committee with recommendations of the Head of the CU. Final approval shall be accorded by the Rector. Following rules shall apply:

- a. The parents/guardians (spouse in case of a married student) shall be the joint borrower(s)/guarantors (irrespective of their means and age of the student).
- b. There shall be no security deposit by the applicant (student). A bond shall be signed between the applicant (student), his/her guarantor and BU, mentioning also the repayment schedule.
- c. The final transcript or degree shall not be issued prior clearance of all payable loans by the student.

General Rules for Award of BU Scholarships

Eligibility of students for scholarship shall be subject to following conditions:

- a. Student(s) of Bahria University in any semester are eligible, subject to the conditions as indicated with respect to their respective category.
- b. The student(s) has to follow the academic road map with regular course load for all type of Merit Based Scholarships.

c. Student(s) already in receipt of one scholarship/fee concession from university or external resources are ineligible to apply for any other scholarship.

d. Progress of Financial Assistance and all Merit Based Scholarships will be reviewed every semester.

Any International student falling under Merit Scholarship category shall be awarded as per the policy. However, for Need Based scholarships, special approval shall be sought from Honorable Rector.

6. Sponsor a Student Scheme

Sponsor a Student Scholarship Scheme is introduced at Bahria University with an objective to financially support students from less privileged class of society. For this specific program, University shall approach well off individuals/corporate companies'/donor agencies to financially support fully or partially the needy student(s). Interested sponsors shall be requested to bear the educational, expenses of the student(s) along with boarding/meal/books allowance as per sponsors willingness. Award of scholarship under this category shall be purely on Need based grounds, keeping in view the

financial background of the applicant's family. This program shall be launched for all programs at UG and PG level both.

7. Interest Free Laptop Loan Scheme

Investment in youth has been recognized as the best long-term speculation for prosperous future of any nation. Bahria University facilitate its students in different ways to fulfill their dream of becoming successful graduates so as to perform exceptionally good in their practical life. Laptop is now an important gadget for students to perform their academic and research activities. In this information age, personal computing devices, like a laptop, is a must especially for students at Higher Education level. Keeping this reality in consideration and realizing its importance BU

has launched its Loan policy for Laptop procurement

w.e.f. Fiscal year 2020-21. This scheme shall support financially underprivileged students at UG Level to buy laptops as per their academic requirements.

Eligibility Criteria; Following shall be the eligibility criteria;

a. Loan for laptop procurement shall be offered to the students from 2nd semester to 6th semester students holding minimum CGPA of 2.5 at UG level and incase of annual system student of 2nd year/3rd year with 50% Marks can apply/avail the facility.

b. Selection shall be made based on need assessment of students i.e. those students who cannot afford to buy laptops for their academic use shall be eligible to apply.

c. Two committees one at Campus Level and other at Head Office will evaluate the individual cases and put up the recommendation to Honorable Rector for final approval.



BU College of Allied Health Sciences

The Bahria University College of Allied Health Sciences (BUCAHS) was established in 2018 with the launch of its flagship BS Medical Laboratory Technology (BS-MLT) program, laying the foundation for producing highly skilled allied health professionals. In 2023, the College expanded further with the addition of the BS Biotechnology program, broadening its academic portfolio to meet modern healthcare and life sciences demands. BUCAHS is committed to preparing graduates with strong theoretical knowledge, advanced practical skills, and an innovative research mindset essential for addressing emerging challenges in healthcare and biotechnology industries.

The campus is equipped with state-of-the-art facilities, including spacious lecture halls, tutorial rooms, advanced science laboratories, a video-linked conference room, a modern library, auditorium, cafeteria, gym, prayer rooms, and dedicated common areas for male and female students. For clinical training, students have access to the PNS Shifa Teaching Hospital, ensuring real-world exposure. The campus also houses the Multidisciplinary Research Laboratory (MDRL), a cutting-edge facility supporting hands-on practical training, translational research, and interdisciplinary collaborations in health sciences and biotechnology.

BUCAHS emphasizes academic excellence, professional ethics, innovation, and community engagement. Supported by experienced faculty and a dynamic curriculum aligned with international standards, the College strives to produce competent, ethical, and research-driven graduates who are well-prepared to contribute to healthcare delivery, diagnostics, biotechnological advancements, and scientific innovation at national and global levels.



Message from the Desk of Dean Health Sciences



Prof. Dr. Shazia Shakoor
Dean Health Sciences

My Dear Students,

Welcome to Bahria University Health Sciences Campus Karachi, where you will spend four years of your life in pursuit of knowledge and become qualified biotechnologists. We will facilitate you in converting the “information” given in “Books” to “knowledge” with “understanding” and how to use this knowledge ‘wisely’ for the benefit of humanity as health care provider.

This study guide will give you a road map for the forthcoming activities including the objectives, contents, learning strategies and assessment of your educational course; which we regard as essential. Use this study guide as a reference for your “Code of Conduct”. It gives policies and rules pertaining to examinations, electives, attendance and rotations etc. A competent team of experienced professional teaching faculty will guide you towards learning goals in different clinical settings through effective use of different tools of teaching and assessment. You will be encouraged to integrate your learning across the disciplines.

Advancements in biotechnology have allowed physicians to better diagnose and treat their patients since the beginning of the professional practice of medicine. Thanks to the continuous development of technology in the medical field, countless lives have been saved and the overall quality of life continues to improve over time.

Your social and moral values should be explanatory. It is here where you change from a technical student to reliable, dependable professional biotechnologists, who are empathetic and take responsibility for human lives very seriously and religiously. You as student are expected to demonstrate professional and responsible behavior towards your teachers, colleagues, health professionals and patients. Communication skills and professionalism will play a vital role in your development. You are an adult and adults are responsible for their actions. We use principles of adult learning here. Your teachers are here to guide you but you are the decision makers. Results will depend on how committed, honest and hard-working you are yourself.

I hope you will enjoy the co-curricular activities that are planned for you. Have fun but do not forget that you are here to become a biotechnologist. I hope you will become the best biotechnologist that you can. Dress up properly and always smile.

Message from the Desk of Principal

Bahria University College of Allied Health Sciences



Professor Dr. Mehreen Lateef
Principal Bahria University
College of Allied Health Sciences

Dear Students,

Heartiest congratulations and welcome to Bahria University Health Sciences Campus. Selection in Biotechnology department of college is the evidence of sheer hard work, incessant struggle, and relentless efforts towards achieving the goals. State of the art facilities and adroit faculty of this college will ensure smooth transition of a student to a highly trained practitioner. The logical convergence towards the aim will be explained stepwise in the study guide which includes forthcoming activities, content, and learning strategies.

The highly proficient teaching faculty will provide necessary guidance related to learning objectives, effective use of teaching tools and integrated teaching methods. The study programs also support social and moral development of a BS- Biotechnology student besides achieving academic excellence. A team of highly trained and professional teachers act as mentors to guide students on social and academic related affairs.

The mandate of biotechnology education is to equip future professionals with requisite knowledge, skills, and attitude. As a biotechnology student it is expected of you to keep an exemplary character and honest morality. Plan and strive hard with full sincerity and devotion. This marks the beginning of your professional career where attitude defines your altitude and acts as a panacea in practical life

Bahria University College of Allied Health Sciences (BUCAHS) at a Glance

About US

Bahria University is a Federally Chartered Public-Sector Non-Profitable institution established on 7th February 2000 through a Presidential Ordinance. Being a multi-campus (Isb/Lhr/Khi) institution of higher education, we aim to attain highest standards in teaching, learning and research that fall in accordance with global compatibility.

Bahria University College of Allied Health Sciences (BUCAHS) has established in 2018 with the initiation of BS-MLT (Medical Lab Technology) program as a first step to develop Allied Health Sciences College. Later on, BS-Biotechnology (4 years) program has added in 2023 to the BU College of Allied Health Sciences as horizontal expansion of the college.





Learning & Teaching Methods

Today Bahria University is considered to be one of Pakistan's 21st century, business-facing university. We are committed to giving our students the skills they need to succeed in the global marketplace. We strive to develop the qualities of confidence, self-worth and high employable skills with in our students so that they can excel in the field they choose to work in We strive to achieve this by:

- ❖ Combining traditional teaching methods by top academic staff with digital resources.
- ❖ Teaching courses that are all designed with the input of business and professional bodies.
- ❖ Giving students the change to learn about employability through listening to the experience of our alumni.
- ❖ Organizing networking events where staff, students and graduates can meet.
- ❖ Offering a vibrant multicultural campus.
- ❖ Giving students the option of studying at one of our partner universities overseas.
- ❖ Offering students valuable work experience in research, business or industry before their final academic year.
- ❖ Evening classes, summer schools and short courses at community venues Public lectures and workshops.
- ❖ Part-time study, continuing education program, and new foundation degree



Career Office

Bahria University remains committed in providing not only quality academic services but also offers career services that include employment opportunities, professional grooming and counseling to its students and alumni. The Office of Student Affairs and Career Services keeps on strengthening academic linkages with industry in order to provide the market with our talented and skilled graduates as valuable workforce. Dedicated staff has been appointed in all BU Campuses to facilitate students and Alumni in best possible way. A very efficient mechanism is followed where the students and alumni are assisted in choosing the right career paths and future goals. BU strive hard to meet the very dynamic requirements of job market and graduates by creating innovative ways of bridging the gap of academic world and industry. The Office of Student Affairs and Career Services acts as a central hub for its students and alumni and apart from routine job alerts, it organizes various training programs, seminars and workshops by inviting market professionals who share their expert opinion and experiences which helps

Career Counseling can help you:

- discuss your interest /profession
- discover what you can do along with your major
- learn the way to investigate profession fields, industries, and employers
- discover what an internship is, why you want one, and the way to get one
- Critique your resume
- develop networking talents

Getting Professional:

Professionalism, Evaluation & Learning
Professionalism is a cornerstone of any organization and is essential to achieving excellence in research, education, clinical care and university and community service. It requires an ongoing commitment to honesty, integrity, respect, altruism, accountability, compassion, empathy and self-improvement. Bahria University reaffirms this commitment to a climate of respect, civility and cooperation among students, interns, residents, faculty,

administrators, staff and society. Programs and services offered by Bahria University support and enhance the goals to educate and oversee student's personal and professional accountability as well as to ensure academic success. These include

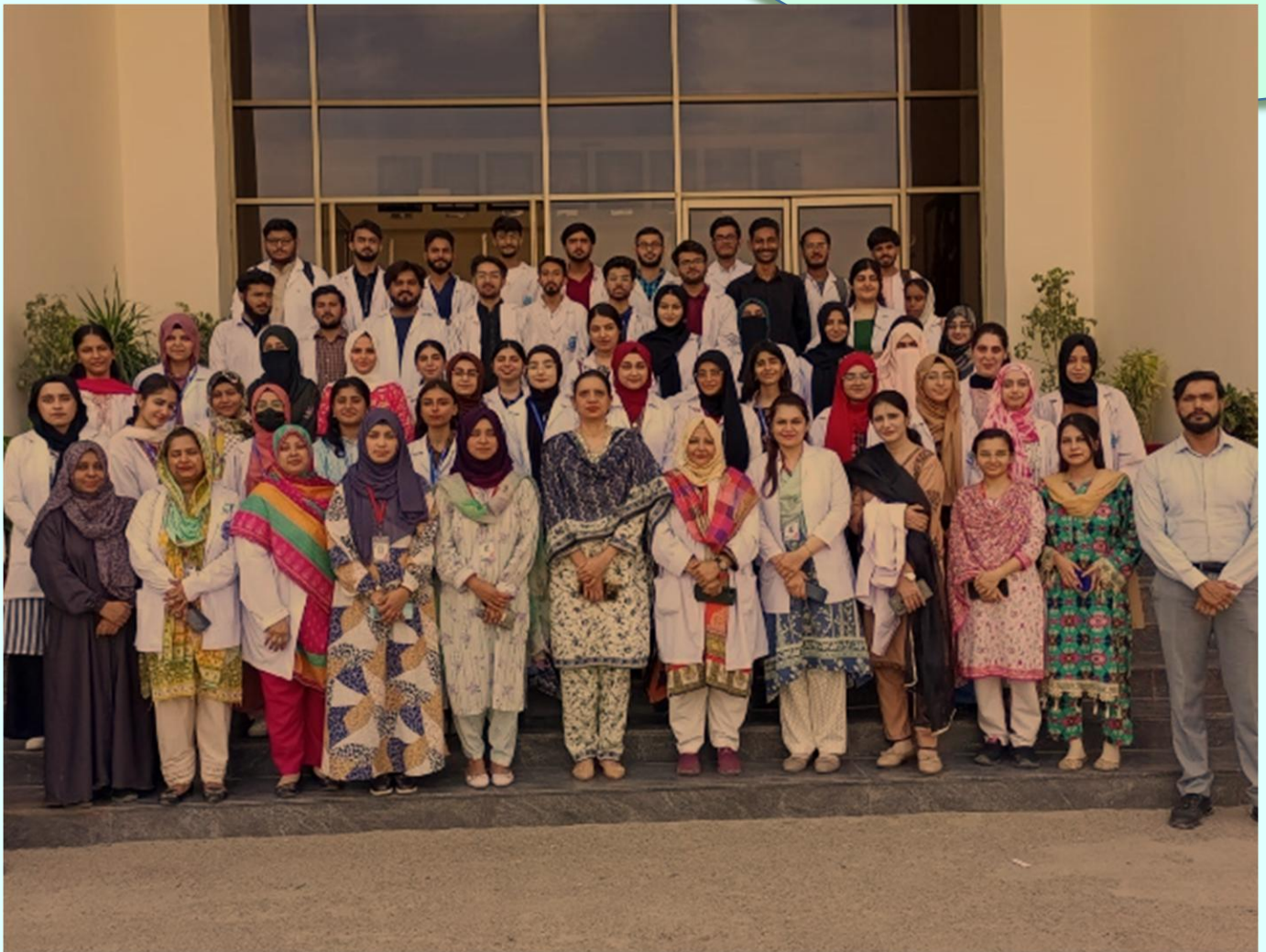
- Faculty-student mentoring programs
- Course and instructor evaluations
- Administration of the Learning Resource Center
- Academic enrichment intervention strategies,
- Supervision of exam proctors,
- Academic enhancement workshops.

Interactive Approach:

Interactive learning is a hands-on approach to help students become more engaged and retain more material. With or without a form of technology, interactive learning helps students strengthen problem solving and critical thinking skills.



ADDING VALUES



ADDING VALUES



ADDING VALUES



The BU Experience

Want to know what it's really like to be a student at Bahria University?

Bahria University focuses on strong academic grooming of the students along with emphasis on individual development by engaging them in various curricular & co-curricular activities. Bahria support individuals to achieve their goals and make them move forward their professional life. These are the opportunities which everybody is looking forward to enhance their knowledge base & soft skills.

Student life & Engagement is dedicated to offering modern programs to help students get involved on campus giving vast opportunities to expand leadership skills and pursue their future goals. The university works in close liaison with international partner universities to provide international exposure to our students.

Sports at BU

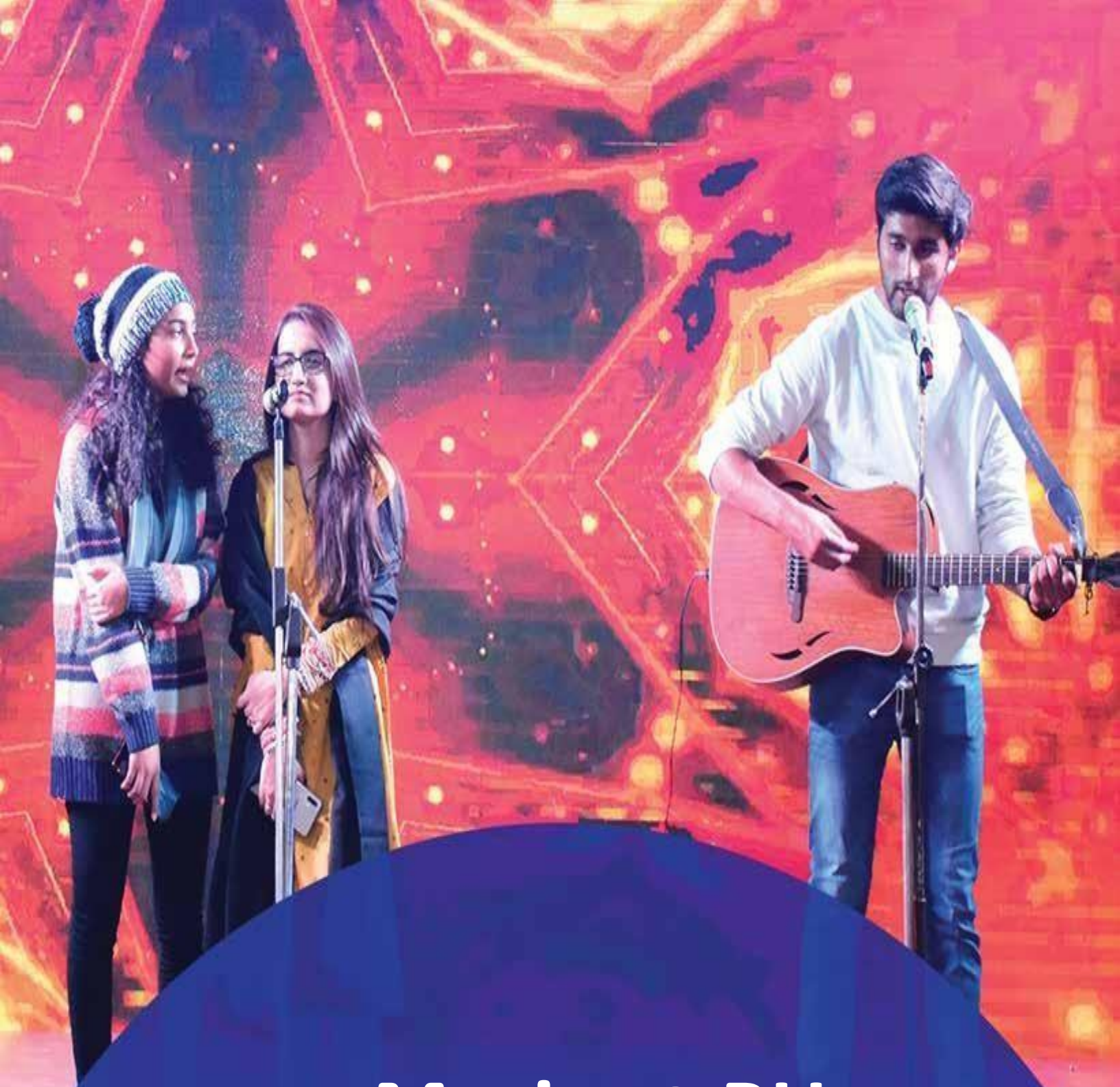
The importance of sports in the life of students is invaluable and plays a pivotal role in their overall development. With this perspective in view, the university provides many opportunities and facilities to its students to participate in international, national and university level sports.

A state of the art Gymnasium having wide range of indoor games facilities: courts for badminton, a fitness room equipped with the latest machines is available at the Campus.





Sports at BU



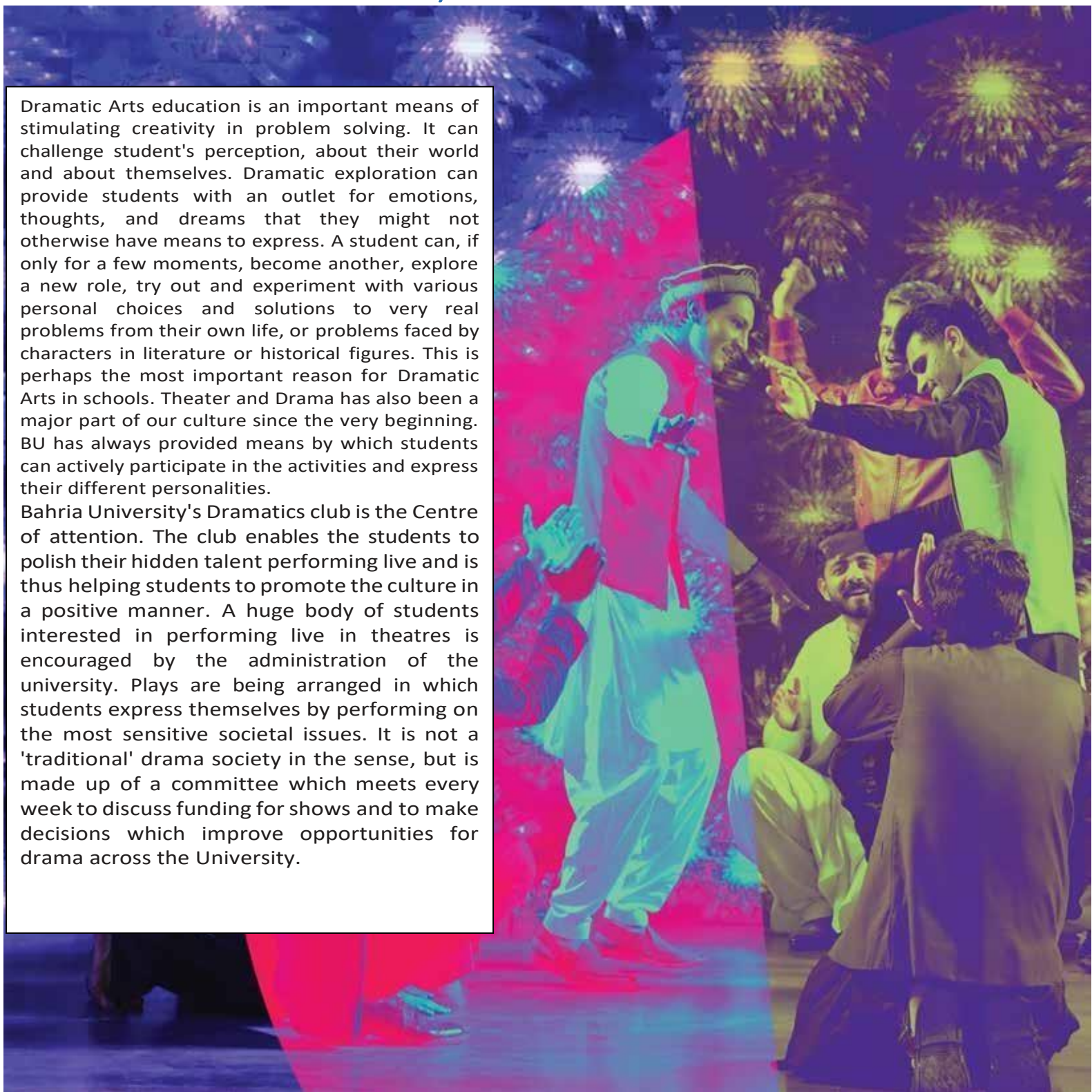
Music at BU

Extra-curricular activities including music are an integral part of life on the campus. Undergraduates, postgraduates, alumni and staff all contribute to the rich musical life of the University. Music Club is a student-run body comprising of a number of talented students of the university. The main objective of the music club is to expose and nurture the hidden talent of the students and giving the

Dramatics at Bahria University

Dramatic Arts education is an important means of stimulating creativity in problem solving. It can challenge student's perception, about their world and about themselves. Dramatic exploration can provide students with an outlet for emotions, thoughts, and dreams that they might not otherwise have means to express. A student can, if only for a few moments, become another, explore a new role, try out and experiment with various personal choices and solutions to very real problems from their own life, or problems faced by characters in literature or historical figures. This is perhaps the most important reason for Dramatic Arts in schools. Theater and Drama has also been a major part of our culture since the very beginning. BU has always provided means by which students can actively participate in the activities and express their different personalities.

Bahria University's Dramatics club is the Centre of attention. The club enables the students to polish their hidden talent performing live and is thus helping students to promote the culture in a positive manner. A huge body of students interested in performing live in theatres is encouraged by the administration of the university. Plays are being arranged in which students express themselves by performing on the most sensitive societal issues. It is not a 'traditional' drama society in the sense, but is made up of a committee which meets every week to discuss funding for shows and to make decisions which improve opportunities for drama across the University.



Bahria University Psychological Services Centers

Trauma Therapy Unit (TTU)

The Psychological Services Centers across Bahria University are committed to providing the best mental health services to all in need of assessment, counseling, and/or psychotherapy. High-quality, problem-focused, and ethical services are ensured. The Centers offer support to all enrolled students, faculty, staff and general public experiencing distress arising from various emotional issues.





Student Support Centre (SSC)

SSC is the hub of all non-academic activities and student centered services to maximize student potential by polishing student talents and skills, developing them into all-rounders with grooming interventions, self-help resources, interactive workshops and participation outside university. The Student Support Centre has a system under which it operates and provide support to students through following three wings:

- The Student Facilitation Centre
- Community Support Program
- Students Resource Centre





INTERNATIONAL LINKAGES

Internationalization is functioning at the heart of BU. Our University is one of the first few universities of the country that has a formal International Office setup to look after academic linkages and ties with international universities. The journey of internationalization of BU is now over a decade old with number academic partnerships in countries such as UK, USA, Australia, Canada, China, Turkey, Netherlands, Italy, Malaysia, Bangladesh, Iran & Thailand.

There are several opportunities for the students of Bahria University to avail international experience through guest lectures by foreign speakers, short study tours to partner Universities, participation in international conferences, attending international internships programs, exchange of students for a semester with universities in Turkey, Australia & UK, credit transfer opportunities to selected partner universities on a 3+1 and 2+2 articulation arrangements, international summer school programs and many more. To view list of existing partner universities of BU, please visit the University website. All international opportunities are advertised through International Office.

UNITED KINGDOM

- University of Plymouth
- University of Bedfordshire
- University of Greenwich
- University of Leicester
- University of Nottingham
- University of Northampton
- York St. John University
- Corbett Cent – King's College
- Southampton Solent University
- Brunel University

UNITED STATES OF AMERICA

- MIT (Resource Sharing)
- University of Idaho
- Valparaiso University

NETHERLANDS

- Amsterdam University of Applied Sciences

CANADA

- Dalhouse University

CHINA

- Hangzhou Dianzi University
- Shanghai Lixin University
- Beijing Technology & Business University

IRAN

- Chabahar Maritime University
- Damghan University

ITALY

- Trieste University

AUSTRALIA

- Griffith University
- Macquarie University
- Edith Cowan University

MALAYSIA

- AIMST University

THAILAND

- Burapha University

TURKEY

- Izmir University of Economics
- Istanbul Kemerburgaz University
- Istanbul Aydin University
- Dogus University
- Yasar University
- Erzurum Technical University
- Hakkari University
- University of Sirnak

Research at Bahria University

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RESEARCH

Research at Bahria University College of Allied Health Sciences

Research at BUCAHS is a core pillar of its academic and scientific mission, emphasizing innovation, interdisciplinary collaboration, and translational relevance across allied health disciplines. The college actively supports faculty and student-led research in fields such as molecular diagnostics, clinical laboratory sciences, physiotherapy, public health, and nutrition. Central to this effort is the Molecular Diagnostics and Research Laboratory (MDRL), a dedicated facility equipped for nucleic acid extraction, PCR-based analysis, and genetic research. In addition, BUCAHS hosts specialized research units with modern infrastructure, including facilities for advanced molecular biology, pharmacological screening, histopathological analysis, and chemical diagnostics. These labs not only support research excellence but also provide students with experiential learning in high-impact scientific techniques. Through these resources, BUCAHS continues to foster a dynamic research environment aligned with national health priorities and global standards.



MULTIDISCIPLINARY RESEARCH LAB



Libraries

The Bahria University libraries aim to encourage and support academic and research activities of university researchers, faculty, staff and students. They provide a full range of services, including books loans, online information searching, reference services, photocopying, access to digital resources, CD searching and research support services, i.e. Endnote training and APA style manual, etc. The libraries are managed by qualified and experienced staff, dedicated to provide quality services for its users.





BUCAHS AIM

THE COLLEGE AIMS

- Training the health sector workforce of the future
- Conducting research that creates new knowledge in the field of health sciences and reviews improvement in existing bodies of knowledge.
- Providing innovative, patient-oriented health care
- Contributing to the economic development and wellbeing of Pakistan through integrated programs in education, research and clinical care.

Objectives of BUCAHS

- To deliver high-quality education in Allied Health Sciences that meets national and international standards that equips students with strong theoretical foundations and practical competencies in allied health sciences.
- To promote a culture of research and innovation to develop allied health professionals capable of contributing to scientific advancement and evidence-based healthcare.
- To produce competent ethical, skilled, and patient-centered professionals who are prepared to deliver high-quality healthcare services and to contribute to the advancement of healthcare services in Pakistan through academic excellence, innovation, and professional leadership by building national and international linkages.
- To foster an environment of intellectual curiosity, critical thinking, and lifelong learning among students and faculty with active community engagement.

1. Academic Excellence

- To offer comprehensive undergraduate and postgraduate programs in Life Science & Allied Health Sciences with a strong foundation in biomedical sciences, clinical practice, and research.
- To implement modern and evidence-based teaching methodologies, including interdisciplinary and integrated learning approaches.

2. Skill Development

To equip students with the practical and technical skills

required for clinical competence in medical laboratories, biotechnology, and other allied health fields.

3. Research and Innovation

- To promote a culture of scientific research and innovation by encouraging student and faculty participation in research activities, publications, and conferences.
- To develop collaborative research projects through national and international linkages.

4. Professionalism and Ethics

- To instill professional ethics, responsibility, and moral values essential for healthcare practice.
- To prepare students to work effectively in multidisciplinary healthcare teams with integrity and empathy.

5. Community Engagement and Leadership

- To encourage community service and public health awareness through student outreach programs and health campaigns.
- To develop leadership qualities and communication skills that enable graduates to contribute to the healthcare system and society at large.

6. Continuous Improvement

- To maintain a continuous quality assurance system for monitoring and improving academic standards, infrastructure, and faculty development.
- To ensure adaptability and responsiveness to evolving trends in Biotechnology & Allied Health Science.

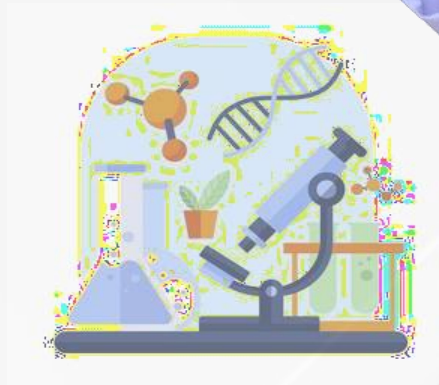




2025



BS BIOTECHNOLOGY



BAHRIA UNIVERSITY COLLEGE OF ALLIED HEALTH SCIENCES

BIOTECHNOLOGY PROGRAM

MISSION:

To prepare qualified graduates equipped with knowledge, latest technological skills and innovative research expertise in the field of biotechnology, attained in a collegiate environment supported through national and international linkages, for provision of high quality services in the society to serve community.



PROGRAM EDUCATIONAL OBJECTIVES:

BS-Biotechnology program is designed to

- To demonstrate comprehensive understanding of the core concepts, principles, applications and advancement in biotechnology for life-long learning and professional growth (academic education and scientific knowledge).
- Equip students with hands-on lab experience, experimental designs, and data analysis techniques for problem solving in biotechnology
- Develop students' ability to

effectively communicate biotechnical concepts experimental data and finding through oral written and visual presentations to encourage active engagement with society.

- Encourage critical thinking and responsible decision making to promote sustainable and ethically sound biotechnological applications to serve the community.
- Identify and analyze different biotechnological problems leading to designing and implementation of novel biotechnological research solutions for coping the global challenges.



PROGRAM LEARNING OUTCOMES (PLOs)

At the end of the program, student will be able to

- Demonstrate a comprehensive understanding of the fundamental and specialized knowledge in the field of biotechnology.
- Develop effective communication skills, including written oral, and visual presentation of

biotechnological scientific data to diverse audiences

- Apply the laboratory techniques and analytical skills to conduct experiments, analyze data, and solve problems in various fields of biotechnology
- Evaluate the legal, ethical, and social implications of biotechnological advancements
- Design and formulate biotechnological solutions using scientific literacy through identifying complex issues in biotechnology



FUTURE CARRER PROSPECTS

This program provides excellent career opportunities to students with a

quality learning experience and development of expertise in technological practices required for biotechnologist.

Upon completing the degree, graduates will be qualified to work as a biotechnologist in

- ❖ Research laboratories
- ❖ Clinical/Diagnostic laboratories
- ❖ Industries
- ❖ Universities

This program will provide a career path to the students and lab workers with advanced research opportunities as scientists, which can boost their professional career and enhances the promotion chances up to senior and supervisor level.

BS Biotechnology Road Map Aligned with HEC UEP Policy

Year	Semester	Course Codes	Title of Course	Credit hrs
1 st year	I	CBI 105	Cell Biology	3 (3-0)
		OCH 104	Organic Chemistry	3 (3-0)
		POB 102	Natural Science – Principles of Biology	3 (2-1)
		MAS 102	Mathematics-I (per calculus) (Quantitative Reasoning I Category)	3 (3-0)
		ENG 106	English-I	3 (3-0)
		PAK 105	Pakistan Studies	2(2-0)
		ISL 107	Tajweed (Non credit Hr)	One contact hr/ week
			Total Credit hrs	17
	II	BIO 112	Biochemistry – I	3 (2-1)
		MIC 102	Microbiology	3 (2-1)
		BIO 203	Ecology & Biodiversity	3 (3-0)
		ISL 101	Islamic Studies (Ethics for non-Muslim students)	2 (2-0)
		BMA 106	Biomathematics (Quantitative Reasoning II)	3 (3-0)
		ENG 112	English II (Expository Writing)	3 (3-0)
		ISL 108	Understanding Quran-I (Non credit Hr)	One contact hr/ week
			Total Credit hr	17
2 nd year	III	BIO 210	Biochemistry – II	3 (2-1)
		CGE 116	Principles of Genetics	3 (3-0)
		PHC 111	Physical Chemistry	3 (3-0)
		BPH 209	Biophysics	3 (3-0)
		SOC 112	Sociology (Social Science Category)	2 (2-0)
		ICT 201	Applications of Information & Communication Technologies (ICT)	3 (2-1)
		HSS 219	Civics & Community Engagement	2 (2-0)
		ISL 109	Understanding Quran-II (Non credit Hr)	One contact hr/ week
			Total Credit hr	19
	IV	BIT 301	Introduction to Biotechnology	3 (3-0)
		IMM 302	Immunology	3 (3-0)
		MCB 403	Molecular Biology	3 (3-0)
		ACI 210	Analytical Chemistry & Instrumentation	3 (2-1)

		BSC 211	Behavioral Sciences	2 (2-0)
		MGT 363	Entrepreneurship	2 (2-0)
		PAK 109	Ideology & Constitution of Pakistan	2 (2-0)
		ISL 110	Understanding Quran-III (Non credit Hr)	One contact hr/ week
			Total Credit hr	18
3rd year	V	MBT 307	Microbial Biotechnology	3 (2-1)
		BIO 301	Methods in Molecular Biology	3 (2-1)
		BSS 307	Biostatistics	3 (3-0)
		BIN 305	Bioinformatics	3 (2-1)
		RDT 307	Recombinant DNA Technology	3 (2-1)
		ISL 111	Understanding Quran-IV (Non credit Hr)	One contact hr/ week
			Total Credit hr	15
	VI	BIO 408	Genomics & Proteomics	3 (3-0)
		FBT 309	Food Biotechnology	3 (2-1)
		AGB 308	Agriculture Biotechnology	3 (3-0)
		RMS 311	Research Methodology & Skill Enhancement	3 (3-0)
		PBE 305	Principles of Biochemical Engineering	3 (3-0)
		ISL 112	Understanding Quran-V (Non credit Hr)	One contact hr/ week
			Total Credit hr	15
4th year	VII	IMB 404	Industrial Biotechnology	3 (2-1)
		HBT 405	Health Biotechnology	3 (3-0)
		BET 407	Biosafety & Bioethics	2 (2-0)
		AIB 415	Artificial Intelligence in Biotechnology	2 (2-0)
			Elective – I *	3
		RGS 490	Capstone	3
		ISL 113	Seerah-I (Non credit Hr)	One contact hr/ week
			Total Credit hr	16
	VIII	MMB 303	Nano biotechnology	3 (3-0)
		EMB 403	Environmental Biotechnology	3 (2-1)
			Elective – II *	3
			Elective – III *	3
			Elective – IV *	3
		ISL 114	Seerah-II (Noncredit Hr)	One contact hr/ week
			Total Credit hrs	15

Detailed Course Contents of Semester I

Course Codes	Title of Course	Credit hrs
CBI 105	Cell Biology	3 (3-0)
OCH 104	Organic Chemistry	3 (3-0)
POB 102	Principles of Biology (Natural Science)	3 (2-1)
MAS 102	Mathematics-I (per calculus) (Quantitative Reasoning I Category)	3 (3-0)
ENG 106	English-I	3 (3-0)
PAK 105	Pakistan Studies	2(2-0)

Course Title: Cell Biology 3 (3-0)

Course Code: CBI 105

Pre-requisite: Basic education (intermediate)

Course Description:

The structure and function of cellular organelles, the processes of cell division, differentiation, and signaling, the mechanisms of cellular communication and transport.

Course Learning Outcomes:

Upon completion of course the students will be able to:

1. Describe the structure and function of cellular organelles.
2. Explain the processes of cell division, differentiation, and signaling.
3. Analyze the mechanisms of cellular communication and transport.

Course Title: Organic Chemistry 3 (3-0)

Course Code: OCH-104

Pre-requisite: Basic Chemistry (Introductory Level)

Course Description:

This course provides an understanding of the fundamental principles of organic chemistry, focusing on bonding, reaction mechanisms, hydrocarbons, and functional group chemistry. It aims to equip students with problem-solving skills and analytical

reasoning in biotechnological applications.

Course Learning Outcomes (CLOs):

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

- Understand the structure, properties, and reactions of organic molecules.
- Understand principles of organic synthesis and reaction mechanisms.
- Analyze and predict the behavior of organic compounds based on their functional groups.

Course Title: Principles of Biology (Natural Science) 3 (2-1)

Course Code: POB 102

Pre-requisite: Basic education (intermediate). This course is designed to provide students with both basic and advanced concepts of biology to ensure a strong foundation for the study of biotechnology, regardless of their prior background in the subject.

Course Description:

Branches of Biology, Two kingdom and five kingdom classification, Diversity in the living world, The Chemical Context of Life, Water and Life, Structure and Function of Large Biological Molecules, An Introduction to Metabolism, ATP Powers Cellular work, Human Physiology: Nutrition, Transport and exchange of material between cells, Homeostasis and Osmoregulation, Gene Expression,

Mendelian pattern of inheritance, Mechanism of Evolution, Angiosperms reproduction and biotechnology

Course Learning Outcomes:

Upon completion of course the students will be able to

1. Explain fundamental biological concepts related to cells, genetics, evolution, and ecology.
2. Develop a comprehensive understanding of biological classification.
3. Relate biological principles to real-world applications, particularly in biotechnology

Course Title: Mathematics-I (per calculus) (Quantitative Reasoning I Category) 3 (3-0)

Course Code: MAS 102

Pre-requisite: Intermediate

Course Description:

This course provides an understanding of Algebra: Linear equations: formation, solving techniques and applications in biological contexts. Quadratic equations: solutions via factorization, completing the square, and the quadratic formula; interpreting quadratic models in biology. Introduction to polynomials: Graphing polynomials; understanding symmetry in polynomial functions. Matrices: Introduction to matrices, Types of matrices, operations of matrices, Determinants, Inverse of

matrices, System of linear equations, Cramer's Rule.

Quadratic Equation: Solution of quadratic equations, qualitative analysis of roots of a quadratic equations, equations reducible to quadratic equations, cube root of unity, relation between roots and coefficient of quadratic equations. Sequence and series: Definition of sequences and series, Types of sequences (arithmetic, geometric, recursive, and special sequences), Arithmetic progression, geometric progression, Applications in biological growth models (e.g., linear growth in cell cultures), Decay processes in biological systems. Binomial theorem: Introduction to mathematical induction, binomial theorem with rational and irrational indices. Trigonometry: Fundamentals of trigonometry, trigonometric identities.

Course Learning Outcomes (CLOs):

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

1. Apply Fundamental Mathematical Concepts in Biotechnology
2. Demonstrate proficiency in algebra to solve biotechnological problems.
3. Analyze and interpret biological data using mathematical techniques.
4. Enhance Problem-Solving Abilities Through Mathematical Applications

Course Title: English I 3 (3-0)**Course Code: ENG 106****Pre-requisite:** Intermediate**Course Description:**

This course provides an understanding of Basics of Grammar including: Parts of speech and use of articles, Sentence structure, active and passive voice, Practice in unified sentence, Analysis of phrase, clause and sentence structure, Transitive and intransitive verbs, Punctuation and spelling. Comprehension: Answers to questions on a given text. Discussion General topics and every-day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students). Listening to be improved by showing documentaries/films carefully selected by subject teachers. Translation skills Urdu to English Paragraph writing. Presentation skills

Course Learning Outcomes (CLOs):

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

1. Enhance language skills and develop critical thinking.
2. improve listening and reading & writing skills in English
3. Be able to communicate in written and oral English with peers and teachers.

Course Title: Pak Studies 2(2-0)**Course Code: PAK 105****Pre-requisite:** Intermediate**Course Description:**

This course is designed to provide students with a comprehensive exploration of Pakistan's Identity, spanning geographical, historical, and cultural dimensions. It delves into the diverse landscapes, ancient civilizations, and rich cultural heritage that define Pakistan. Moreover, it examines the socio-cultural and political transformations in Pakistan over time including democratic transitions and military intervention. The aim of this course is to inculcate in students a nuanced understanding of Pakistan's past, present, and potential future trajectories, enabling them to critically evaluate the complex dynamics shaping the nation's development.

Course Learning Outcomes (CLOs):

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

1. Have enhanced knowledge of the geographical, historical, and political aspects of Pakistan.
2. Understand the society and culture of Pakistan.
3. Understand and explain the socio-economic development in Pakistan.
4. Explore contemporary issues and challenges faced by Pakistan and their implications for the future.

Detailed Course Contents of Semester II

Course Codes	Title of Course	Credit hrs
BIO 112	Biochemistry – I	3 (2-1)
MIC 102	Microbiology	3 (2-1)
BIO 203	Ecology & Biodiversity	3 (3-0)
ISL 101	Islamic Studies (Ethics for non-Muslim students)	2 (2-0)
BMA 106	Biomathematics (Quantitative Reasoning II)	3 (3-0)
ENG 112	English II (Expository Writing)	3 (3-0)
	Total Credit hours	17

Course Title: Biochemistry – I 3 (2-1)**Course Code: BIO 112**

Pre-requisite: Foundational courses with the necessary background in biology and chemistry.

Course Description:

This course introduces the fundamental principles of biochemistry, covering water, pH, buffers, and the biochemical composition of cells. It explores the structure, classification, and functions of carbohydrates, proteins, lipids, enzymes, coenzymes, and vitamins. Enzyme kinetics, including K_m and V_{max} , and factors affecting enzyme activity are also discussed. The course provides a strong foundation for understanding biochemical processes in living systems.

Course Contents:

Introduction to biochemistry; water, pH, buffers, and biochemical composition of cells; carbohydrates - structure and classification; proteins - overview with emphasis on their composition and structure, classification and function; lipids - structure, classification and biological significance; enzymes - properties, nomenclature, classification, and factors affecting enzyme activity including inhibitors, basic kinetics, derivation of K_m and V_{max} ; coenzymes and vitamins; structure and function. Lipids and its classification

Practical:

Preparation of laboratory solutions and pH determination; qualitative and quantitative tests for carbohydrates,

proteins and lipids; enzyme assays and the effect of pH, temperature and substrate concentration on enzyme activity.

Course Learning Outcomes:

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

- 1- Understand the chemical nature of nucleic acids and proteins.
- 2- Explain the biochemical principles of metabolic integration and regulation.
- 3- Understand enzymes, enzyme activity and kinetics and their role in biochemical and metabolic reactions.

Course Title: Ecology & Biodiversity 3 (3-0)**Course Code: BIO 203**

Pre-requisite: Prior knowledge of Biological diversity, classification and different modes of nutrition. Or students should have studied (Principles of Biology) course taught in semester-I.

Course Description:

Introduction; ecosystem and ecological pyramids; role of environment on phenotype of organisms; food chain, webs and trophic levels; factors influencing environment, atmosphere composition and cycles; pollution; climate change (greenhouse effect and global warming); ozone layer – composition and state across the globe, Plant biodiversity – history, importance, usefulness and evolution, impact of environment on loss of genetic diversity and speciation; in situ and ex situ Conservation. Conservation Parks in

Pakistan. Pakistan's Animal and Plant Quarantine Acts

Course Learning Outcomes:

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

1. Explain the principles of ecology, biodiversity and conservation.
2. Describe the interactions between organisms and their environments.
3. Analyze the impact of human activities on biodiversity and ecosystems and develop strategies for their protection

Course Title: Microbiology 3 (2-1)

Course Code: MIC 102

Pre-requisite: Foundational knowledge in biology and chemistry

Course Description:

Overview and history of microbiology including microbial diversity (Archaea, bacteria, fungi, algae, protozoa), nutrition, growth, metabolism; cultivation; viruses; control of microorganisms: sterilization and disinfection, antimicrobial agents, antibiotics, antibiotic resistance and susceptibility, antifungal and antiviral agents; cell death; symbiosis, carbon, nitrogen, sulfur and phosphorus cycles; microbiology of soil, freshwater and seawater.

Labs:

Sterilization techniques; culturing of bacteria in liquid and on solid medium; Gram-staining of bacteria; colony and

cell morphology; bacterial cell count and growth curves; biochemical tests.

Course Learning Outcomes:

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

1. Describe the structure, function, and diversity of microorganisms.
2. Demonstrate laboratory skills in isolating and identifying microorganisms.
3. Analyze the role of microorganisms in disease, ecology, and biotechnology.

Course Title: English-II 3 (3-0)

Course Code: ENG 112

Pre-Requisite: ENG 106

Course Description:

This course is designed to enhance students' proficiency in written and spoken communication through practical exercises and theoretical understanding. The writing component focuses on crafting professional CVs, job applications, technical reports, essays, letters, memos, and meeting minutes. Students will also develop skills in transforming narratives, analyzing visual data, mastering active and passive voice, and refining their understanding of phrases, clauses, punctuation, and tenses. The speaking module includes group discussions, individual presentations, and role-play activities to improve fluency and confidence. The listening

component incorporates documentaries, movies, and online resources to enhance comprehension and pronunciation. Additionally, students will learn to effectively utilize library and internet resources for academic and professional research. This course provides a comprehensive approach to developing strong communication skills essential for academic and professional success.

Course Content:

Writing Skill: CV and job application, Technical Report writing, Writing styles, Changing narration: Converting a dialogue into a report, Converting a story into a news report, Converting a graph or picture into a short report or story, Active and Passive voice, Letter / memo writing and minutes of the meeting, use of library and internet resources, Essay writing, Phrases - Types and functions, Clauses - Types and functions, Punctuation: Tenses - Types, Structure, Function, Conversion into negative and interrogative.

Speaking Skill: Group Discussion (Various topics given by the teacher), Presentation by the students (individually), Role Play Activities for improving Speaking.

Listening Skill: Listening Various Documentaries, Movies, and online listening activities to improve the listening as well as pronunciation of the words.

Course Learning Outcomes (CLOs):

At the end of the program, students will be able to

1. Demonstrate the ability to write CVs, job applications, technical reports, essays, letters, and meeting minutes with appropriate structure, coherence, and professional style.
2. Apply grammar concepts, including tenses, phrases, clauses, narration, active and passive voice, and punctuation, to construct grammatically accurate and meaningful sentences.
3. Convert dialogues, stories, graphs, and images into structured reports or news articles, showcasing critical thinking and data interpretation skills.
4. Utilize formal writing styles, memo writing, and communication techniques for academic and professional purposes, including the effective use of library and internet resources.
5. Engage in group discussions, role-play activities, and presentations to enhance fluency, pronunciation, and confidence while improving listening comprehension through documentaries, movies, and online materials.
6. Analyze and interpret various forms of information, applying appropriate language, tone, and style in professional, academic, and social

contexts for clear and effective communication.

7. Employ appropriate writing styles, documentation methods, and formal communication techniques for academic research, professional correspondence, and laboratory documentation, including memos and the effective use of scientific resources.

Course Title: Islamic Studies 2 (2-0)

Course Code: ISL 101

Pre-requisite: - None

Course Description:

The course introduces students to the Holy Quran and Sunnah. It also includes Quranic Arabic vocabulary and basic grammar. This course provides insight about Deen, Ibadah, and Halaal o Haraam. Selected verses from the Holy Quran and Hadeeth have been included. It also includes brief history of Prophet PBUH and impact of his life on humanity. It includes the significance and importance of Muslim scientists and their role in various scientific fields. The course will give a clear vision to students regarding economic, political, and social system of Islam. The designed course also encompasses the topic of Islamic culture and civilization

Course Learning Outcomes:

Upon completion of the course, students will be able to:

1. Understand with clarity the Islamic concepts in the guidance of the Holy Quran and Sunnah
2. Understand the Islamic Ideology and its deep link with our lives. With understanding of basic Arabic grammar.
3. Understand the way of Islam: Beliefs and practices.
4. Develop ethical behavior in social and professional work environments.
5. Understand Salah (Namaz) and Duas (Azkaar), as required in connection with our daily lives.
6. Learn important teachings, decisions and actions of Prophet Muhammad PBUH in Makkah and Madinah.
7. Identify the contribution of Muslim Scientists towards various fields of sciences and their important achievements.
8. Understand the significance of health, obedience of Law and other basic necessities of human life so that He / She may become a responsible citizen.

Course Title: Bio-Mathematics 3 (3-0)

Course Code: BMA-106

Pre-requisite: Mathematics I

Course Description

- The objective of this course is to provide students with the essential concepts of biomathematics and how these can be employed for analyzing real data.
- Fundamental mathematical concepts, including algebra, calculus, probability, and statistics, relevant to biotechnological applications. Apply mathematical models to understand biological systems, such as enzyme kinetics, genetic inheritance, and population dynamics. Develop the ability to present mathematical concepts, calculations, and statistical analyses clearly in written, oral, and visual formats. Use appropriate mathematical language, graphs, and computational tools to communicate findings to both scientific and non-scientific audiences. Utilize mathematical techniques to analyze experimental data, model biological processes, and solve quantitative problems in biotechnology. Apply statistical methods for hypothesis testing, data

interpretation, and decision-making in biotechnological research. Integrate mathematical reasoning and scientific literacy to develop solutions for complex biotechnological challenges.

- Use computational tools, modeling techniques, and quantitative reasoning to enhance research in biotechnology and related

Course Learning Outcomes

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

1. Understand of Mathematical Principles in Biotechnology
2. Effective Communication of Mathematical and Biotechnological Data
3. Application of Mathematical and Analytical Skills in Biotechnology Research
4. Designing and Formulating Biotechnological Solutions Using Mathematical Literacy

Detailed Course Contents of Semester III

Course Codes	Title of Course	Credit hrs
BIO 210	Biochemistry – II	3 (2-1)
CGE 116	Principles of Genetics	3 (3-0)
PHC 111	Physical Chemistry	3 (3-0)
BPH 209	Biophysics	3 (3-0)
SOC 112	Sociology (Social Science Category)	2 (2-0)
ICT 201	Applications of Information & Communication Technologies (ICT)	3 (2-1)
HSS 219	Civics & Community Engagement	2 (2-0)

Course Title: Biochemistry II 3 (2-1)**Course Code: BIO 210****Pre-requisite:** Biochemistry I**Course Description:**

This course is a continuation of Principles of Biochemistry I, and aims to familiarize students with the key concepts of intermediary metabolism of proteins, nucleic acids, carbohydrates and lipids.

Course Contents:

Introduction to metabolism and basic aspects of bioenergetics and biochemical thermodynamics (endergonic and exergonic reactions); phosphoryl group transfer and ATP production; metabolism, oxidation reduction; carbohydrate metabolism and regulation (glycolysis, glycogenolysis; gluconeogenesis; pentose phosphate pathway); citric acid cycle (reactions, energetics and control), electron transport chain, oxidative phosphorylation, shuttle mechanisms (glycerol-phosphate shunt), lipid metabolism (energy yield from fatty acid oxidation, ketone bodies, acyl glycerol, compound lipids, cholesterol); photosynthesis; Calvin Cycle; metabolism of nitrogenous compounds (amino acid synthesis, catabolism, purine and pyrimidine synthesis); nucleic acid metabolism and control; urea cycle; integration of metabolism.

Practical:

Basic biochemical methods such as iodine test for polysaccharides, fermentation of sugars by Baker's yeast; isolation of amylose and amylopectin from starch; extraction of glycogen from liver; acid and enzymatic hydrolysis of glycogen; extraction and estimation of lipids from plant tissue/seed and lipid separation from different tissues; fractionation by thin layer chromatography (TLC).

Course Learning Outcomes:

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

- 1- Understand the chemical nature of nucleic acids and proteins.
- 2- Explain the biochemical principles of metabolic integration and regulation.
- 3- Understand enzymes, enzyme activity and kinetics and their role in biochemical and metabolic reaction.

Course Title: Principles of Genetics 3 (3+0)**Course Code: CGE 116**

Pre-requisite: Basic biology, students should have studied Principles of Biology course offered in semester-1.

Course Description

Classical Mendelian genetics; monohybrid crosses, dominance, recessiveness, co-dominance; principle of independent assortment; dihybrid and trihybrid

ratios; gene interactions; epistasis and multiple alleles; ABO blood type alleles and Rh factor alleles in humans; probability in Mendelian inheritance; sex determination; linkage and crossing over, organization of genes and genomes; Epistasis, multiple alleles, pedigree analysis and probability calculations in human genetics, gene expression regulation

Course Learning Outcomes:

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

1. Explain the principles of classical and modern genetics.
2. Analyze genetic data to predict inheritance patterns and gene interactions
3. Explain the structural organization of genes their role in inheritance and variation

Course Title: Biophysics 3 (3-0)

Course Code: BPH 209

Pre-requisite: Basic idea of molecular biology, Biomolecules stability, physiology and bioenergetics.

Course Description:

Scope and Importance of biophysics, Laws of Thermodynamics, Molecular orbital theory and subatomic particles, Gibb's Free energy, Enthalpy & Entropy. Structural stability of biomolecules, Principles of protein folding, Laws of thermodynamics governing biological organisms, Light spectrum and energy order of different

waves, Biophysical techniques for structural determination of molecules, X-ray Crystallography Basics, Nuclear Magnetic Resonance (NMR), Advanced Spectrophotometric Techniques

Course Learning Outcomes:

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

1. Describe the physical principles governing biological systems.
2. Understand biophysical techniques to study the structure and function of biomolecules.
3. Analyze the dynamics of molecular interactions in biological processes.

Course Title: Physical Chemistry 3 (3-0)

Course Code: PHC-111

Pre-requisite: Basic Chemistry (Introductory Level)

Course Description:

This course provides an understanding of the fundamental principles of physical chemistry, focusing on thermodynamics, chemical equilibrium, solution chemistry, and kinetics. It aims to equip students with problem-solving skills through theoretical and mathematical approaches while fostering analytical reasoning in biotechnological applications.

Course Learning Outcomes:

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

1. Understand the principles of thermodynamics, kinetics, and quantum chemistry.

2. Understand the physical factors affecting chemical reactions.
3. Explain mathematical models to describe physical and chemical phenomena.

Course Title: Sociology 2 (2-0)
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Course Code: SOC 112

Pre-requisite: - N/A

Course Description:

Definition and scope of sociology, sociology is a science, Islamic Sociology, medical Sociology, introduction contribution of sociology to medicine, health and disease, social definition of illness, social and emotional component of illness, patient and paramedic, paramedics view of disease and patient, psychology of patient / paramedic relationship, mental illness sociological perspective, social implication of mental illness, rehabilitation, physical, mental handicap, method in rehabilitation: Guidance counseling and vocational training, social disorganization, the concept and factor of social organization, family, group and community disorganization, problem of community problem of crime, method of treatment and preventative measure, educational problems, deterioration of education standard in school, college and university, health problems, illness behavior, delivery and utilization of health services, introduction to applied sociology, definition of applied sociology, nature and causative analysis of social problem and the role of sociologist in solving social problems, application of social research in social problems social serve and social research, nature purpose and function

Course Learning Outcomes:

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

1. Outline socio-economic explanations for health inequalities in morbidity and mortality and describe how social divisions (including gender, diversity, disability, sexuality) more generally influence health and health outcomes.
2. Provide a basic account of sociological theories of deviance as applied to the doctor-patient relationship, violence and critical approaches to health behaviors.
3. Discuss critical approaches to healthcare organization drawing on a range of theoretical models, including medical imperialism, managerialism, consumerism and how such challenges have affected medical practice in various settings.
4. Consider migration in the context of globalisation and its implications for models of health in rich and poor settings, with worked examples such as medical tourism and the spread of new pathogens
5. Assess critically the usefulness of social theory in published research that investigates a health problem using both quantitative and qualitative analytic approaches.

Course Title: Application of Information & Communication Technology 3 (2-1)**Course Code:** ICT 201**Pre-requisite:** N/A**Course Description:**

The course provides a concise overview of ICT and the Internet, starting with the history and classification of computers and basic digital concepts. It covers various computer types, essential system components like the CPU and I/O devices, and explains memory hierarchies including cache, primary, and secondary storage. Students learn fundamental programming concepts through algorithms, flowcharts, and an introduction to different programming paradigms. The curriculum also addresses data representation through number systems, binary arithmetic, and logic gates, followed by a study of networking principles, including topologies and TCP/IP layers. Finally, the course explores data management by comparing file systems with databases and introduces emerging technologies such as AI, ML, IoT, cloud computing, AR, and VR.

Course learning outcomes (CLOS):

Upon successful completion of the course, the student will be able to:

1. Explain the fundamental concepts of ICT, computer architecture, and number systems, and apply them in scientific and technical contexts.
2. Develop algorithms, design flowcharts, utilize basic

programming paradigms, and understand network topologies to enhance computational approaches in scientific studies.

3. Analyze the impact of emerging technologies such as AI, IoT, Cloud Computing, and VR, and effectively communicate their applications and ethical considerations.

Course Title: Civic and Community Engagement 2 (2-0)**Course Code:** HSS 219**Pre-requisite:** None**Course Description:**

This course provides fundamental knowledge about civics, citizenship, and community engagement. Students will explore civil society, government structure, civic responsibilities, inclusivity, and effective methods of participation in shaping society. The course aims to connect theoretical knowledge with real-world applications, empowering students to positively impact their communities.

Course Learning Outcomes (CLOs):

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

1. Demonstrate a fundamental understanding of civics, government, citizenship, and civil society.
2. Understand the concept of community and recognize the significance of community engagement.
3. Recognize the importance of diversity and inclusivity for societal harmony and peaceful coexistence.

Detailed Course Contents of Semester IV

Course Codes	Title of Course	Credit hrs
BIT 301	Introduction to Biotechnology	3 (3-0)
IMM 302	Immunology	3 (3-0)
MCB 403	Molecular Biology	3 (3-0)
ACI 210	Analytical Chemistry & Instrumentation	3 (2-1)
BSC 211	Behavioral Sciences	2 (2-0)
MGT 363	Entrepreneurship	2 (2-0)
PAK 109	Ideology & Constitution of Pakistan	2 (2-0)

Course Title:	Introduction to Biotechnology 3 (3-0)
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Course Code: BIT 301

Pre-requisite: Sound knowledge of biology

Course Description:

Biotechnology- definition and history; foundations of biotechnology and interdisciplinary pursuit; branches and/or applications of biotechnology in medicine, agriculture (food, livestock, fisheries, algae, fungi, etc.); protection of biotechnological products; safety in biotechnology; public perception of biotechnology; biotechnology and ethics; biotechnology and the developing world

Course Learning Outcomes:

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

1. Understand the history of biotechnology and its role in basic biological sciences.
2. Demonstrate knowledge of major biotechnological tools and techniques and explain the fundamental concepts, principles and scope of biotechnology.
3. Understand the Scope as well as ethical and safety issues in Biotechnology

Course Title:	Immunology 3 (3-0)
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Course Code: IMM 302

Pre-requisite: Basic knowledge of biological systems

Course Description:

Overview of the immune system as the body's main defense mechanism, Elements

of innate and acquired immunity, Cells and organs of the immune system, Properties of antibodies and antigens: structure, function, and interactions, Genetics of antibody structure and diversity, Expression of immunoglobulin genes, VDJ recombination, Antigen processing and presentation, Major histocompatibility complex, Monoclonal and polyclonal antibodies, T-cell receptors: maturation, activation, and differentiation, B-cell generation, activation, and differentiation, Complement system, Hypersensitivity, Cytokines, Resistance and immune response to infectious diseases, Cell-mediated effector response, Leukocyte migration and inflammation, Vaccines, Diseases of the immune system, Autoimmunity, Transplantation immunology

Course Learning Outcomes:

Upon completion of the course, the students will be able to:

1. Describe the components and functions of the immune system.
2. Explain the mechanisms of immune responses to pathogens.
3. Analyze the principles and applications of vaccination and immunotherapy.

Course Title:	Molecular Biology 3 (3-0)
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Course Code: MCB 403

Pre-requisite: Basic Biotechnology

Course Description:

Introduction to molecular biology and history; structure and function of DNA; chromatin and structure of chromosomes; protein structure and function; DNA replication in prokaryotes and eukaryotes; transcription in prokaryotes and eukaryotes;

post transcriptional processing (e.g., RNA splicing, alternative splicing, editing); genetic code; translation, post-translational processing in prokaryotes and eukaryotes; protein folding, targeting and turnover; DNA damage and repair, recombination and transposable elements. Signaling and control of gene regulation in prokaryotes and eukaryotes.

Course Learning Outcomes:

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

1. Understand the Central Dogma of molecular biology.
2. Understand gene regulation and expression in prokaryotes and eukaryotes.
3. Explain the mutations, DNA damage and repair mechanisms.

Course Title: Behavioral Sciences 2 (2-0)

Course Code: BSC 211

Pre-requisite: None

Course Description

Fundamentals of behavioral sciences, history, scope, and major theoretical perspectives, empirical research findings, psychological principles, and scientific problem-solving methods, research design, statistical procedures, APA writing, and effective communication, application of psychology to social issues, public policy, and

real-world case studies, critical analysis and ethical considerations in behavioral sciences.

Course Learning Outcomes (CLOs)

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

1. Understand key concepts, theoretical perspectives, empirical findings, and research methods in behavioral sciences, including the scientific approach to problem-solving.
2. Apply critical thinking and analytical skills to evaluate psychological literature, research studies, and statistical procedures.
3. Demonstrate effective communication skills in behavioral sciences through written and oral presentations, including APA-style writing.
4. Utilize psychological principles to address social issues and contribute to public policy, societal needs, and real-world problem-solving.

Course Title: Entrepreneurship 2 (2-0)

Course Code: MGT 363

Pre-requisite: None

Course Description

This course is designed to cultivate an entrepreneurial mindset among students, encouraging them to think critically, identify business opportunities, and transform ideas into successful ventures. It imparts essential knowledge, skills, and abilities needed to establish and manage a business. The course covers key topics such as business initiation, market research, opportunity identification, financial literacy, marketing, team building, and regulatory compliance in Pakistan.

Course Learning Outcomes (CLOs)

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

1. Demonstrate knowledge of fundamental entrepreneurial concepts, skills, and processes.
2. Understand different personal, social, and financial aspects associated with entrepreneurship.
3. Analyze regulatory requirements for setting up an enterprise in Pakistan, particularly export businesses.
4. Develop a feasible business plan by applying acquired knowledge, skills, and competencies with reference to bio tech start up

Course Title: Analytical Chemistry and Instrumentation 3 (2-1)

Course Code: ACI 210

Pre-requisite: Basic Chemistry (Introductory Level)

Course Description:

This course introduces fundamental analytical chemistry concepts and their applications in molecular-level identification and analysis. Students will learn a variety of analytical techniques, including chromatography and spectroscopy, as well as instrumentation methods used for chemical and biochemical analysis.

Course Learning Outcomes (CLOs):

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

1. Describe the principles and techniques of common analytical instruments.
2. Apply analytical methods to identify and quantify chemical/biochemical substances.
3. Interpret data obtained from analytical techniques to solve chemical problems.

Course Title: IDEOLOGY AND CONSTITUTION OF PAKISTAN 2 (2-0)

Course Code: PAK 109

Pre-requisite: PAK 105, foundational knowledge about Pakistan's history, independence movement, and governance structure before diving into its ideology and constitutional framework.

Course Description:

This course is designed to provide students with a fundamental exploration of the ideology and the constitution of Pakistan. The course focuses on the underlying principles, beliefs, and aspirations that have been instrumental in shaping the creation and development of Pakistan as a sovereign state. Moreover, the course will enable students to understand the core provisions of the Constitution of the Islamic Republic of Pakistan concerning the fundamental rights and responsibilities of Pakistani citizens to enable them function in a socially responsible manner.

Course Learning Outcomes (CLOs):

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

1. Demonstrate enhanced knowledge of the basis of the ideology of Pakistan with special reference to the contributions of the founding fathers of Pakistan.
2. Demonstrate fundamental knowledge about the constitution of

- Pakistan 1973 and its evolution with special reference to state structure.
3. Explain about the guiding principles on rights and responsibilities of Pakistani citizens as enshrined in the Constitution of Pakistan 1973.

Detailed Course Contents of Semester V

Course Codes	Title of Course	Credit hrs
BIO 301	Methods in Molecular Biology	3 (2-1)
MBT 307	Microbial Biotechnology	3 (2-1)
BSS 307	Biostatistics	3 (3-0)
BIN 305	Bioinformatics	3 (2-1)
RDT 307	Recombinant DNA Technology	3 (2-1)

Course Title: Methods in Molecular Biology 3 (2-1)**Course Code:** BIO 301**Pre-requisite:** Sound knowledge of Molecular biology and cell biology**Course Description:**

Introduction to recombinant DNA technology; restriction and modifying enzymes; cloning and expression vectors and their types; expression of recombinant proteins and their purification by affinity chromatography; polymerase chain reaction (PCR) - types; (inverse, touch-down, nested, hemi-nested, pit stop, multiplex, reverse transcriptase, RACE, real-time) and its applications; detection of mutations and/or SNPs; DNA fingerprinting; analysis of nucleic acids by gel electrophoresis – horizontal, vertical, pulse field, denaturing gradient gel electrophoresis; analysis of proteins by native and SDS-PAGE; 2-D gels; generation of antibodies and their uses; enzyme-linked immunosorbent assay; Southern, Western, Northern blotting.

Labs:

Preparation of stock and working solutions; isolation of nucleic acids and their quantification; restriction digestion of DNA and preparation of restriction maps; gel electrophoresis; polymerase chain reaction (PCR); detection of mutations by restriction fragment length polymorphism; preparation of chemically competent cells; transformation of bacteria with plasmid DNA; analysis of proteins by SDS- PAGE

Course Learning Outcomes:

Upon completion of course the students will be able to:

1. Understand fundamental molecular biology techniques.
2. Interpret experimental data from molecular biology assays.
3. Design molecular biology experiments to investigate gene function and expression.

Course Title: Microbial Biotechnology 3 (2-1)**Course Code:** MBT 307**Pre-requisite:** Microbiology basic knowledge, as well as deep understanding of biotechnology methods**Course Description:**

Issues and scope of microbial biotechnology; genetically modified microorganisms; microbes as tools for microbiological research; biotechnological potential of microbes; significance of microorganisms in food production, fermentation, pharmaceutical and other industries; vaccine development and production; microbiological mining, biofuels and use of microbes in petroleum industry; plant microbe interactions; bio-fertilizers, biopesticides, composting; antimicrobials; significance of microbial biotechnology in the

Course Learning Outcomes:

Upon completion of course the students will be able to:

1. Explain the scope and significance of microbial biotechnology in various other fields of biotechnology.
2. Apply techniques for the cultivation,

manipulation, and utilization of microorganisms to solve various environmental problems and address these solutions to community

3. Evaluate microbial metabolic pathways for biotechnological applications and their role in different industrial sectors.
4. Evaluate the economic impact of microbial biotechnology in Pakistan, including its contributions to agriculture, health, and industry

Course Title: Biostatistics 3 (3-0)
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Course Code: BSS 307

Pre-Requisite: Basic Mathematics

Course Description:

Frequency distribution, exercise frequency distribution, measures of central tendency, measures of dispersion and measures of location. Second part of the study will cover the areas of statistical hypothesis and significance, null and alternative hypothesis, confidence interval, tests involving binomial distribution, tests involving normal distribution, F-distribution, student's t-distribution, chi-square test, tests of independence and contingency tables. In the third part lectures will cover the following topics: Analysis of Variance (ANOVA), LSD test, experimental designs, Completely Randomized Design (CRD), Randomized Complete Block Design (RCBD), Latin Square Design, Markov chains and Models and their applications in Bioinformatics such as gene predication, sequence analysis, profile

HMMs, probabilistic approaches to phylogeny, etc.Text

Course Learning Outcomes:

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

1. Understand basic statistical concepts and methods used in biological research.
2. Apply statistical techniques to analyze and interpret biological data.
3. Use software tools to perform statistical analyses for experimental results.

Course Title Bioinformatics 3 (2+1)
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Course Code: BIN 305

Pre-requisite: Comprehensive understanding of Cell biology, molecular biology and techniques used in biotechnology. Students should have studied the offered courses at university, i.e., Cell biology, molecular biology and Methods in molecular biology

Course Description:

Introduction to Bio-computing; Biological databases – types, Retrieval of nucleic acid (or genomic) or protein sequence information, Sequence alignment - pairwise, multiple; phylogenetics; In silico identification of protein motifs and domains; Structural bioinformatics of proteins and RNAs including protein modeling and prediction of their interactions with other proteins and small molecules; Identification of genes and promoter regions within

genomes; networks; Strategies for whole genome sequencing and assembly.

Course Learning Outcomes:

Upon completion of course the students will be able to

1. Explain key principles of bioinformatics, including sequence alignment, database searching
2. Apply commonly used bioinformatics software for DNA, RNA, and protein sequence analysis and protein structure prediction.
3. Learn the principles, methodologies, and applications of whole genome sequencing in bioinformatics

Course Title: Recombinant DNA Technology 3(2-1)
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Course Code: RDT 307

Pre-requisite: Should have sound knowledge of Molecular Biology, Cell biology and biotechnology

Course Description:

Introduction and History of Recombinant DNA technology, Basic techniques, gel electrophoresis, Blotting techniques, restriction endonucleases, restriction mapping, vectors and their types, cloning vectors, transformations, Polymerase Chain reaction, Cloning strategies, Site-directed mutagenesis. Sequencing strategies, Application of recombinant DNA Technology (agriculture, health, industry, environment, and basic research).

Practical: DNA and plasmid isolation and agarose gel electrophoresis, conjugation,

transformation, role of mutagenic agents in mutation, Blotting techniques.

Course Learning Outcomes:

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

- Describe the principles and techniques of recombinant DNA technology.
- Design strategies for cloning, expressing, and analyzing recombinant genes.
- Evaluate the applications of genetic engineering in research and industry.

Detailed Course Contents of Semester VI

Course Codes	Title of Course	Credit hrs
BIO 408	Genomics & Proteomics	3 (3-0)
FBT 309	Food Biotechnology	3 (2-1)
AGB 308	Agriculture Biotechnology	3 (3-0)
RMS 311	Research Methodology & Skill Enhancement	3 (3-0)
PBE 305	Principles of Biochemical Engineering	3 (3-0)
ISL 112	Understanding Quran-V (Non credit Hr)	One contact hr/ week

Course Title: Genomics & Proteomics 3 (3-0)

Course Code: BIO 408

Pre-requisite: A thorough understanding of molecular biology techniques. Should have studied methods in molecular biology.

Course Description:

Organization and structure of genomes; genetic mapping (RFLP, microsatellite, SNP); flow cytometry; somatic cell and radiation hybrids; artificial chromosomes in bacteria and yeast; DNA sequencing strategies, microarray and RNA interference; proteomics; cellular communication/signaling pathways; protein-protein interactions and validation - yeast two hybrid system; gene detection, gene identification and gene expression analyses, cDNA; Real-time PCR, Protein isolation; quantification, miRNA-extraction, SDS PAGE, western blotting, Genotyping, Haplotyping, Genetic modeling, Protein Isolation, and Quantification, recombination and transformation

Course Learning Outcomes:

Upon completion of course the students will be able to:

1. Explain the principles and techniques used in genomics and proteomics.
2. Analyze genomic and proteomic data to identify gene and protein functions
3. Apply the molecular biology

techniques for genomics and proteomics.

Course Title: Food Biotechnology 3 (2+1)

Course Code: FBT 309

Pre-requisite: Biotechnology, rDNA technology.

Course Description:

Food composition, proximate analysis. Probiotics. Fermented foods, Food enzymes, colors and additives, Microbial Food spoilage and food born disease, Food preservation methods, Food engineering principles, Modified atmospheric packaging, Food marketing principles. Mathematical Modeling in food technology. Microbial biotechnology of food flavors production, oil and fats, dairy products, meat and cereal foods, Food Safety and quality control.

Practical:

Estimation of moisture, ash, carbohydrates, protein, fat, crude fiber in food, Detection of proteases, amylases in milk. Determination of iodine number of fats. Determination of specific gravity of sugar. Separation of gluten from wheat flour. Detection of E.coli in drinking water. Detection of yeast and mould in dairy and bakery products. Production of cheese.

Course Learning Outcomes (CLOs):

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

1. Explain the application of biotechnology in food production and processing.

2. Describe the principles of fermentation and bioprocessing in food technology.
3. Analyze the impact of genetically modified organisms on food safety and nutrition.

Course Title: Agriculture Biotechnology 3(3-0)

Course Code: AGB 308

Pre-requisite: Prior knowledge of Plant biology, Cell biology, biotechnology, molecular biology and rDNA technology classification and different modes of nutrition. Students should have studied relevant courses in previous years.

Course Description:

Agricultural biotechnology and its applications in crop and livestock improvement; Plant cell and plant tissue culture; Molecular markers; gene transfer methods: Agrobacterium-mediated transformation, gene gun method, chloroplast transformation, and PEG-mediated transformation; transgenic crops with herbicide and Insect resistance, Genome editing other than transgenic approach in crop improvement; genetically modified livestock; environmental impacts of GMOs; ethical, environmental, and regulatory aspects of GMOs.

Course Learning Outcomes:

Upon completion of course the students will be able to

1. Explain the principles and applications of genetic modification in crop and livestock improvement.
2. Analyze the impact of biotechnology on food security and sustainable agricultural practices.
3. Discuss the ethical and regulatory issues in agricultural biotechnology.

Course Title: Research Methodology & Skill Enhancement 3 (3-0)

Course Code: RMS 311

Pre-requisite: None

Course Description:

This course introduces students to various research methods and recent trends in biotechnology. It emphasizes reading and analyzing scientific literature, designing research projects, preparing scientific manuscripts, and presenting research findings effectively.

Course Learning Outcomes (CLOs):

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

1. Design and implement rigorous experimental protocols using advanced biotechnological techniques.
2. Analyze and interpret empirical data using statistical and computational tools.

3. Synthesize and effectively communicate research findings through scholarly reports.

Course Title: Principles of Biochemical Engineering 3 (3-0)

Course Code: PBE 305

Pre-requisite: Strong background of microbiology, biotechnology, biochemistry and molecular biology. Students should have studied Cell Biology, Biochemistry, Microbiology, Introduction to Biotechnology and Molecular Biology courses offered in prior semesters

Course Description:

Introduction to microorganisms and biological molecules, Principles of enzyme catalysis, Methods of enzyme and cell immobilization enzyme kinetics, Internal mass transfer effect on immobilized growth, Stoichiometry models of microbial growth, Continuous Stirred tank bioreactor, Plug-flow and packed bed bioreactors imperfect mixing, Fed batch bioreactors, Gas liquid mass transfer in bioreactors, Power requirement for bioreactor, Sterilization, Heat transfer in bioreactors, Introduction to bioproduct recovery, Manufacture of biological products, Economic analysis of bioprocesses, Case study Penicillin.

Course Learning Outcomes (CLOs):

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

1. Understand the principles of biochemical engineering and their role in biotechnology.

2. Explain the kinetics of enzyme-catalyzed reactions and cell growth.
3. Design bioreactors and optimize bioprocess parameters for industrial applications.

Detailed Course Contents of Semester VII

Course Codes	Title of Course	Credit hrs
IMB 404	Industrial Biotechnology	3 (2-1)
HBT 405	Health Biotechnology	3 (3-0)
BET 407	Biosafety & Bioethics	2 (2-0)
AIB 415	Artificial Intelligence in Biotechnology	2 (2-0)
	Elective – I *	3
RGS 490	Capstone	3

Course Title: Industrial Biotechnology 3 (2-1)

Course Code: IMB 404

Pre-requisite: A thorough understanding of molecular biology techniques. Should have studied methods in molecular biology, Microbiology and Principles of Biochemical Engineering.

Course Description:

Industrial biotechnology – introduction and scope; microorganisms commonly used in industry; media and nutritional requirements of industrial organisms; screening for productive strains and strain improvement; culture collections; fermentation and fermenters; extraction of fermented products; production of beer, wines, spirits and vinegar; use of single cell proteins as food products; biocatalysts; microbial insecticides; production of metabolites: organic acids and amino acids; vaccines and antibiotic production

Practical: Isolation of lactobacillus from dairy products, fruit juices, etc.; fermentation of different sugars by bacteria (or other microorganisms); identification of proteases/ amylases producing bacteria; extraction of hydrolytic crude enzymes from microbes; effect of environmental factors (e.g., pH, temperature, salt, etc.) on activity of crude enzymes.

Course Learning Outcomes:

Upon completion of course the students will be able to:

1. Understand industrial-scale bioprocesses.

2. Evaluate the use of various biocatalysts and fermentation techniques in industrial processes.

Understand the optimization and scaling up of biotechnological processes in industry.

Course Title: Health Biotechnology 3 (3-0)

Course Code: HBT 405

Pre-requisite: Biotechnology, rDNA technology.

Course Description:

Introduction to health biotechnology; social acceptance of medical biotechnology; molecular basis of disease; molecular and genetic markers; detection of mutations and infectious agents; active and passive immunization; vaccines (live, killed, recombinant DNA vaccines, subunit vaccines, DNA vaccines, edible vaccines); organ transplantation; applications of transgenic animals (animal models of diseases, farming and enhancement of farm animals); drug delivery systems; blood transfusion and grafting techniques; pharmacogenetics; gene therapy; biopharmaceuticals from plants; stem cell technology.

Course Learning Outcomes (CLOs):

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

1. Describe the role of biotechnology in the development of diagnostics and therapeutics.
2. Explain the principles of gene therapy and regenerative medicine.

3. Evaluate the ethical and regulatory issues in health biotechnology.

Course Title: Biosafety & Bioethics 2(2-0)

Course Code: BET 407

Pre-requisite: None.

Course Description:

Introduction to Biosafety - definition, concept, uses and abuses of genetic information, and biohazards; good laboratory practices; risks related to genetically modified organisms (GMO); international rules and regulations for biosafety and GMOs; introduction to bioethics; ethical issues related to GMOs; euthanasia, reproductive and cloning technologies, transplants and eugenics; patenting, commercialization and benefit sharing; role of national bioethics committees; biosafety guidelines from a national perspective.

Course Learning Outcomes:

Upon completion of course the students will be able to

1. Understand levels, protocols and regulations of biosafety and biosecurity.
2. Evaluate biosecurity measures to prevent the misuse of biotechnological advances.
3. Understand ethical considerations in biotechnology research and applications

Course Title: Artificial Intelligence in Biotechnology 2 (2-0)

Course Code: AIB 415

Pre-requisite: Basic knowledge of computer science, Bioinformatics, genomics. Or Students should have studied Applications of Information & Communication Technologies, Bioinformatics and Genomics & Proteomics Courses offered in earlier semesters

Course Description:

Role of artificial intelligence (AI) in biotechnology; basics of machine learning, supervised and unsupervised learning, neural networks; AI tools and software including Python; data preprocessing, cleaning, and feature selection for biological datasets; AI applications in genomics, and data analysis; AI in drug discovery, predictive modeling; AI in proteomics, crop genomics, and pest resistance; AI in bioremediation, and case studies on AI applications in biotechnology

Course Learning Outcomes (CLOs):

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

1. Explain the fundamental concepts of artificial intelligence and its applications in biotechnology.
2. Identify the role of artificial intelligence in various biotechnological processes and research.
3. Demonstrate an understanding of the ethical considerations related to artificial intelligence in biotechnology.

Detailed Course Contents of Semester VIII

Course Codes	Title of Course	Credit hrs
MMB 303	Nano biotechnology	3 (3-0)
EMB 403	Environmental Biotechnology	3 (2-1)
	Elective – II *	3
	Elective – III *	3
	Elective – IV *	3
ISL 114	Seerah-II (Noncredit Hr)	One contact hr/ week

Course Title: Nano biotechnology 3 (3-0)

Course Code: MMB 303

Pre-requisite: Thorough understanding of Chemistry, Biology

Course Description:

Introduction; interface between nanotechnology and bio-nanotechnology; manipulating molecules; carbon fullerenes and nanotubes; non-carbon nanotubes and fullerene-like materials; quantum dots; nanowires, nanorods nanomaterial's; and other magnetic nanoparticles; natural biological assembly at the nanoscale and nanometric biological assemblies (complexes); nanobionics and bio-inspired nanotechnology; applications of biological assemblies in nanotechnology; medical, cosmetics, agriculture, water and other applications of nano-biotechnology; future prospects of nano-biotechnology; use of nanotechnology for diagnosing and curing disease.

Course Learning Outcomes:

Upon completion of course the students will be able to:

1. Describe the fundamental principles of nanobiotechnology and its interface with biological systems.
2. Explain the methods for the synthesis, characterization, and manipulation of nanomaterials using different techniques and their application in the various fields.
3. Analyze the applications of nanobiotechnology in medicine, cosmetics, agriculture, water

treatment, and disease diagnostics.

4. Discuss the impact, future advancements, and ethical considerations of nanobiotechnology across various fields.

Course Title: Environmental Biotechnology 3 (2-1)

Course Code: EMB 403

Pre-requisite: Biotechnology, rDNA technology.

Course Description:

Introduction to environmental biotechnology; fundamentals of biological interventions; genetic manipulation strategies in environmental biotechnology; pollution indicators and pollution control strategies; bioreactors; domestic waste water treatment; industrial effluent treatment; sludge treatment; contaminated land and bioremediation; phytoremediation; landfills and composts; concept of integrated environmental biotechnology; biodegradation and biotransformation of hazardous chemicals; products environmental biotechnology.

Course Learning Outcomes (CLOs):

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

1. Describe the fundamental principles of environmental biotechnology and its role in pollution control and sustainable development.
2. Implement genetic manipulation strategies, bioreactor operations, and

biological interventions used in environmental biotechnology to address various environmental problems.

3. Analyze the potential of environmental biotechnology in wastewater treatment, bioremediation, phytoremediation, and biodegradation of hazardous chemicals.
4. Discuss the impact, future advancements, and ethical considerations of nanobiotechnology across various fields

Detailed Course Contents of Electives

Course Codes	Title of Course	Credit hrs
VIR 310	Virology	2+1
BIO 410	Cell and tissue culture	2+1
MOD 312	Molecular diagnostics	2+1
BIO 402	Biosensors	3+0
BIO 403	Water and waste water treatment	2+1
BIO 404	Hospital waste management	2+1
RAB 403	Radiobiology	2+1
EPD 410	Biofuels and bio refineries	3+0
GRC 306	Marine biotechnology	2+1
BIO 405	Animal biotechnology	2+1
BIO 406	Fungal biotechnology	2+1
BIO 407	Fermentation biotechnology	2+1
RPT 406	Pharmaceutical biotechnology	2+1

Course Title: Virology 3 (2-1)**Course Code: VIR 301****Pre-requisite:** None**Course Description:**

Provides a comprehensive overview of virology, covering virus classification, replication, pathogenesis, immune response, laboratory diagnosis, epidemiology, antiviral strategies, and emerging viral diseases. The practical component emphasizes virus detection, quantification, and diagnosis techniques.

Practical:

The practical component emphasizes virus detection, quantification, and diagnosis techniques.

Course Learning Outcomes (CLOs):

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

1. Describe the general properties, classification, and replication of viruses.
2. Analyze the pathogenesis, immune response, and epidemiology of viral infections.
3. Evaluate diagnostic techniques, antiviral therapies, and the role of viruses in gene therapy.

Course Title: Cell and Tissue Culture 3 (2-1)**Course Code: BIO 410****Pre-requisite:** None**Course Description:**

This course provides students with an in-depth understanding of the principles and applications of cell and tissue culture in life

sciences. It covers essential techniques in plant and mammalian cell culture, including sterile techniques, media preparation, cell growth, and applications in Biotechnology.

Practical:

Aseptic techniques, media preparation, sterilization, callus induction, cell suspension culture, protoplast isolation, embryo culture, micropropagation, mammalian cell culture, subculturing, cell viability assessment, cryopreservation, contamination detection, bioreactor design, and applications of cell culture.

Course Learning Outcomes (CLOs):

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

1. Understand the principles and techniques of plant and animal cell culture.
2. Apply sterile techniques and media preparation for in vitro culture.
3. Analyze the use of tissue culture techniques in genetic engineering and biotechnology.

Course Title: Molecular Diagnostics 3 (2-1)**Course Code: MOD 312****Pre-requisite:** Basic molecular biology**Course Description:**

Introduction and applications of molecular diagnostics techniques in agriculture and forensic sciences; polymerase chain reaction (PCR); detection of mutations and single nucleotide polymorphisms (SNPs) by restriction fragment length polymorphisms (RFLPs); blotting techniques (e.g., Southern, Northern and Western); enzyme-linked

immunosorbent assays (ELISA); immunofluorescence staining and immunohistochemistry; micro-arrays; in situ hybridization; molecular cytogenetics

Practical:

Primer designing, Polymerase chain reaction (PCR); detection of mutations and single nucleotide polymorphisms (SNPs) by restriction fragment length polymorphisms (RFLPs); blotting techniques (e.g., Southern, Northern and Western); enzyme-linked immunosorbent assays (ELISA); immunofluorescence staining, Visits to various diagnostic, pathology laboratories and/or research institutes.

Course Learning Outcomes (CLOs):

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

1. Explain the principles and applications of molecular diagnostic techniques in agriculture and forensic sciences, including PCR, blotting techniques, ELISA, immunohistochemistry, and microarrays.
2. Apply molecular techniques such as PCR, RFLP, and blotting methods for the detection of genetic variations, mutations, and disease markers.
3. Demonstrate competency in laboratory techniques related to molecular diagnostics, including primer designing, immunofluorescence staining, and enzyme-based assays.
4. Evaluate the significance of molecular cytogenetics and in situ hybridization in genetic analysis and disease diagnostics.

Course Title: Biosensors 3 (3-0)

Course Code: BIO 402

Pre-requisite: None

Course Description:

This course provides a comprehensive introduction to biosensors, its principles, types, and applications in biotechnology and healthcare, focusing on optical, electrochemical, and enzyme-based detection methods. It explores miniaturization, surface plasmon resonance (SPR), and piezoelectric biosensors for diagnostics and industrial use.

Course Learning Outcomes (CLOs):

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

1. Understand the principles of biosensors and their various detection mechanisms.
2. Analyze different types of biosensors, including optical, electrical, and enzymatic sensors.
3. Evaluate real-world applications of biosensors in biotechnology, healthcare, and environmental monitoring.

Course Title: Water and Waste Water Treatment 3 (2-1)

Course Code: BIO 403

Pre-requisite: Students must have studied prior courses and have knowledge of Biotechnological process

Course Description:

Water and wastewater sources and characteristics; drinking water treatment process; industrial effluent treatment

process; novel treatment processes and recycling technology; theory and application of commonly used processes; sedimentation, coagulation, filtration, disinfection, gas transfer, activated sludge, trickling filters, oxidation ponds, sorption, and sludge stabilization and disposal; process combinations to produce treatment systems; role of microorganisms in waste treatment; utilization and management of waste; microbial characterization.

Practical:

Designing individual aerobic and anaerobic unit processes; physicochemical characteristics of drinking water and waste water; analytical analysis of drinking and waste water for detecting heavy metals and minerals.

Course Learning Outcomes (CLOs):

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

1. Explain the sources, characteristics, and treatment processes of water, wastewater, and hazardous waste.
2. Describe the principles and applications of drinking water and industrial effluent treatment processes and apply these techniques to solve environmental problems.
3. Analyze the role of microorganisms in waste treatment, including microbial processes in different treatment strategies to solve the global pollution problems
4. Evaluate novel treatment technologies and recycling processes for sustainable waste management.

Course Title: Hospital Waste Management 3 (2-1)

Course Code: BIO 404

Pre-requisite: Prior knowledge of hospital environment and Biosafety

Course Description:

An introduction to the management of infectious materials/waste; various types of infectious material and methods of their handling and disposal; laboratory and hospital acquired infections - possible sources and causes; hazardous microorganisms; basic containment rules and laboratory contamination levels, control measures; guidelines for workers in microbiology and pathology labs, and post-mortem rooms; rules for safe conduct during field work and outdoor activities; risk assessment including recognition of hazards; competence and elimination of hazards; collection of data, etc.; risk group personnel and their education, training and monitoring; radiation hazards and disposal of radioactive waste.

Practical:

Techniques for waste minimization; waste sorting; anaerobic and aerobic composting; industrial and hospital waste treatment processes.

Course Learning Outcomes (CLOs):

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

1. Identify types of infectious and hazardous hospital waste, their sources, and associated health risks.
2. Explain safe handling, containment, and disposal methods for hospital waste following regulatory guidelines

and communicate these guidelines with the society

3. Apply risk assessment strategies and control measures to minimize contamination and occupational hazards which can affect population.
4. Evaluate the role of education, training, and monitoring in effective hospital waste management and control spread of various environmental hazards.

Course Title: Radiobiology 3 (2-1)

Course Code: RAB 403

Pre-requisite: Students should have knowledge of physics and have studied Biophysics offered in earlier years

Course Description:

Introduction to radiobiology, radioisotopes and types and sources of radiation; physics of radioactive substances; effects of radiation on living cells; exposure and radiation dose-effect; molecular basis of cellular effects and cell radiation sensitivity; radiation therapy, radiation protection, safety measures and treatment of radiation injuries; fundamental aspects and relationship of imaging physics and radiobiology including current regulation and recommendations in radiation biology, use of radioisotopes as diagnostic and therapeutic tools.

Practical:

Principles, applications, and safety aspects of radiobiology using X-ray, MRI, CT scan, ultrasound, and radiation therapy. Students will observe medical imaging techniques, radiation effects on tissues, protective measures, and clinical applications in diagnostics and treatment within a hospital setting.

Course Learning Outcomes (CLOs):

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

1. Explain the fundamental principles of radiobiology, radioisotopes, types of radiation, and their sources.
2. Analyze the radiation dose-effect on living cells to apply radiations in therapy and diagnostic imaging.
3. Evaluate the applications of considering current safety regulations and recommendations.

Course Title: Biofuels and Bio Refineries 3 (3-0)

Course Code: EPD 410

Pre-requisite: Students should have knowledge of microbiology and have studied major biotechnology courses offered in earlier years

Course Description:

Biofuels - introduction, types and sources; agro-industrial byproducts and biodegradable materials; genomics of biofuels; metabolic engineering; biorefineries; biobased industrial products; basics of green bio-refineries; agriculture, forestry and primary refinery raw material; lingo-cellulosic feedstock bio-refinery; whole-crop bio-refinery based on wet/dry milling and products from whole-crop bio-refinery; fundamental sugar platform and syngas platform.

Course Learning Outcomes (CLOs):

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

1. Describe the types, sources, and production processes of biofuels.
2. Analyze the role of genomics, metabolic engineering, and biorefineries in biofuel production to mitigate different environmental problems.
3. Evaluate different biorefinery models and their industrial applications to develop new problem solving strategies.
4. Assess the sustainability and environmental impact of biofuels and demonstrate its potential to solve various global pollution challenges.

Course Title: Marine Biotechnology 3 (2-1)

Course Code: GRC 306

Pre-requisite: Students must have studied prior courses and have knowledge of Biotechnological process

Course Description:

Introduction to marine microorganisms and marine biotechnology; flora/phytoplankton; techniques; marine microbes marine aquaculture of biotechnological importance; primary and secondary metabolites (e.g., antibiotics, organic acids, toxins, etc); role of marine microbes in global carbon cycling; genomics of marine organisms; recent progress in discovery of drugs and enzymes from marine sources.

Practical:

Mangroove field trip, study of marine ecology. Biochemical estimation of marine seaweeds/ fish/ fish waste/ shellfish and shell fish waste. Estimation of chitin in crustacean. Exploitation of biotechnological marine products.

Course Learning Outcomes (CLOs):

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

1. Describe the diversity, characteristics, and biotechnological significance of different marine species and marine microorganisms.
2. Apply molecular techniques to study marine organisms and their applications in various fields of biotechnology.
3. Analyze the role of marine microbes in global carbon cycling and the production of primary and secondary metabolites.
4. Evaluate recent advancements in marine biotechnology, including drug discovery, enzyme production, and marine aquaculture innovations and their potential to solve many biotechnological problems.

Course Title: Animal Biotechnology 3 (2-1)

Course Code: BIO 405

Pre-requisite: Prior knowledge of Cell biology, biotechnology, molecular biology and rDNA technology. Students should have studied relevant courses in previous years.

Course Description:

Introduction and history of transgenic animals; role of synthetic peptides/proteins in animal health; use of monoclonal antibodies as a diagnostic/therapeutic agents; cytokines and their potential therapeutic value as applicable to the diagnosis of microbial infections; micromanipulations of farm animal embryos; use of biotechnological techniques in animal breeding strategies; gene transfer through

embryo microinjection; ethical and social issues in animal biotechnology.

Practical:

Aquaculture methods and various DNA recombinant techniques for animal biotechnology.

Course Learning Outcomes (CLOs):

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

1. Explain the principles and techniques of transgenic animal production, including gene transfer methods and embryo micromanipulations.
2. Analyze the applications of animals and transgenic animals in biotechnology, focusing on their role in medicine, and research.
3. Evaluate the ethical, social, and regulatory considerations related to transgenic animal technology.

Course Title: Fungal Biotechnology 3 (2-1)

Course Code: BIO 406

Pre-requisite: Prior knowledge of microbes and fungal species and different biotechnology process. Students should have studied relevant courses in previous years.

Course Description:

Introduction to mycology; production techniques used in fungal biotechnology; metabolites produced by fungi; utilization of fungi in medical and agricultural biotechnology; industrial uses of fungi including food deterioration manufacturing; and bio- biodegradation; biotechnology and the control of pathogenic fungi; current applications of fungal biotechnology and screening of fungal metabolites; mycotoxins.

Practical:

Fungal morphology; identification of fungi; sexual and asexual reproductive structures of fungi; DNA extraction from hyphae and zoospores; molecular techniques for detecting genetic variations among different fungi.

Course Learning Outcomes (CLOs):

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

1. Describe the diversity, characteristics, and industrial significance of fungi in different fields of biotechnology.
2. Analyze fungal metabolites and their applications in medical, agricultural, and industrial biotechnology and formulate different process to solve Biotechnological problems.
3. Evaluate production techniques and biotechnological processes used in fungal biotechnology, and apply new techniques to develop beneficial products.
4. Assess strategies for controlling pathogenic fungi and mitigating mycotoxin contamination in agriculture and food industries.

Course Title: Pharmaceutical Biotechnology 3 (2-1)

Course Code: RPT 406

Pre-requisite: Students must have studied prior courses and have knowledge of Biotechnological process

Course Description:

Introduction and basic concepts of pharmaceutical biotechnology; properties of an effective drug; drug development process; selection of a lead molecule from available pool, lab-scale studies, pilot scale studies and clinical trials (Phase I, II and III); drug toxicity;

impact of genomics and other related technologies on drug discovery; use of DNA and protein microarrays in identification of disease targets and for monitoring effectiveness of drugs; pharmacogenomics; plants and microorganisms as sources of drugs; polymers: classification, polymerization and characterization; controlled drug release system and its advantages and disadvantages over conventional release methods; legal and regulatory issues.

Practical:

The labs will focus on laboratory safety, physicochemical characterization, drug design, bioactive compound extraction, formulation and stability testing, cytotoxicity assays, cell culture, protein microarrays, pharmacogenomics, controlled drug release, nanoparticle drug delivery, endotoxin detection, regulatory testing, and case studies on biopharmaceuticals.

Course Learning Outcomes (CLOs):

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

1. Describe the fundamentals of pharmaceuticals, biologics, and biopharmaceuticals, including their history, development, and regulatory framework.
2. Explain the key stages of drug development, including pharmacogenetics, preclinical studies, pharmacokinetics, pharmacodynamics, and regulatory approval processes.
3. Analyze upstream and downstream processing techniques for biopharmaceutical production, purification, and final product formulation.

4. Evaluate product quality, potency, and safety through immunological detection of contaminants, endotoxin testing, and metabolic studies in animal models.

Course Title: Fermentation Biotechnology 3 (2-1)

Course Code: BIO 406

Pre-requisite: Prior knowledge of microbes, fermentation technology and different biotechnology process. Students should have studied relevant courses in previous years.

Course Description:

Overview of fermentation technology: definition, economics, applications; strain development and improvement: isolation of microorganisms - plating, criteria for selection and improvement through genetic engineering; growth requirement of various organisms and stoichiometry of media preparation; microbial growth; preparation of inoculum; microbial growth kinetics in batch culture; continuous culture; sterilization: modes & kinetics of sterilization, design of batch and continuous sterilization process, air sterilization & theory of fibrous filters; fluid rheology: classification, Newtonian & non-Newtonian factors effecting KLa in fermentation vessel; design of bioreactors and configuration for free and immobilized cells; waste treatment; tissue engineering for plant and animal cell cultures; aeration and agitation; product recovery; scaling-up of fermentation process.

Practical:

Initiation of a bacterial/plant or animal cell/tissue culture in a simple conical flask or in a fermenter depending on availability and

its handling according to the techniques introduced in theory as sterilization, media formulation, growth kinetics, product recovery etc.

Course Learning Outcomes (CLOs):

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

1. Demonstrate the principles, applications, and economic significance of fermentation technology.
2. Analyze strain development techniques, microbial growth kinetics, and media preparation for fermentation processes.
3. Evaluate sterilization techniques, fluid rheology, aeration, and agitation in bioreactors for optimal fermentation.
4. Assess bioreactor design, scale-up strategies, product recovery, and waste treatment in fermentation-based industries.



BS-MLT



MEDICAL LAB TECHNOLOGY PROGRAM MISSION:

The mission of the medical technology program is to prepare allied health sciences professionals equipped with knowledge, skills, and innovative research expertise, attained in a collegiate environment supported through national and international linkages, for provision of high quality



PROGRAM EDUCATIONAL OBJECTIVES:

- To prepare a team of health technologists who can effectively assist senior health professionals in the delivery of quality health services.

- To prepare graduate medical technologists with the knowledge and abilities needed for certification by nationally recognized professional agencies
- To prepare paramedical workers for all levels of the health care delivery system from primary to tertiary level.
- To introduce and impart standard technical education with advanced techniques by replacing the conventional methods of pre-service training (certificate level).
- To provide paramedical workers a status and recognition in the health care delivery system through improving their capacity along with increasing awareness of their responsibilities, authority and job description.
- To facilitate paramedical staff with modern skills and techniques and latest technical knowledge of international level

PROGRAM LEARNING OUTCOMES (PLOs)

1. **Knowledge & Lab Skills:**
Graduates will possess basic knowledge, skills, and relevant experiences in communication to enable consultative interactions with members of the healthcare team, external relations, customer service and patient education.

2. **Communication and Inter Personal Skills:** Graduates will be able to deal efficiently with all departments including financial, operations, marketing, and human resource management of the clinical laboratory to enable cost-effective, high-quality, value-added laboratory service.
3. **Technical & Lab Skills:** Graduates will be able to deliver the services in performing the full range of clinical laboratory tests in areas such as hematology, clinical chemistry, immunohematology, microbiology, serology/immunology, coagulation, molecular, and other emerging diagnostics.
Professionalism and Ethics: Graduates will have diverse responsibilities in areas of analysis and clinical decision-making, regulatory compliance with applicable regulations, education, and quality assurance/performance improvement wherever laboratory testing is, developed or performed.
4. **Critical Thinking & Problem Solving:** Graduates will also be able to do effective, timely, accurate, and cost-effective reporting of laboratory-generated information, Research design/practice sufficient to evaluate published

studies as an informed consumer.

5. **Career and Professional Development:** Graduates will be prepared as proficient medical professionals that work with physicians and other members of the healthcare team, preparing specimens and analyzing blood and other body fluids to diagnose and detect disease.



THE BUCAHS AIMS TO REALIZE THIS MISSION BY:

- Training the health sector workforce of the future
- Conducting research that creates new knowledge in the field of health sciences and reviews improvement in existing bodies of knowledge.
- Providing innovative, patient-oriented health care
Contributing to the economic development and wellbeing of Pakistan through integrated programs in education, research and clinical care



RATIONALE

Medical technologists are vital members of the health care team. Doctors make many of their decisions about diagnosis and treatment of disease based on laboratory test results and about 70 percent of treatment decisions are based on these results. By this, the graduate medical technologist will be prepared with the knowledge and abilities needed for certification by nationally recognized professional agencies. With the help of this undergraduate program, highly trained professionals will be developed who can utilize proven technology to provide life-saving medical information used to treat patients.

This program will provide excellent opportunity to technicians already working in clinical laboratories and hospitals to establish their career as medical technologist and can earn a respectable salary.

This program will provide a career path to the students and laboratory professionals with advanced research opportunities as scientists, which can boost their professional career and enhances the promotion chances up till senior and supervisor level.

This program will also enable the medical college to fully utilize its preexisting resources like multidisciplinary research laboratory in undergraduate teaching as well.

This program will develop conscientious, caring, skilled professionals that are highly capable of comprehending, practicing medical technology to meet challenges healthcare needs of the society.

FUTURE CARRER PROSPECTUS

This program provides excellent career opportunities students with a quality learning experience and development of expertise in technological practices required for professional clinical laboratory scientist.

Upon completing the degree, graduates will be qualified to work as a medical technologist in

- ❖ Hospitals
- ❖ Diagnostic laboratories
- ❖ Research laboratories
- ❖ Physician's Office
- ❖ Universities

This program will provide a career path to the students and lab workers with advanced research opportunities as

scientists, which can boost their professional career and enhances the promotion chances up to senior and supervisor level.

This program will provide excellent opportunity to technicians already working in clinical laboratories and hospitals to establish their career as medical technologist and secure attractive career prospects.

BS MLT Road Map Aligned with HEC UEP Policy

Year	Semester	Course Codes	Title of Course	Credit hrs
1 st year	I	MBC 103	Medical Biochemistry -I	2 + 1
		HAT 111	Human Anatomy	2 + 1
		ENG 106	English -I	3 + 0
		PAK 105	Pakistan Studies	2 + 0
		MAS 102	Mathematics – I (pre-calculus)	3+0
		IMB 405	Introduction to Medical Lab Technology	2+1
		ISL 107	Tajweed	One contact Hr/ week
	II	MBC 107	Medical Biochemistry -II	3 + 1
		HPH 131	Human Physiology-I	2 + 1
		BMA 106	Biomathematics	3+0
		HSS 219	Civic and Community Engagement	2+0
		ENG 118	English -II	3 + 0
		IST 101	Islamic Studies	2 + 0
		ISL 108	Understanding Quran - I	One contact hr/ week
2 nd year	III	BSC 211	Behavioral Sciences	2+0
		ICT 201	Applications of Information and Communication Technologies (ICT)	2+1
		HSS 330	Physical Education and Sports	2+0
		HPH 132	Human Physiology-II	2 + 1
		GPT 111	General Pathology-I	2+1
		GPH 202	General Pharmacology	2+1
		ISL 109	Understanding Quran-II	One contact hr/ week
	IV	MGT 363	Entrepreneurship	2+0
		BSS 307	Biostatistics	2+1
		HMT 202	Hematology - I	2+1
		MLI 306	Medical Lab Instrumentation	2+1
		DMB 204	Diagnostic Microbiology-I	2+1
		BTC 305	Biotechnology	2+1
		ISL 110	Understanding Quran-III	One contact hr/ week
	V	HGN 203	Human Genetics	2+1
		GPT 205	General Pathology-II	2+1
		DMB 207	Diagnostic Microbiology-II	2+1
		HMT 208	Hematology -II	2+1

3rd year		CVM 210	Clinical Virology and Mycology	2+1
		ISL 111	Understanding Quran-IV	One contact hr/ week
	VI	RMT 309	Research Methodology	2+1
		WPD 301	WBCS and Platelets Disorders	2+1
		CPS 303	Clinical Parasitology	2+1
		CPT 304	Clinical Pathology	2+1
			Elective 1	2+1
		CPT 209	Chemical Pathology	2+1
		ISL 112	Understanding Quran-V	One contact hr/ week
4th year	VII		Elective 2	2+1
		IAS 308	Immunology and serology	2+1
		BLB 310	Blood Banking	2+1
		MLM 401	Medical Laboratory Management Skills	2+1
		FYP 401	Final Year Project	3+0
		ISL 113	Seerah-I	One contact hr/ week
	VIII		Elective 3	2+1
			Elective 4	2+1
		SDB 405	Systematic Diagnostic Bacteriology	2+1
		CAC 406	Cytology and Cytogenetic	2+1
		BIN 410	Bioinformatics	1+1
		INT 407	Internship	3+0
		ISL 114	Seerah-II	One contact hr/ week

Detailed Course Contents of Semester I

Course Codes	Title of Course	Credit hrs
MBC 103	Medical Biochemistry -I	2 + 1
HAT 111	Human Anatomy	2 + 1
ENG 106	English -I	3 + 0
PAK 105	Pakistan Studies	2 + 0
MAS 102	Mathematics – I (pre-calculus)	3+0
IMB 405	Introduction to Medical Lab Technology	2+1

Course Title: Medical Biochemistry I 3 (2 + 1)**Course Code:** MBC 103**Pre-requisite:** Intermediate**Course Contents:**

Biochemical composition and functions of the cell membrane; Chemistry of signals and receptors; Structure and function of Carbohydrates, Proteins and lipids; biochemical functions of vitamins; biochemical function of Sodium, potassium, chloride, calcium, phosphorus, magnesium, sulfur, iodine and fluoride; Composition and function of saliva, gastric juice, gastric acid (HCL), pancreatic juice, bile and intestinal secretion; Digestion and absorption of proteins, carbohydrates, lipids, vitamins and minerals; Body buffers and their mechanism of action; Acid base regulation in human body; Biochemical mechanisms for control of water and electrolyte balance; Mechanism of action of hormones.

Practical:

1. Good laboratory Practices
2. Preparation of Solutions
3. Principles of Biochemistry analyzers (spectrophotometer, flame photometer)
4. Determination of Cholesterol, TG, HDL, LDL, sugar, calcium and phosphorus in blood
5. SOP of centrifuge, water bath and microscope

Course Learning Outcomes:

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

After completion of the course students are expected to be able to:

1. Explain the synthesis of carbohydrates and their role in metabolic pathway with their regulation.
2. Explain the synthesis of proteins and their role in metabolic pathways along with their regulation.
3. Describe the synthesis of lipids and their role in metabolic pathways along with their regulation.
4. Describe the synthesis of nucleic acids and their role in metabolic pathways along with their regulation.
5. Describe the acid-base balance, electrolytes balance and significance of vitamins and minerals

Course Title: Human Anatomy 3 (2 + 1)**Course Code:** HAT 111

Pre-requisite: Students of 1st year MLT should have basic understanding of the following concepts:

1. Basic Biology and Human Body Structure
 2. Medical Terminologies
 3. Basic Histology
- Basic use of microscopes for tissue identification

Course Description:

This foundational course delves into the gross and microscopic anatomy of the human body, focusing on systems pertinent to medical laboratory technology. Students will explore the structural organization of various body systems, understand the relationships between different anatomical structures, and correlate these with their physiological functions. The course integrates theoretical knowledge with practical applications, preparing students for

advanced studies in medical laboratory diagnostics.

Course Learning Outcomes:

1. Explain the basic knowledge of human anatomy and physiology, defines anatomy.
2. Define the main structures composing human body, relates structure and functions of tissue structure and functions of sense organs
3. Explain endocrine system, skeletal system, properties of digestive and excretory systems, lists organs of digestive system, importance of excretory system, and recognizes organs of excretory system, properties of circulatory and respiratory systems, lists organs of circulatory system, and explains structure and functions of heart
4. Defines structure and functions of joints, explains properties of bone tissue nervous system and sense organs, categorizes nervous system, and recognizes cells of nervous system.

Course Title: English I 3 (3 + 0)

Course Code: ENG 106

Pre-requisite: Intermediate

Course Description:

This course provides an understanding of Basics of Grammar including: Parts of speech and use of articles, Sentence structure, active and passive voice, Practice in unified sentence, Analysis of phrase, clause and sentence structure, Transitive and intransitive verbs, Punctuation and spelling. Comprehension: Answers to questions on a given text. Discussion General topics and every-day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students). Listening to be improved by showing

documentaries/films carefully selected by subject teachers. Translation skills Urdu to English Paragraph writing. Presentation skills

Course Learning Outcomes (CLOs):

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

1. Enhance language skills and develop critical thinking.
2. improve listening and reading & writing skills in English
3. Be able to communicate in written and oral English with peers and national and international community.

Course Title: Pak Studies 2 (2 + 0)

Course Code: PAK 105

Pre-requisite: Intermediate

Course Description:

This course is designed to provide students with a comprehensive exploration of Pakistan's Identity, spanning geographical, historical, and cultural dimensions. It delves into the diverse landscapes, ancient civilizations, and rich cultural heritage that define Pakistan. Moreover, it examines the socio-cultural and political transformations in Pakistan over time including democratic transitions and military intervention. The aim of this course is to inculcate in students a nuanced understanding of Pakistan's past, present, and potential future trajectories, enabling them to critically evaluate the complex dynamics shaping the nation's development.

Course Learning Outcomes (CLOs):

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

1. Have enhanced knowledge of the geographical, historical, and political aspects of Pakistan.

2. Understand the society and culture of Pakistan.
3. Understand and explain the socio-economic development in Pakistan.
4. Explore contemporary issues and challenges faced by Pakistan and their implications for the future.

**Course Title: Mathematics-I (per calculus)
(Quantitative Reasoning I Category) 3 (3 +0)**

Course Code: MAS 102

Pre-requisite: Intermediate

Course Description:

This course provides an understanding of Algebra: Linear equations: formation, solving techniques and applications in biological contexts. Quadratic equations: solutions via factorization, completing the square, and the quadratic formula; interpreting quadratic models in biology. Introduction to polynomials: Graphing polynomials; understanding symmetry in polynomial functions. Matrices: Introduction to matrices, Types of matrices, operations of matrices, Determinants, Inverse of matrices, System of linear equations, Cramer's Rule.

Quadratic Equation: Solution of quadratic equations, qualitative analysis of roots of a quadratic equations, equations reducible to quadratic equations, cube root of unity, relation between roots and coefficient of quadratic equations. Sequence and series: Definition of sequences and series, Types of sequences (arithmetic, geometric, recursive, and special sequences), Arithmetic progression, geometric progression, Applications in biological growth models (e.g., linear growth in cell cultures), Decay processes in biological systems. Binomial theorem: Introduction to mathematical induction,

binomial theorem with rational and irrational indices. Trigonometry:

Fundamentals of trigonometry, trigonometric identities.

Course Learning Outcomes (CLOs):

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

1. Apply Fundamental Mathematical Concepts in Medical Lab Technology
2. Demonstrate proficiency in algebra to solve lab problems.
3. Analyze and interpret biological data using mathematical techniques.
4. Enhance Problem-Solving Abilities Through Mathematical Applications

Course Title: IMB-105 INTRODUCTION TO MEDICAL LAB TECHNOLOGY 3 (2+1)

Course Code: IMB-405

Prerequisite: NIL

Course Description:

Definition, history and scope of medical laboratory technology, Roles and responsibilities of medical laboratory technologists, types of laboratory tests and procedures, Laboratory safety and quality assurance. Laboratory Safety and Quality Assurance, Laboratory Safety Protocols and Procedures, Strategies for improving laboratory safety and quality assurance, Laboratory Equipment and Instrumentation, Microscopes and microscopy techniques, Centrifuges and centrifugation techniques, Calibration and validation of laboratory equipment, Analyzers and automated testing systems, Point-of-care testing devices and equipment, Types of laboratory tests and procedures, Hematology Clinical

chemistry Microbiology Immunology tests and procedures, Pipetting and measuring techniques, Blood Cell Morphology Complete blood counts (CBCs) and blood smear analysis Blood glucose and lipid profiles, Liver function tests (LFTs) and kidney function tests (KFTs) Analyzers and automated testing systems, Spectrophotometers and chromatography systems Cultures and antibiotic susceptibility testing, Serological tests and molecular diagnostics, Laboratory information systems and components Laboratory management and administration, Ethics and professionalism in medical laboratory technology Case studies in medical laboratory technology

PRACTICALS: Collection of blood samples, types of collection tubes, Phlebotomy Techniques, Slide preparations and staining techniques, Working on various instruments used, laboratory process in medical lab, Demonstration of maintenance, equipments and reagents, Sample format for reporting test results, Introductory Lesson Note on Pipetting, Demonstration of automation of clinical Hematology laboratory, Demonstration of automation of clinical biochemistry laboratory, Demonstration of policies and procedures for infection controls, Patients Preparation for Various test, Visual Training (Working principle of spectrophotometer), Lab acquired infections and prevention

Course Learning Outcomes:

By the end of course student will be able to,

1. Define the role and scope of medical lab technology in health
2. Explain the fundamental principles of laboratory testing including specimen

collection, processing and analysis with special reference to phlebotomy.

3. Describe the different types of laboratory tests, including hematology, clinical chemistry, microbiology and immunology and safely practice in a healthcare laboratory setting.
4. Evaluate the impact of lab tests on patient care and treatment

Detailed Course Contents of Semester II

MBC 107	Medical Biochemistry -II	3 + 1
HPH 131	Human Physiology	2 + 1
BMA 106	Biomathematics	3+0
HSS 219	Civic and Community Engagement	2+0
ENG 118	English -II	3 + 0
IST 101	Islamic Studies	2 + 0

Course Title: Medical Biochemistry-II 4 (3 +1)

Course Code: MBC 107

Course Description:

Balance food, Major food groups, Nutritional status of Pakistani nation, Metabolic changes in starvation, Protein energy malnutrition, Regulation of food intake, Obesity; metabolism of carbohydrates (Citric Acid Cycle, Glycolysis, Pentose Phosphate Pathway), proteins (urea and corie cycle), nucleotides (uric acid formation) and lipids (beta oxidation); Respiratory chain and oxidative phosphorylation, components of respiratory chain, electron carriers, ATP synthesis coupled with electron flow, phosphorylation of ADP coupled to electron transfer; clinical diagnostic enzymology: clinical significance of ALT, AST, ALP, LDH, CK, CKMB, Pancreatic lipase and amylase, cholinesterase, G6PD, GGT.

Practical:

- Determination of liver, cardiac, pancreatic enzymes
- Determination of urea and uric acid.

Course Learning Outcomes:

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

1. To understand the metabolism of carbohydrates, lipids and proteins.
2. To understand clinical role of enzymes in human being.
3. To understand about the nutrition.

Course Title: Human Physiology-I 3 (2+1)

Course Code: HPH 131

Pre-requisite: The BS MLT students are expected to have a basic

understanding of the organs of the body

Course Description:

The course focuses on providing basic knowledge of the normal functioning of the human body. The students are expected to understand the normal functional organization of the human body, as well as to correlate it with the medical lab diagnostic studies that will be explored later. The physiology laboratory is also very well equipped with the latest and modern gadgets, apparatus and instruments which will further help the process of opening gateways of learning new medical lab technology.

Course Learning Outcomes:

1. Have an enhanced knowledge and appreciation of human physiology, understand the functions of important physiological systems including the cardio-respiratory, renal, reproductive and metabolic systems.
2. Understand how these separate systems interact to yield integrated physiological responses to challenges such as exercise, fasting and ascent to high altitude, and how they can sometimes fail.
3. Be able to perform, analyze and report on experiments and observations in physiology.
4. Be able to recognize and identify principal tissue structures

Course Title: Bio-Mathematics 3 (3-0)

reasoning to enhance research in biotechnology and related fields.

Course Code: BMA-106**Pre-requisite: Mathematics****Course Description**

- The objective of this course is to provide students with the essential concepts of biomathematics and how these can be employed for analyzing real data.
- Fundamental mathematical concepts, including algebra, calculus, probability, and statistics, relevant to biotechnological applications. Apply mathematical models to understand biological systems, such as enzyme kinetics, genetic inheritance, and population dynamics. Develop the ability to present mathematical concepts, calculations, and statistical analyses clearly in written, oral, and visual formats. Use appropriate mathematical language, graphs, and computational tools to communicate findings to both scientific and non-scientific audiences. Utilize mathematical techniques to analyze experimental data, model biological processes, and solve quantitative problems in biotechnology. Apply statistical methods for hypothesis testing, data interpretation, and decision-making in biotechnological research. Integrate mathematical reasoning and scientific literacy to develop solutions for complex biotechnological challenges.
- Use computational tools, modeling techniques, and quantitative

Course Learning Outcomes

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

1. Understand of Mathematical Principles in Medical Lab Technology
2. Effective Communication of Mathematical and Medical Lab technological Biotechnological Data
3. Application of Mathematical and Analytical Skills in lab Research
4. Designing and Formulating Biotechnological Solutions Using Mathematical Literacy

Course Title: Civic and Community Engagement 2 (2-0)**Course Code: HSS-219 2 (2-0)****Pre-requisite: None****Course Description**

This course provides fundamental knowledge about civics, citizenship, and community engagement. Students will explore civil society, government structure, civic responsibilities, inclusivity, and effective methods of participation in shaping society. The course aims to connect theoretical knowledge with real-world applications, empowering students to positively impact their communities.

Course Learning Outcomes (CLOs)

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

1. Demonstrate a fundamental understanding of civics, government, citizenship, and civil society.

2. Understand the concept of community and recognize the significance of community engagement.
3. Recognize the importance of diversity and inclusivity for societal harmony and peaceful coexistence.

Course Title: English-II 3 (3-0)

Course Code: ENG 118

Course Description:

This course is designed to enhance students' proficiency in written and spoken communication through practical exercises and theoretical understanding. The writing component focuses on crafting professional CVs, job applications, technical reports, essays, letters, memos, and meeting minutes. Students will also develop skills in transforming narratives, analyzing visual data, mastering active and passive voice, and refining their understanding of phrases, clauses, punctuation, and tenses. The speaking module includes group discussions, individual presentations, and role-play activities to improve fluency and confidence. The listening component incorporates documentaries, movies, and online resources to enhance comprehension and pronunciation. Additionally, students will learn to effectively utilize library and internet resources for academic and professional research. This course provides a comprehensive approach to developing strong communication skills essential for academic and professional success.

Course Content:

Writing Skill: CV and job application, Technical Report writing, Writing styles, Changing narration: Converting a dialogue into a report, Converting a story into a news report, Converting a graph or picture into a short report or story, Active and Passive voice, Letter / memo writing and minutes of the meeting, use of library and internet resources, Essay writing, Phrases - Types and functions, Clauses - Types and functions, Punctuation: Tenses - Types, Structure, Function, Conversion into negative and interrogative.

Speaking Skill: Group Discussion (Various topics given by the teacher), Presentation by the students (individually), Role Play Activities for improving Speaking.

Listening Skill: Listening Various Documentaries, Movies, and online listening activities to improve the listening as well as pronunciation of the words.

Course Learning Outcomes (CLOs):

At the end of the program, students will be able to

1. Demonstrate the ability to write CVs, job applications, technical reports, essays, letters, and meeting minutes with appropriate structure, coherence, and professional style.
2. Apply grammar concepts, including tenses, phrases, clauses, narration, active and passive voice, and punctuation, to construct grammatically accurate and meaningful sentences.
3. Convert dialogues, stories, graphs, and images into structured reports or news articles, showcasing critical thinking and data interpretation skills.

4. Utilize formal writing styles, memo writing, and communication techniques for academic and professional purposes, including the effective use of library and internet resources.

5. Engage in group discussions, role-play activities, and presentations to enhance fluency, pronunciation, and confidence while improving listening comprehension through documentaries, movies, and online materials.

6. Analyze and interpret various forms of information, applying appropriate language, tone, and style in professional, academic, and social contexts for clear and effective communication.

7. Employ appropriate writing styles, documentation methods, and formal communication techniques for academic research, professional correspondence, and laboratory documentation, including memos and the effective use of scientific resources.

Course Title: Islamic Studies 2 (2-0)

Course Code: ISL 101

Course Description:

The course introduces students to the Holy Quran and Sunnah. It also includes Quranic Arabic vocabulary and basic grammar. This course provides insight about Deen, Ibadah, and Halaal o Haraam. Selected verses from the Holy Quran and Hadeeth have been included. It also includes brief history of

Prophet PBUH and impact of his life on humanity. It includes the significance and importance of Muslim scientists and their role in various scientific fields. The course will give a clear vision to students regarding economic, political, and social system of Islam. The designed course also encompasses the topic of Islamic culture and civilization

Course Learning Outcomes:

1. Upon completion of the course, students will be able to:
2. Understand with clarity the Islamic concepts in the guidance of the Holy Quran and Sunnah
3. Understand the Islamic Ideology and its deep link with our lives. With understanding of basic Arabic grammar.
4. Understand the way of Islam: Beliefs and practices.
5. Develop ethical behavior in social and professional work environments.
6. Understand Salah (Namaz) and Duas (Azkaar), as required in connection with our daily lives.
7. Learn important teachings, decisions and actions of Prophet Muhammad PBUH in Makkah and Madinah.
8. Identify the contribution of Muslim Scientists towards various fields of sciences and their important achievements.
9. Understand the significance of health, obedience of Law and other basic necessities of human life so that He / She may become a responsible citizen.

Detailed Course Contents of Semester III

Course Code	Courses	Credit hours
BSC 211	Behavioral Sciences	2+0
ICT 201	Applications of Information and Communication Technologies (ICT)	2+1
HSS 330	Physical Education and Sports	2+0
HPH 132	Human Physiology-II	2 + 1
GPT 111	General Pathology-I	2+1
GPH 202	General Pharmacology	2+1

Course Title: Behavioral Sciences 2 (2+0)**Course Code:** BSC 211**Pre-requisite:** Intermediate**Course Contents:**

Introduction to Behavioral Sciences and its importance in health: Bio-Psycho-Social Model of Health Care and the Systems Approach, Normality vs Abnormality, Importance of Behavioral sciences in health, Desirable Attitudes in Health Professionals Understanding Behavior: Sensation and sense organs, Perception, Attention and concentration, Memory, Thinking, Communication, Individual Differences: Personality, Intelligence, Emotions, Motivation, Learning, Stress and Stressors, Life Events, Stress, Management, Interviewing / Psychosocial History Taking, Allied Health Ethics-Hippocratic oath, Culture and Allied Health practice, Psychological reactions, Breaking Bad News, Pain, Sleep, Consciousness.

Course Learning Outcomes:

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

After completion of the course students are expected to be able to:

1. Assess the major concepts, theoretical perspectives, empirical findings, and historical trends in behavioral sciences. Explain the basic research methods in the behavioral sciences
2. Utilize the scientific approach to solve problems related to behavioral sciences. Define

principles and terminology in the behavioral sciences to understand problems related to behavior and mental processes.

3. Critical Analysis: Critically analyse existing literature of a topic in psychology. Research Design and Statistics: Design research studies, including the application of statistical procedures.
4. Written and Oral Communication: Demonstrate written and oral communication skills, especially the ability to write in APA (American Psychological Association) style. Application and Social Issues: Articulate how psychological principles can be used to explain social issues, address pressing societal needs, and/or inform public policy.

Course Title: Application of Information & Communication Technology (2+1)**Course Code:** ICT 201**Pre-requisite:** N/A**Course Description:**

The course provides a concise overview of ICT and the Internet, starting with the history and classification of computers and basic digital concepts. It covers various computer types, essential system components like the CPU and I/O devices, and explains memory hierarchies including cache, primary, and secondary storage. Students learn fundamental programming concepts through algorithms, flowcharts, and an introduction to different programming paradigms. The curriculum

also addresses data representation through number systems, binary arithmetic, and logic gates, followed by a study of networking principles, including topologies and TCP/IP layers. Finally, the course explores data management by comparing file systems with databases and introduces emerging technologies such as AI, ML, IoT, cloud computing, AR, and VR

Course Learning Outcomes:

1. Explain the fundamental concepts of ICT, computer architecture, and number systems, and apply them in scientific and technical contexts.
2. Develop algorithms, design flowcharts, utilize basic programming paradigms, and understand network topologies to enhance computational approaches in scientific studies.
3. Analyze the impact of emerging technologies such as AI, IoT, Cloud Computing, and VR, and effectively communicate their applications and ethical considerations.

Course Title: Physical Education and Sports 2 (2+0)

Course Code: HSS 330

Pre-requisite: Intermediate

Course Description:

Introduction to Physical Education & Fitness, Anatomy & Physiology for Physical Fitness, Strength & Conditioning Training, Cardiovascular & Endurance Training, Flexibility & Mobility

Training, Sports Skills & Techniques, Nutrition & Recovery in Fitness, Fitness Assessment & Program Design, Mental Well-being & Motivation in Fitness, Injury Prevention & First Aid in Sports, Lifestyle & Long-Term Fitness Planning, Practical Application & Evaluation

Course Learning Outcomes (CLOs):

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

1. Development of communication, cooperation, and leadership skills through group activities.
2. Lifelong Fitness Mindset Commitment to maintaining an active and healthy lifestyle beyond university years. Students will develop improved strength, endurance, flexibility, and overall health. Ability to perform and apply techniques in various physical activities and sports.
3. Understanding of exercise science, training methods, and injury prevention. Integration of proper nutrition, stress management, and fitness into daily life. Enhanced agility, balance, and reaction time for better performance.

Course Title: Human Physiology-II 3 (2 + 1)

Course Code: HPH 132

Pre-requisite: The BS MLT students are expected to have a basic understanding of the following:

1. Neural physiology

2. Cardiovascular physiology

Course Description:

The course focuses on providing basic knowledge of the normal functioning of the human body. The students are expected to understand the normal functional organization of the human body, as well as to correlate it with the medical lab diagnostic studies that will be explored later. The physiology laboratory is also very well equipped with the latest and modern gadgets, apparatus and instruments which will further help the process of opening gateways of learning new medical lab technology.

Course Learning Outcomes (CLOs):

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

1. Have an enhanced knowledge and appreciation of mammalian physiology.
2. Understand the functions of important physiological systems including the cardio-respiratory, nervous system, cardiovascular system and immunity systems.
3. Understand how these separate systems interact to yield integrated physiological responses to challenges such as exercise, fasting and ascent to high altitude, and how they can sometimes fail.
4. Be able to perform, analyze and report on experiments and observations in physiology.

Course: General Pathology-I 3 (2+1)

Course Code: GPT-111

Pre-requisite: Nil

Course Description:

Introduction to pathology, Cell injury, Cellular adaptation, Acute Inflammation, Chronic Inflammation, Cell Repair & Wound Healing, Regeneration & Repair, Haemodynamic Disorders, Edema, Haemorrhage, Thrombosis, Embolism, Infarction & Hyperaemia, Shock, compensatory mechanism of shock, possible consequences of thrombosis & difference between arterial & venous emboli, Neoplasia, Dysplasia, benign and malignant neoplasms, metastasis.

Practical's:

Benign prostatic hyperplasia and Endometrial hyperplasia, Barette's esophagus, Coagulative necrosis and liquefactive necrosis, Acute appendicitis, Chronic cholecystitis, Chronic granulomatous inflammation, Thrombus Practical 2 Hr Syeda shabana nLipoma and Leiomyoma, Fibroadenoma Breast, Ductal carcinoma, Basal, . Squamous cell carcinoma.

Course Learning Outcomes (CLOs):

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

1. Identify the fundamental causes and mechanisms of disease, and the associated

alterations in the structure and function of cells, tissues, organs and systems.

2. Describe basic mechanisms of cellular pathology, including cell injury, necrosis, and cellular adaptations.
3. Describe the etiology and classification of inflammatory responses, and the mechanisms involved in healing and repair.

Course Title: General Pharmacology 3 (2+1)

Course Code: GPH 202

Pre-requisite: Students of 2nd year MLT should have basic understanding of the following concepts:

1. General Pharmacology
2. Biological effects, and therapeutic uses of drugs.
3. Basic Pharmacokinetics & Pharmacodynamics of drug

Course Description:

Drugs acting on cardiovascular system; Drugs for heart failure, anti hypertensive drugs, anti arrhythmic drugs, antianginal drugs, Anti Hyperlipidemic drugs, Blood drugs, Diuretics, Insulin and glucose lowering drugs, Chemotherapeutic drugs, Antibiotics, Drugs acting on Respiratory system, Anesthetics.

PRACTICALS:

1. Weight conversions and measurements
2. Preparation Sulfur ointment
3. Preparation of pilocarpine drops
4. Prescription writing

Course Learning Outcomes:

By the end of course student will be able to,

1. Acquire knowledge of the mechanisms responsible for the absorption, distribution, metabolism and excretion of pharmacologically active molecules, either natural or synthetic.
2. Have knowledge of the main pharmacokinetic parameters.
3. Have knowledge of the main classes of pharmacological targets, with a specific focus on membrane and intracellular receptors.
4. Evaluate the behavior of a pharmacologically active compound based on its pharmacokinetic and pharmacodynamics characteristics. Have of knowledge of the pharmacologically active compounds and therapeutic activities of medicinal drugs/botanicals belonging to different chemical or therapeutic classes.

Detailed Course Contents of Semester IV

Course Codes	Courses	Credit Hours
MGT 363	Entrepreneurship	2+0
BSS 307	Biostatistics	2+1
HMT 202	Hematology - I	2+1
MLI 306	Medical Lab Instrumentation	2+1
DMB 204	Diagnostic Microbiology-I	2+1
BTC 305	Biotechnology	2+1

Course Title: Entrepreneurship 2 (2+0)

Course Code: MGT-363

Course Contents:

This course is designed to cultivate an entrepreneurial mindset among students, encouraging them to think critically, identify business opportunities, and transform ideas into successful ventures. It imparts essential knowledge, skills, and abilities needed to establish and manage a business. The course covers key topics such as business initiation, market research, opportunity identification, financial literacy, marketing, team building, and regulatory compliance in Pakistan. After the course the student will have obtained skills in project management, communication and networking. The format is based on real life case studies and students will work on concrete projects and cases, meet with contractors and participate in interactive seminars where they will learn from and with each other.

Course Learning Outcomes:

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

After completion of the course

students are expected to be able to:

1. Demonstrate knowledge of fundamental entrepreneurial concepts, skills, and processes with reference to life and lab sciences
2. Understand different personal, social, and financial aspects associated with entrepreneurship.
3. Analyze regulatory requirements for setting up an enterprise in Pakistan, particularly export businesses.

4. Develop a feasible business plan by applying acquired knowledge, skills, and competencies with reference to bio tech start up.

Course Title Biostatistics 3 (3-0)

Course Code: BSS 307

Course Description:

Frequency distribution, exercise frequency distribution, measures of central tendency, measures of dispersion and measures of location. Second part of the study will cover the areas of statistical hypothesis and significance, null and alternative hypothesis, confidence interval, tests involving binomial distribution, tests involving normal distribution, F-distribution, student's t- distribution, chi-square test, tests of independence and contingency tables. In the third part lectures will cover the following topics: Analysis of Variance (ANOVA), LSD test, experimental designs, Completely Randomized Design (CRD), Randomized Complete Block Design (RCBD), Latin Square Design, Markov chains and Models and their applications in Bioinformatics such as gene predication, sequence analysis, profile HMMs, probabilistic approaches to phylogeny, etc.

Course Learning Outcomes:

1. Understand basic statistical concepts and methods used in biological research.

2. Apply statistical techniques to analyze and interpret biological data.
3. Use software tools to perform statistical analyses for experimental results.

Course Title: HEMATOLOGY – I 3 (2+1)

Course Code: HMT-202

Pre-requisite: NIL

Course Description:

Introduction to hematology, physiology of blood and composition, introduction to bone marrow, structure and function of bone marrow, blood formation in the body (Intra-uterine and extra-uterine), factors governing hematopoiesis, erythropoiesis, different stages and factor effecting on erythropoiesis, granulopoiesis, different stages and factor effecting on granulopoiesis, megakariopoiesis, different stages and factor effecting on megakariopoiesis, introduction to hemoglobin structure, synthesis and function, complete blood count and its importance, morphology of red blood cells and white blood cells, introduction to anemia and classification of anemia, introduction to hemolysis (physiological and pathological), introduction to WBC disorders, introduction to leukemia, etiology, pathogenesis and its classification, leukocytosis, leukopenia, neutrophilia, condition related to neutrophilia, neutropenia,

condition related to neutropenia, eosinophilia, condition related to eosinophilia, eosinopenia, condition related to eosinopenia, monocytosis, condition related to monocytosis, monocytopenia, condition related to monocytopenia, lymphocytosis, condition related to lymphocytosis, lymphopenia, condition related to lymphopenia, basophilia, condition related to basophillia, introduction to hemostasis, mechanism of hemostasis, function of platelets and coagulation factors, coagulation cascade, quantitative disorder of platelets, , qualitative disorder of platelets.

Practical:

Collection of blood sample, Preparation and staining of peripheral blood smear, Total leucocyte count, RBC count, Determination of absolute values, Differential leucocyte count; platelets count and reticulocytes count to determine the ESR, Determine bleeding time; prothrombin time; activated partial thromboplastin time

Course Learning Outcomes (CLOs):

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

1. Development of communication, cooperation, and leadership skills through group activities.
2. Lifelong Fitness Mindset Commitment to maintaining an active and healthy lifestyle beyond university years. Students will

develop improved strength, endurance, flexibility, and overall health. Ability to perform and apply techniques in various physical activities and sports.

3. Understanding of exercise science, training methods, and injury prevention. Integration of proper nutrition, stress management, and fitness into daily life. Enhanced agility, balance, and reaction time for better performance.

Course Title: Medical Laboratory Instrumentation 3 (2 +1)

Course Code: MLI 306

Pre-requisite: Prior knowledge in laboratory Instruments and laboratory setup.

Course Description:

Principle, procedure, calibration and maintenance of microscope, colorimeter, photometer, flame photometer, water bath, centrifuge, balance, incubator, pH meter, vertex mixer, oven, water still, deionizer, safety cabinet, electrophoresis assembly, thermo-cycler, chromatography, spectroscopy, flow cytometry, hematology analyzer, blood bank instruments and radiometric system.

Practical:

1. Microscope, Spectrophotometer, Water bath, Centrifuge, Balance, Incubator, pH meter
Vertex mixer, Oven, Water still, Deionizer, Safety cabinet, electrophoresis assembly, thermo-cycler, spectroscopy and hematology analyzer.

Course Learning Outcomes:

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

- 1- Understand conceptual knowledge of principle, working, application and quality control of laboratory Instruments.
- 2- Describe, calibration, preventive and corrective maintenance of Laboratory Instruments in case of troubleshooting.
- 3- To Monitor quality control of laboratory Instruments and processes and systems of laboratory.

Course Title: Diagnostic Microbiology 3 (2 +1)

Course Code: DMB-207

Pre-requisite: Prior basic knowledge of Microbiology

Course Description:

Gram negative and gram positive cocci. Characteristics, lab diagnosis and pathogenesis of Gram negative and gram positive cocci, Gram negative coccobacilli, nocardia and actinomycetes, mycobacteria, spirochaetes, mycoplasma, Rickettsia and chlamydia, minor bacterial pathogen

Practical:

1. Identification of bacteria of Medical importance dealt in the theory.
2. Preparation of culture media
3. Isolation and identification of pure bacterial isolated
4. Biochemical test
5. Gram staining
6. AFB staining
7. Capsule staining
8. Widal test
9. Typhidot test

Course Learning Outcomes (CLOs):

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

1. Demonstrate how to properly use the compound light microscope, as well as know its parts, their functions, how to safely transport and clean it.
2. Determine etiologic agent and identify disease given a series of original infectious diseases case studies. Describe the structures/functions of external and internal components of both prokaryotic and eukaryotic cells.
3. Outline the physiology and genetic processes of microorganisms. Explain the dynamics of host-parasite interaction.
4. Explore the characteristics of selected pathogens, and the diseases caused by each. Interrogate the role of genes, chromosomes, mutations and human manipulation in heredity of prokaryotic cells.

Course Title: Biotechnology (2 +1)

Course Code: BTC 305

Pre-requisite: Prior knowledge in molecular biology

Course Description:

Introduction and scope, Green revolution, Restriction and modification system, Properties of restriction endonucleases, their occurrence and recognition sequences, Practical uses of endonucleases, DNA sequencing, PCR: its application and primer designing, Labeling methods of probes, Construction of genomic libraries, important enzymes production, vaccine production, Genetic engineering for better animal production, cloning, herbicide

resistant crops, petroplants, Bioremediation.

Practical:

1. Methods of nucleic acid isolation (DNA & RNA)
2. Gel electrophoresis
3. Restriction Fragments Length Polymorphism
4. Southern, Northern and Western blotting Techniques.
5. Polymerase Chain Reaction

Course Learning Outcomes:

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

1. Apply biotechnological methods to investigate the treatment strategies against new and old disease.
2. Establish modern strategies using genetic engineering and tools to harness microorganisms for production of high value fine chemicals and pharmaceuticals.
3. Explore the methods to improve food quality, quantity and processing.
4. Introduce innovative approaches with respect to vaccine production.
5. Design and initiate research in the field of biotechnology by linking PCR and its application, DNA sequencing and genetic engineering
6. Identify the ethical, social and religious concerns related to biotechnology

Detailed Course Contents of Semester V

Course Codes	Courses	Credit Hours
HGN 203	Human Genetics	2+1
GPT 205	General Pathology-II	2+1
DMB 207	Diagnostic Microbiology-II	2+1
HMT 208	Hematology -II	2+1
CVM 210	Clinical Virology and Mycology	2+1

Course Title: General Pathology-II 3 (2+1)**Course Code:** GPT-205**Pre-requisite:** General Pathology-I**Course Contents:**

Health effects of climate change, toxicity of chemical and physical agents, environmental pollution, effect of tobacco, effect of alcohol, injury by therapeutic drugs and drugs of abuse, general principles of microbial pathogenesis, special techniques for identifying infectious agents, agents of bioterrorism, heart failure, congenital heart diseases, ischemic heart diseases, hypertensive heart diseases, arrhythmias, atelectasis, chronic obstructive pulmonary disease, asthma, bronchiectasis, pneumonias, pneumothorax, hemothorax, nephrotic syndrome, renal stone, hydronephrosis, aphthous ulcer, gastritis, peptic ulcer, hemorrhoid, jaundice, liver cirrhosis, viral hepatitis, cholecystitis, urinary tract infections, arthritis.

Practical:

Left ventricular hypertrophy, Myocardial infarction, Tuberculosis, Pneumonia, Squamous cell carcinoma– lung, Renal cell carcinoma, Chronic cholecystitis, Adenocarcinoma stomach, Chronic pancreatitis, Osteochondroma, Osteosarcoma

Course Learning Outcomes:

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

After completion of the course students are expected to be able to:

1. Identify the fundamental causes and mechanisms of disease, and the associated alterations in the structure and function of cells, tissues, organs and systems.
2. Describe basic mechanisms of cellular pathology, including cell injury, necrosis, and cellular adaptations.
3. Demonstrate the effects of toxicity of chemical and physical agents, environmental pollution, tobacco, alcohol, injury by therapeutic drugs and drugs of abuse.
4. Describe the etiology and classification of inflammatory responses, and the mechanisms involved in healing and repair.
5. Have knowledge of general principles of microbial pathogenesis, special techniques for identifying infectious agent

Course Title: Diagnostic Microbiology –II 3(2+1)**Course Code:** DMB- 207**Pre-requisite:** DIAGNOSTIC MICROBIOLOGY- II**Course Contents:**

Introduction to clinical mycology, introduction to fungi, fungal characteristic, morphology, structure, replication and classification, mechanism of fungal pathogenesis, growth and isolation of fungi, laboratory approaches to diagnose fungal infection, clinical categorization of fungal infections, superficial mycoses, cutaneous mycosis, subcutaneous mycoses, systemic

mycoses and opportunistic fungi, introduction to clinical virology, Viral morphology, structure, replication and classification, general properties of virus, pathogenesis and control of virus, DNA viruses (envelop and nonenvelop), RNA viruses (envelop and non-envelop), Hepatitis viruses, Arboviruses, tumor viruses, slow viruses and Prions, minor viral pathogens.

Practical:

- Perform the preparation of various culture media
- Isolation & identification of pure bacterial isolates.
- Biochemical analysis of bacteria
- Lab diagnosis of Gram Negative and Gram positive Bacteria

Course Learning Outcomes:

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

1. Explain the basic features of every group of microorganisms
2. Identify an unknown bacterial organism based on results of lab procedures performed like smear preparation, staining procedures using appropriate PPE required for this laboratory course.
3. Perform aseptic transfer techniques, chemotherapeutic agents and interpretations of laboratory results.

Course Title: HEMATOLOGY II 3(2 +1)

Course Code: HMT-208

Pre-requisite: Hematology-I

Course Contents:

Course Description: Iron metabolism, introduction to iron deficiency anemia, different stages and diagnosis, introduction

to thalassemia, classification, pathophysiology and its diagnosis, introduction to Sideroblastic anemia, etiology and diagnosis, folate and vitamin B12 metabolism, introduction to megaloblastic anemia, etiology and diagnosis, introduction to G6PD deficiency anemia, pathophysiology and diagnosis, introduction to sickle cell anemia, pathophysiology and diagnosis, introduction to hereditary spherocytosis, pathophysiology and diagnosis, introduction to hemolytic anemia, Immune hemolytic anemia, non-immune hemolytic anemia, aplastic anemia, etiology and diagnosis.

Practical: Blood film preparation & Staining, Morphology of smears, Morphology of Normocytic Normochromic anemia, Morphology of Microcytic Hypochromic anemia, Morphology of Macrocytic Normochromic anemia, Morphology of Thalassemia, Morphology of Sideroblastic anemia, Morphology of Folate deficiency anemia, Morphology of Vitamin B-12 deficiency anemia, Morphology of G6-PD, Morphology of HS anemia, Morphology of HE anemia, Morphology of Sickle cell anemia, Morphology of Hemolytic anemia, Morphology of Non-Hemolytic anemia, Serological tests for Hemolytic anemia

Course Learning Outcomes:

- To introduce the students about the basic concepts in Hematology and acquire skill in practical work to produce a team of Medical Technologists steeped in knowledge of Pathology.
- To equip Medical Technologists with latest advancements in the field of hematology.

Course Title: Clinical Virology and Mycology 3 (2+1)**Course Code:**

Pre-requisite: Prior knowledge in basic Microbiology

Course Contents:

Introduction to clinical mycology, introduction to fungi, fungal characteristic, morphology, structure, replication and classification, mechanism of fungal pathogenesis, growth and isolation of fungi, laboratory approaches to diagnose fungal infection, clinical categorization of fungal infections, superficial mycoses, cutaneous mycosis, subcutaneous mycoses, systemic mycoses and opportunistic fungi, introduction to clinical virology, Viral morphology, structure, replication and classification, general properties of virus, pathogenesis and control of virus, DNA viruses (envelop and no envelop), RNA viruses (envelop and non-envelop), Hepatitis viruses, Arboviruses, tumor viruses, slow viruses and Prions, minor viral pathogens.

Course Learning Outcomes:

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

1. Understand Fundamental Concepts of clinical mycology and virology, including fungal and viral morphology, structure, replication, and classification.
2. Analyze Fungal Pathogenesis and Laboratory Diagnosis
3. Describe the mechanisms of fungal pathogenesis and the factors contributing to fungal infections and

perform the laboratory techniques for the isolation, growth, and diagnosis of fungal infections.

4. Describe the general properties of viruses, their pathogenesis, and their interactions with the host immune system.
5. Explain the characteristics, pathogenesis, and impact of specific viruses such as Hepatitis viruses, Arboviruses, tumor viruses, slow viruses, and Prions and discuss prevention, treatment, and control measures for clinically significant fungal and viral infections.

Detailed Course Contents of SEMESTER VI

Course Codes	Courses	Credit Hours
RMT 309	Research Methodology	2+1
WPD 301	WBCS and Platelets Disorders	2+1
CPS 303	Clinical Parasitology	2+1
CPT 304	Clinical Pathology	2+1
	Elective 1	2+1
CPT 209	Chemical Pathology	2+1

Course Title: Research Methodology 3 2+1**Course Code:** RMT 309**Pre-requisite:****Course Contents:**

Introduction to research (in simple term and a scientific term), concept of research, why do need research, advantage of research, identification of research need and its qualities, component of research, ethical and legal aspect of research and objective of research (definition, purpose, structure) Relevance, Avoidance of duplication, Physibility, Political acceptability, Applicability, Cost efficiencies, work plan, budget required for research work, literature searching, statistical help, material, type of manuscript, printing of manuscript for submission and postage, Principles and reliability of measurement, errors and sources of measurement, types of measurement, measure of disease frequency and screening (introduction, validity and screening test) Studies design (introduction, selection of design), research questionnaire, validity and reliability of research finding, confounding factors, strategies to deal with threats to validity, hypothesis testing, sampling, collect data, data collection procedure, step and data collection survey questionnaire, starting questionnaire

Course Learning Outcomes

1. Understand the basic concepts of research, including its definition, purpose, advantages, and significance in scientific inquiry.

2. Identify research needs, formulate objectives, and design a structured research plan, including budgeting, work plans, and ethical considerations.
3. Demonstrate Knowledge of Data Collection and Analysis
4. Utilize appropriate data collection methods, sampling techniques, and statistical tools to analyze research findings with validity and reliability.
5. Evaluate Research Designs and research proposal fundamentals including research ethics

Course Title: WBC AND PLATELETS DISORDERS**Course Code:** WPD-301**Pre-requisite:** NIL**Course Contents:**

Leukopoiesis, introduction to WBC's disorders, investigations towards WBC,s disorders, introduction to leukemia, causes, classification and diagnosis, introduction to acute leukemia, classification, diagnosis, introduction to acute lymphoblastic leukemia, diagnosis, acute myeloid leukemia, classification and diagnosis, chronic leukemia, classification and diagnosis, chronic myeloid leukemia, pathogenesis, diagnosis and differential diagnosis of chronic myeloid leukemia, chronic lymphocytic leukemia, classification, diagnosis and differential diagnosis, myeloproliferative disorders, introduction to plasma cell dyscrasias, classification, multiple myeloma, lymphoma classification, introduction to hemostasis, primary hemostasis, secondary hemostasis, coagulation, coagulation factors, inhibitors of coagulation, fibrinolytic system, introduction to hemophilia, classification, diagnosis, thrombotic thrombocytopenic purpura,

pathogenesis, and diagnosis, hemolytic uremic syndrome, pathogenesis, diagnosis, von Willebrand diseases, classification and diagnosis, glanzmann thrombasthenia, bernard soulier syndrome, immune thrombocytopenic purpura Correction Studies.

Practical:

Morphology of leukemic slides, Automated differential count, Flowcytometry, Sudan Black B, Myeloperoxidase stain, Periodic acid schiff, Esterase stain, Leukocytes alkaline phosphatase Score, Prothrombin Time, Partial Thromboplastin time, Fibrinogen Assay, FDP,s and D-Dimer, Clot solubility test for factor Xiii, Hess's test.

Course Learning Outcomes:

After completion of the course students are expected to be able to:

1. Define WBCs formation and maturation, leukocytosis and leukemoid reaction and compare leukemoid reaction with leukaemia.
2. Describe the nature of the malignant process and the concept of clonality; relate this to haematological malignancy –abnormal growth, differentiation and apoptosis.
3. Define leukaemia and classify leukaemia into acute (AML and ALL) and chronic (CML and CLL) based on clinical and laboratory findings.
4. Compare and contrast the main differences between acute and chronic leukaemia.
5. Describe the classification of Acute Myeloblastic Leukaemia based on FAB and WHO classifications.
6. Describe the diagnostic pathway required to confirm the diagnosis of leukaemia and describe the

prognostic factors that influence the treatment pathway.

7. Explain the pathology and clinical manifestations of multiple myeloma, staging and lab diagnosis of multiple myeloma

Course Title: Clinical Parasitology 3 2+1

Course Code: CPS 303

Pre-requisite: Prior knowledge in basic Microbiology

Course Contents:

Introduction to clinical parasitology, Parasite (protozoan and metazoan) morphology and classification, general principal of pathogenesis, immunology and diagnosis of parasitic infection, Protozoan: Sporozoa (Plasmodium, Toxoplasma, Cryosporidium, Isospora), Rhizopods (Entamoebahistolytica, Naegleria, Acanthamoeba, Balantidium coli), Flagellates (Gardialamblia, Trichomonas vaginalis, Leishmania, Trypanosoma), Metazoan: Intestinal nematodes (Enterobiusvermicularis, Trichuristrichiura, Ascarislumbricoides, Nectar americanus, Ancylostomaduodenale, Strongyloidesstercoralis), Tissue nematode (Wuchereriabancrofti, Brugiamalayi, Onchocerca volvulus, Loa loa, Dracunculusmedinensis), Cestode (Teniasaginata & solium, Diphyllbothriumlatum, Hymenolepis nana, Echinococcus) and Trematode (Paragonimus, Clonorchis, Schistosoma, Fasciola species).

Practical:

1. Identification of parasites of Medical importance dealt in the theory.
2. Macroscopic and microscopic examination of stool for adult worms, ova, cysts, larvae.

3. Concentration techniques for intestinal parasites in stool.
4. Collection of blood and preparation of thick & thin smears.
5. Staining of blood smears for blood parasites.
6. Examination of blood smears for malaria & microfilaria and their identification.
7. Microscopic examination of urine for trichomonas vaginalis and shistosoma eggs

Course Learning Outcomes:

At the end of the course Students will be able to

1. Describe parasitic diseases and modes of diagnosis.
2. Trace control of parasitic infections.
3. Understand host-parasite relationship.
4. Identify parasitism, parasites and their examples.
5. Diagnose parasite and their identification
6. Analyze Mode of infection /transmission by applying different tests

Course Title: Clinical Pathology 3 2+1

Course Code: CPT 304

Pre-requisite:

Course Contents:

Urine: Physical, chemical and microscopic composition of urine. Faeces: Physical, chemical and microscopic composition of faeces, Cerebrospinal fluid: Physical, chemical and microscopic composition of CSF. Aspiration fluids: Physical, chemical and microscopic composition of ascetic, pleural, pericardial and synovial fluids. Semen

analysis: Physical, chemical and microscopic composition of seminal fluid, Urinary Calculi.

Practical:

- Physical, chemical and microscopic examination of urine
- Physical, chemical and microscopic examination of faeces
- Physical, chemical and microscopic examination of CSF
- Physical, chemical and microscopic examination of ascetic, pleural, pericardial and synovial fluids
- Physical, chemical and microscopic composition of seminal fluid
- Physical and chemical composition of urinary Calculi

Course Learning Outcomes:

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

1. Describe urine formation, excretion, abnormal volumes of urine in different disorders
2. Explain principles of each test included in a routine urine physical, chemical and microscopic examination
3. Explain principles of each test included in a routine faeces physical, chemical and microscopic examination
4. Describe the composition, formation and function of selected body fluids, explain the functions of the different body fluids

5. Evaluate and correlate body fluid laboratory results for the differential diagnosis of various disorders

Course Title: Chemical Pathology 3 (2+1)

Course Code: CPT 209

Pre-requisite:

Course Description:

Course Contents:

Synthesis, function and clinical significance of urea, uric acid and creatinine, determination of Lipids in blood, Cortical hormone, sex hormone, thyroid hormones, Tumour markers: alpha feto protein, CEA, HCG, CA, PSA, CA 125, Phenylketonuria, Aminoaciduria, Glycogen storage disease, Proteinuria, Ketonuria. Nephrotic syndrome, Malabsorption syndrome, Hyperbilirubinaemia & Jaundice, Hypoalbuminaemia, Cushing disease, Myxedema, Hypo & Hyperpituitarism, Amenorrhea, Hirsutism, Rickets, Osteomalacia, Chronic renal failure, OGTT.

✓ Practical:

1. Analysis of kidney function test
2. Analysis of lipids profile test
3. Analysis of hormones and different tumors markers

Course Learning Outcomes:

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

1. Demonstrate a capacity to analyse and problem-solve in chemical pathology including the principle and rationale of various analyses that are estimated, the pre-analytical factors that may impact result integrity.
2. Apply knowledge and understanding of the clinical tests associated with various pathologies and perform the

measurement of a broad range of using a variety of techniques and instrumentation as per established protocols.

3. Describe inborn errors metabolism, metabolic defects, lab diagnosis of various metabolic disorders.
4. Describe Hormones, synthesis, secretion, function and importance in various biological processes.
5. Describe lab diagnosis of hormonal imbalance and abnormal levels. Describe bone disorders, vitamin-D synthesis, function and deficiency.

Detailed Course Contents of Semester VII

Course Code	Course	Credit hr
	Elective 2	2+1
IAS 308	Immunology and serology	2+1
BLB 310	Blood Banking	2+1
MLM 401	Medical Laboratory Management Skills	2+1
FYP 401	Final Year Project	3+0

**Course Title: Immunology and Serology 3
2+1****Course Code:** IAS 308**Pre-requisite:** Prior knowledge of cell structure and cell physiology**Course Description:**

Introduction to immunity, cellular basis of the immune response, antibodies, humoral immunity, cell-mediated immunity, major histocompatibility complex & transplantation, complement, antigen-antibody reactions in the laboratory, hypersensitivity (Allergy), tolerance & autoimmune disease, tumor Immunity, immunodeficiency, introduction to serology, introduction to serology, reactions in serology, serology of bacterial, viral, fungal and parasitic infections.

Course Learning Outcomes (CLOs):

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

1. Demonstrate conceptual knowledge and application of Immunology and serology.
2. Apply the basic principles of antigen-antibody reactions in the performance of serological tests and diagnostic techniques in immunology and serology.
3. Correlate the understandings of Immune system in Transplantation, hypersensitivity and aids.

Course Title: Blood Banking 3(2 +1)**Course Code:** BLB 310**Pre-requisite:** NILL**Course Description:**

Introduction to blood bank, immunoglobulin, structure, different type of immunoglobulin, antigen antibodies reactions, requirements of a standard blood bank, preparation of basic reagents, different anticoagulant use in blood bank, ABO and Rh D group system, Kell blood group system, Duffy blood group system, MNS blood group system, Kidd blood group system, other blood group system, donor selection criteria, phlebotomy of donor, processing of donor blood, blood products, preparation, storage and its importance, hemovigilance in blood banking, cross match, types of cross match, procedure and importance of cross match, anti-human globulin test, types, procedure and importance and quality control of AHG, check cells, preparation and importance of check cells, transfusion reactions, investigation and management of transfusion reaction, hemolytic disease of newborn, classification, pathophysiology, diagnosis and management of HDN, quality control, external quality control, internal quality control in blood bank.

Practical

1. ABO blood grouping (Forward and Reverse grouping)
2. Rh Blood grouping
3. Antibodies screening
4. Cross matching (Major and Minor)
5. Coombs tests (Direct and Indirect)
6. Separation of different blood components

Course Learning Outcomes (CLOs):

1. Understand basic concepts in blood banking and transfusion medicine.

2. prepare various blood components for transfusion and understand their clinical indications in safe blood transfusion practice.
3. To perform latest advance techniques in the field of transfusion medicines. To establish safe blood transfusion practice.

Training and continuing education, Employee performance appraisal, Personnel records, Customer service, Customer satisfaction surveys, Occurrence management, Quality indicators, Documents and records, Standard operating procedures (SOPs), Computerized laboratory information systems, Organizational requirements for a quality management system

Course Title: Medical Laboratory Management Skills

Course Code: MLM 401

Pre-requisite: : Prior knowledge in laboratory setup and management.

Course Description:

Introduction to quality, The quality management system model, Laboratory design, Safety management program, Personal protective equipment, Equipment Selecting and acquiring equipment, Implementing an equipment maintenance program, Equipment maintenance documentation, Purchasing and inventory, Implementing an inventory management program, Forms and logs, Receipt and storage of supplies, sample management, The laboratory handbook, Collection and preservation, Sample storage, retention and disposal, Sample transport, Control materials, Establishing the value range for the control material, Graphically representing control ranges, Interpreting quality control data, Using quality control information, audits, External audit, Internal audit, external quality assessment, International standards and standardization bodies, Certification and accreditation, Personnel, Recruitment and orientation, Competency and competency assessment,

Practical

Preparation of Standard Operating Procedure (SOPs), Lab structure Designing, Emergency Response for Laboratories, Lab Waste Management, Sample Storage and Archiving, Quality Control and QC in Microbiology lab, Lab Equipment management, Purchase and Inventory management, Spill control management, Needle stick cut and sharp Injury, Standards precautions and use of PPE Safe transportation of biological Specimen.

Course Learning Outcomes (CLOs):

1. Understand the Laboratory Management system of different laboratories sections.
2. Explain the Inventory, equipment, sample and financial management in the laboratory.
3. To develop skills to manage and improve the quality of laboratory processes and systems

Detailed Course Contents of Semester VIII

Course Codes	Course	Credit Hours
	Elective 3	2+1
	Elective 4	2+1
SDB 405	Systematic Diagnostic Bacteriology	2+1
CAC 406	Cytology and Cytogenetic	2+1
BIN 410	Bioinformatics	1+1
INT 407	Internship	3+0
ISL 114	Seerah-II	One contact hr/ week

Course Title: Systemic Diagnostic Bacteriology 3(2 +1)**Course Code:** SDB-405**Pre-requisite:** Prior knowledge in microbiology**Course Description:**

Introduction to diagnostic bacteriology, Collection, preservation, transport and processing of clinical specimens for the diagnosis of bacterial infections, detailed study of different methods of antibiotic susceptibility tests, media used, selection of drugs, quality control, beta lactamase detection, MRSA detection, antibiotic assay in blood and body fluids, detailed study of the principle, preparation of media and reagents, methods, interpretation and quality control of the biochemical test used for the Identification of bacteria, detail study of principles and method of preparation, pH adjustments, sterilization, storage of different types of media, transport media, anaerobic media, quality control in media preparation, cultivation of bacteria, Inoculation methods, incubation methods, Inoculation on different types of culture media in Petri dish, slopes, butt, broths, morphological study of bacterial colonies on plated media, anaerobic culture methods with recent advance.

Course Learning Outcomes (CLOs):

1. To recognize basic concepts in diagnostic bacteriology.
2. To perform laboratory procedure used in diagnostic bacteriology.

3. To list differential diagnosis of bacterial infections.
4. To perform technical skills used in diagnostic bacteriology.

Course Title: CYTOLOGY AND CYTOGENETICS 3 (2 + 1)**Course Code:** CAC 406**Course Description:**

Morphology and physiology of cell, cytology of: female genital tract, urinary tract, gastrointestinal tract, respiratory tract, effusions, miscellaneous fluids, collection, preservation, fixation and processing of various cytological specimen, preparation and quality control of various stains and reagents used in cytology, all routine and special staining techniques in cytology, FNAC, immunocytochemistry, flowcytometry, automation in Cytology Cytogenetic Structure and molecular organization of chromosomes, identification of human chromosomes, karyotyping, direct chromosome preparation of Bone Marrow cells, culture techniques, banding techniques, sex Chromatin bodies, autoradiography of human chromosomes, chromosome Identification by image analysis and Quantitative cytochemistry, clinical Manifestations of chromosome disorders

Practical:

1. Morphology of normal and abnormal cells
2. Karyotyping technique
3. Immuno-histochemistry techniques
4. FNAC technique

Course Learning Outcomes (CLOs):

1. Understand the basic concept of cytology and cytogenetics.
2. Perform techniques (fixation and processing, staining) involved in cytology and cytogenetic.
3. Identify normal, abnormal cells of different sites, Female reproductive organs, lungs and body fluids

Course Title: Bioinformatics 1+1**Course Code: : BIN 410**

Pre-requisite: Thorough understanding of Cell biology, molecular biology and techniques used in biotechnology. Students should have studied the offered courses at university, i.e., Cell biology, molecular biology and Methods in molecular biology

Course Description:

Introduction; Introduction to Bio-computing; Biological databases – types, Retrieval of nucleic acid (or genomic) or protein sequence information, Sequence alignment - pairwise, multiple; phylogenetics; In silico identification of protein motifs and domains; Structural bioinformatics of proteins and RNAs including protein modeling and prediction of their interactions with other proteins and small molecules; Identification of genes and promoter regions within genomes; networks; Strategies for whole genome sequencing and assembly.

Course Learning Outcomes (CLOs):

Upon completion of course the students will be able to

1. Explain key principles of bioinformatics, including

sequence alignment, database searching

2. Apply commonly used bioinformatics software for DNA, RNA, and protein sequence analysis and protein structure prediction.
3. Learn the principles, methodologies, and applications of whole genome sequencing in bioinformatics

Detailed Course Contents of Electives

Course Code	Course Title	Credit Hours
FIC 402	Fundamental of infection control	2+1
BIO 404	Hospital waste management	2+1
MCB 403	Molecular Biology	2+1
BIO 401	Cell and tissue culture	2+1
HPT 302	Histopathology	2+1
BIO 401	Cell and tissue culture	3+0
MOD 312	Molecular diagnostics	2+1
BIO 402	Biosensors	3+0
MSC 409	Medical Sociology	2+1

Course Title: Fundamental of infection control 3 (2+1)**Course Code:** FIC 402**Pre-requisite:** Prior Knowledge of Microbiology**Course Description:**

Introduction to Infection Control Infections in the hospital environment Biorisk Management, Primary Controls of Biosafety, Standard precautions and PPE Infection Control Related to Diseases Sterilization, Disinfection and antisepsis Safety Climate in Lab Versus Safety Culture Antimicrobial agents Safety Surveillance Systems and Safety Data Sheets, Laboratory Emergency Preparedness Fire Extinguishers Antibiotic resistance and policy, Biomedical waste management Biosafety levels Standard Operating Procedure s Shipping of Infectious Substances Human Risk factors, Methods for Evaluation of Antibiotic Resistance Hand Hygiene and Vaccination Biological Waste Management Host parasite interaction Risk Groups Classification Containment Levels according to Risk groups Immune response to infection Biosafety Cabinets and their Types Dealing with Bacterial Pathogens in BSC Biosecurity The Dual Use of Pathogens foe Biosecurity and Bioterrorism Laboratory Acquired Infection

Practical:

Demonstration of Glove Removal and Hand Washing Technique, Donning and Doffing of Personal Protective Equipment, Demonstration of Needle Stick Injury in the Laboratory, Demonstration of how to handle spills and aseptic handling, Demonstration of Biomedical Waste Management in

Hospitals , Development of Effective Behavioral Cues in Lab, Demonstration of Emergency Evacuations Evaluation of Different Personalities in Hospital Environment, Working inside a Biosafety Cabinet Antibiotic Susceptibility Testing, Preparation of Bacterial Media for Isolation of Infectious Agents Isolation of Pure Bacterial Culture

Course Learning Outcomes (CLOs):

- To introduce the students with basic concepts in infection control.
- To introduce the students with infection control principles and practices.
- To introduce the students with importance of immunization and hand hygiene in infection control.
- To introduce the students with the role of clinical laboratory in infection control.

Course Title: Hospital Waste Management 3 (2+1)**Course Code:** BIO 404**Pre-requisite:** Prior knowledge of hospital environment and Biosafety**Course Description:**

An introduction to the management of infectious materials/waste; various types of infectious material and methods of their handling and disposal; laboratory and hospital acquired infections - possible sources and causes; hazardous microorganisms; basic containment rules and laboratory contamination levels, control measures; guidelines for workers in microbiology and pathology labs, and post-mortem rooms; rules for safe conduct during field work and outdoor activities; risk assessment including recognition of hazards; competence and elimination of hazards;

collection of data, etc.; risk group personnel and their education, training and monitoring; radiation hazards and disposal of radioactive waste.

Practical:

Techniques for waste minimization; waste sorting; anaerobic and aerobic composting; industrial and hospital waste treatment processes.

Course Learning Outcomes (CLOs):

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

1. Identify types of infectious and hazardous hospital waste, their sources, and associated health risks.
2. Explain safe handling, containment, and disposal methods for hospital waste following regulatory guidelines and communicate these guidelines with the society
3. Apply risk assessment strategies and control measures to minimize contamination and occupational hazards which can affect population.
4. Evaluate the role of education, training, and monitoring in effective hospital waste management and control spread of various environmental hazards.

Course Title: Molecular Biology 3 (3-0)

Course Code: MCB 403

Pre-requisite: Basic Biotechnology

Course Description:

Introduction to molecular biology and history; structure and function of DNA; chromatin and structure of chromosomes; protein structure and function; DNA replication in prokaryotes and eukaryotes; transcription in prokaryotes and eukaryotes; post transcriptional processing (e.g., RNA splicing, alternative splicing, editing); genetic code; translation, post-translational

processing in prokaryotes and eukaryotes; protein folding, targeting and turnover; DNA damage and repair, recombination and transposable elements. Signaling and control of gene regulation in prokaryotes and eukaryotes.

Course Learning Outcomes:

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

1. Understand the Central Dogma of molecular biology.
2. Understand gene regulation and expression in prokaryotes and eukaryotes.
3. Explain the mutations, DNA damage and repair mechanisms.

Course Title: Cell and Tissue Culture 3 (2+1)

Course Title:

Course Code: BIO 410

Course Description:

This course provides students with an in-depth understanding of the principles and applications of cell and tissue culture in life sciences. It covers essential techniques in plant and mammalian cell culture, including sterile techniques, media preparation, cell growth, and applications in Biotechnology.

Practical:

Aseptic techniques, media preparation, sterilization, callus induction, cell suspension culture, protoplast isolation, embryo culture, micropropagation, mammalian cell

culture, subculturing, cell viability assessment, cryopreservation, contamination detection, bioreactor design, and applications of cell culture.

Course Learning Outcomes (CLOs):

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

1. Understand the principles and techniques of plant and animal cell culture.
2. Apply sterile techniques and media preparation for in vitro culture.
3. Analyze the use of tissue culture techniques in genetic engineering and biotechnology.

Course Title: Histopathology 3(2 +1)

Course Code: HPT 302

Pre-requisite: NIL

Course Description:

Course Contents:

Fixation of tissues: Phenomenon, Common fixatives composition advantages and disadvantages. Tissue Processing: dehydration, Clearing; Paraffin Embedding process; Sectioning Process: Microtomes and their types and uses, Problems encountered and their remedies. Freezing microtome / Cryostat and frozen sectioning, Staining: Procedure, uses and interpretation of: Routine Haematoxylin and Eosin, special stains for connective tissues, nervous tissues, glycogen, PAS and PAS-D stain, Vital and supravital dyes and study of cells; FNAC & Cell block formation, Tumor markers, Immunohistochemistry Staining and its application in identification of Tumors.

Practicals

- Gross Examination & fixation of specimen
- Steps of Tissue processing
- Tissue Embedding & sectioning
- Routine Histological staining- H&E and special staining
- Immunohistochemistry & FNAC

Course Learning Outcomes:

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

1. Understand the principles and procedures involved in tissue processing, including fixation, embedding, sectioning.
2. Perform common staining techniques, such as H&E staining, special stains, and immunohistochemistry, with proficiency.
3. Understand the basic concept of cytology and cytogenetics

Course Title: Molecular Diagnostics 3 (2+1)

Course Code: MOD 312

Pre-requisite: Basic education (intermediate)

Course Description:

Introduction and applications of molecular diagnostics techniques in agriculture and forensic sciences; polymerase chain reaction (PCR); detection of mutations and single nucleotide polymorphisms (SNPs) by restriction fragment length polymorphisms (RFLPs); blotting techniques (e.g., Southern, Northern and Western); enzyme-linked immunosorbent assays (ELISA); immunofluorescence staining and

immunohistochemistry; micro-arrays; in situ hybridization; molecular cytogenetics

Practical:

Primer designing, Polymerase chain reaction (PCR); detection of mutations and single nucleotide polymorphisms (SNPs) by restriction fragment length polymorphisms (RFLPs); blotting techniques (e.g., Southern, Northern and Western); enzyme-linked immunosorbent assays (ELISA); immunofluorescence staining, Visits to various diagnostic, pathology laboratories and/or research institutes.

Course Learning Outcomes (CLOs):

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

1. Explain the principles and applications of molecular diagnostic techniques in agriculture and forensic sciences, including PCR, blotting techniques, ELISA, immunohistochemistry, and microarrays.
2. Apply molecular techniques such as PCR, RFLP, and blotting methods for the detection of genetic variations, mutations, and disease markers.
3. Demonstrate competency in laboratory techniques related to molecular diagnostics, including primer designing, immunofluorescence staining, and enzyme-based assays.
4. Evaluate the significance of molecular cytogenetics and in situ hybridization in genetic analysis and disease diagnostics.

Course Title: Biosensors 3 (3+0)

Course Code: BIO 402

Pre-requisite: None

Course Description:

This course provides a comprehensive introduction to biosensors, its principles, types, and applications in biotechnology and healthcare, focusing on optical, electrochemical, and enzyme-based detection methods. It explores miniaturization, surface plasmon resonance (SPR), and piezoelectric biosensors for diagnostics and industrial use.

Course Learning Outcomes (CLOs):

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

1. Understand the principles of biosensors and their various detection mechanisms.
2. Analyze different types of biosensors, including optical, electrical, and enzymatic sensors.
3. Evaluate real-world applications of biosensors in biotechnology, healthcare, and environmental monitoring.

Course Title: Medical Sociology 2(2-1)

Course Code: MSC 409

Pre-requisite: - None

Course Description:

Sociology, Introduction to Medical Sociology, Definition & Scope of Sociology; Sociology as a Science, Islamic Sociology Contribution of Sociology to Medicine, Health, and Disease Social Definition of Illness; Social & Emotional Components of Illness Patient and Paramedic Relationship; Psychology of Patients & Paramedics Mental Illness: Sociological Perspective & Social Implications Rehabilitation of Physically & Mentally

Handicapped Individuals Guidance Counseling
and Vocational Training Social Disorganization:
Causes & Effects on Family and Community
Community Problems: Crime, Treatment, and
Prevention Educational Problems:
Deterioration of Education Standards Health
Problems: Illness Behavior & Health Services
Utilization Introduction to Applied Sociology
and its Definition Nature & Analysis of Social
Problems; Role of Sociologists Application of
Social Research in Solving Social Problems

inequalities, and ethical
concerns in medical sociology

Course Learning Outcomes:

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

1. Understand the fundamental concepts of sociology & medical sociology, including its definition, scope, and role in healthcare.
2. Analyze the social determinants of health, illness, and healthcare delivery, including the impact of culture, mental health, and rehabilitation.
3. Evaluate the role of sociological perspectives in healthcare settings, including the relationships between patients, paramedics, and healthcare professionals.
4. Apply sociological theories and research methods to study health-related issues, including social disorganization, health