

AGENDA
for
NINETEENTH (19th) MEETING OF BOARD
OF STUDIES OF BOTANY

To be held on
31st July 2025



DEPARTMENT OF BOTANY HAZARA
UNIVERSITY MANSEHRA

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F. No. Acad 7(40)/HU-REG/2025/229

July 09, 2025

NOTIFICATION

Consequent upon the recommendations of the Dean, Faculty of Biological and Health Sciences, the Vice Chancellor is pleased to constitute the Board of Studies for the Department of Botany under section 03(2)(i-iv) of *Hazara University Constitution, Functions & Powers of Authorities of the University Statutes, 2016*.

1.	Prof. Dr. Ghulam Mujtaba Shah Chairperson, Department of Botany	Convener	Sec. 3. (2). (i)
2.	Prof. Dr. Zafar Iqbal Professor, Department of Botany	Member	Sec. 3. (2). (ii)
3.	Prof. Dr. Jan Alam Professor, Department of Botany Hazara University, Mansehra	Member	Sec. 3. (2). (ii)
4.	Prof. Dr. Aftab Afzal Professor, Department of Botany Hazara University, Mansehra	Member	Sec. 3. (2). (ii)
5.	Dr. Niaz Ali Associate Professor, Department of Botany Hazara University, Mansehra	Member	Sec. 3. (2). (ii)
6.	Dr. Uzma Khan Associate Professor, Department of Botany Hazara University, Mansehra	Member	Sec. 3. (2). (ii)
7.	Dr. Alia Gul Associate Professor, Department of Botany Hazara University, Mansehra	Member	Sec. 3. (2). (ii)
8.	Dr. Ejaz ul Islam Associate Professor, Department of Botany University of Azad Jammu and Kashmir	Member	Sec. 3. (2). (ii)
9.	Dr. Asad Ullah Director, Centre of Plant Biodiversity University of Peshawar	Member	Sec. 3. (2). (iii)
10.	Dr. Zafar Jamal Associate Professor, GPGC No.1, Abbottabad	Member	Sec. 3. (2). (iii)
11.	Dr. Amjad Hassan Director ORIC, University of Wah, Wah Cant	Member	Sec. 3. (2). (iv)
12.	Dr. Ijaz Hussain Associate Professor, Department of Agriculture University of Haripur	Member	Sec. 3. (2). (iv)

The term of office of members of the Board of Studies other than ex-officio members shall be **three years**. The quorum for meetings of the Board of Studies shall be one-half of the total number of members excluding non-existent categories, a fraction being counted as one.


Assistant Registrar
(Academics)

Copy to:

1. Dean, Faculty of Biological and Health Sciences
2. Chairperson, Department of Botany
3. PS to Vice Chancellor
4. PA to Registrar
5. All Concerned through Department
6. Concerned File

Item # 01: Confirmation of minutes of 18th meeting of the Board of Studies of Botany

Meeting of the 18th Board of Studies of the Department of Botany was held under the chairmanship of the Prof. Dr. Ghulam Mujtaba Shah, Chairman Department of Botany at conference room of the department on January 26, 2022. The following were present at the meeting:

S.No	Name / Designation	Address	Role
1	Prof. Dr. Ghulam Mujtaba Shah (Chairman)	Department of Botany, Hazara University, Mansehra	Convener
2	Prof. Dr. Ghulam Murtaza (Faculty Dean)	Department of Botany, University of AJK, Muzaffarabad	Member
3	Prof. Dr. Azhar Mehmood (Principal)	Govt. Post Graduate College, Mandian Abbottabad	Member
4.	Dr. Abdul Waheed (Director)	NTHRI, Shinkiari, Mansehra	Member
5.	Dr. Niaz Ali (Associate Professor)	Department of Botany, Hazara University, Mansehra	Member
6.	Dr. Aftab Afzal (Associate Professor)	Department of Botany, Hazara University, Mansehra	Member
7	Dr. Jan Alam (Associate Professor)	Department of Botany, Hazara University, Mansehra	Member
8	Dr. Abdul Majid (Assistant Professor)	Department of Botany, Hazara University, Mansehra	By Invitation
9	Dr. Rabia Masood (Lecturer)	Department of Botany, Hazara University, Mansehra	By Invitation

Meeting started with recitation from Holy Quran by Dr. Aftab Afzal Associate Professor, Department of Botany. Professor Dr. Ghulam Mujtaba Shah (Convener of the board) proposed a vote of thanks to all the participants particularly Prof. Dr. Ghulam Murtaza, Dean Faculty of Biological Sciences at University of AJK for travelling a long way to Hazara University. Convener BOS also highlighted the agenda items for the current meeting and requested the board for their valuable input.

The following items were presented before board for thorough revision, comments and suggestions.

Item I: Approval of the new scheme of studies

As per directives of the Academic Council Hazara University, each department of the university had to design a scheme of studies following standard format shared by Directorate of Academics and research. Scheme for Department of Botany was presented. Board requested thorough discussion and suggestions before approval. They were informed that scheme of studies will be included in faculty handbook after its approval from Board of Faculty and Academic Council.

Decision: The Board approved the new scheme of studies after thorough discussion.

Item # 02: Approval of Revised Curriculum for BS (4 Years) Botany as per HEC undergraduate policy

The curriculum model for BS Botany was presented before the Board. After thorough discussion and input from the external members.

Decision: Board approved the revised curriculum for BS Botany and recommended it for further process through higher bodies.

Item # 03: Approval of Revised Curriculum for MPhil and PhD in Botany as per HEC graduate policy

The curriculum model for MPhil and PhD Botany g was presented before the Board, after thorough discussion and input from the external members, the curriculum for MPhil and PhD was approved.

Decision: Board approved the revised curriculum for MPhil and PhD in Botany and recommended it for further process through higher bodies.

Meeting ended with a vote of thanks

*(PROF. DR. Ghulam Mujtaba Shah)
Chairman
Department of Botany
Hazara University Mansehra*

Item II

SCHEME OF STUDIES FOR BS BOTANY

Item # 02. The Revised curriculum model for the BS Botany:

The program meets all the requirement of the Undergraduate Education Policy (UGEP) Version 1.1 of Higher Education Commission of Pakistan which is effective from Fall, 2023. As per Undergraduate Education Policy (UGEP) Version 1.1, the program of BS Botany will be offered with a minimum of 132 credit hours.

As per HEC undergraduate Policy 2023, the curriculum for BS Botany is designed following international academic standards and structure, where all courses are divided into different categories. These categories are:

S. No.	Category	No. of Courses	Credit Hours
1	General Education (or University Requirement courses)	13	32
2	Interdisciplinary/Allied Courses (Supporting Courses)	04	12
3	Discipline-Specific Foundation/Major/Core Courses	24	72
4	Minor/Elective Courses	04	12
5	Field Experience/ Internship	01	03
6	Capstone Project	01	03
	Total Credit Hours		134

Scheme of Studies (BS Botany): The whole program is divided into eight semesters as follows:

Code	Title	Cr Hr		Code	Title	CrHr
	Year 1, Semester I				Year 1, Semester II	
XXX	General Education-I	3 (3+0)		XXX	General Education- V	3 (3+0)
XXX	General Education-II	3 (2+1)		XXX	General Education-VI	2 (2+0)
XXX	General Education-III	3 (3+0)		XXX	General Education-VII	3 (3+0)
XXX	General Education- IV	3 (2+1)		XXX	Interdisciplinary-I	3 (2+1)
XXX	Major-I	3 (2+1)		XXX	Interdisciplinary-II	3 (2+1)
XXX	Major-II	3 (3+0)		XXX	Major-III	3 (3+0)
	Year 2, Semester III				Year 2, Semester IV	
XXX	General Education VIII	2 (2+0)		XXX	General Education-XI	2 (2+0)
XXX	General Education IX	2 (2+0)		XXX	General Education-XII	2 (2+0)
XXX	General Education-X	2 (2+0)		XXX	General Education-XIII	2 (2+0)
XXX	Interdisciplinary-III	3 (2+1)		XXX	Major-V	3 (3+0)
XXX	Interdisciplinary-IV	3 (2+1)		XXX	Major-VI	3 (3+0)
XXX	Major-IV	3 (2+1)			Major-VII	3 (2+1)
XXX	Minor-I	3 (2+1)		XXX	Major-VIII	3 (2+1)
	Year 3, Semester V				Year 3, Semester VI	
XXX	Major-IX	3 (2+1)		XXX	Major-XV	3 (2+1)
XXX	Major-X	3 (2+1)		XXX	Minor-II	3 (2+1)
XXX	Major-XI	3 (2+1)		XXX	Major-XVI	3 (2+1)
XXX	Major-XII	3 (2+1)		XXX	Minor-III	3 (2+1)
XXX	Major-XIII	3 (2+1)		XXX	Major-XVII	3 (2+1)
XXX	Major-XIV	3 (3+0)		XXX	Major-XVIII	3 (2+1)

	Year 4, Semester VII					
XXX	Minor-IV	3 (2+1)		XXX	Major-XXI	3 (2+1)
XXX	Minor-V	3(2+1)		XXX	Major-XXII	3 (2+1)
XXX	Major-XIX	3 (2+1)		XXX	Major-XXIII	3 (2+1)
XXX	Major-XX	3(2+1)		XXX	Major-XXIV	3 (2+1)
XXX	Field Experience/Internship	3 (0+3)		XXX	Capstone Project	3 (0+3)

Details of General Education Courses as per HEC policy 2023

The minimum requirement for the general education component is 32 credits in all the undergraduate/equivalent degree programs. Universities may, however, add more courses as and when required provided that the minimum credits and course categories as prescribed in this policy are maintained. The students will be required to complete 13 courses, i.e., 32 Cr Hrs. from the list given below.

S. No.	General education Clusters (Details)	Credit Hours
1	Art and Humanity* (Philosophy, History, Creative Arts, etc.)	2 (2+0)
2	Natural Sciences* (Physics, Chemistry, Geology, Biology, Ecology, etc.)	3 (2+1)
3	Social Sciences* (Anthropology, Economics, Psychology, Sociology, Social Work, Political Science, International Relations etc.)	2 (2+0)
4	Functional English** (grammar, vocabulary and the use of English in its authentic context etc.)	3 (3+0)
5	Expository Writing** (Academic writing including technical and report writing skills etc.)	3 (3+0)
6	Quantitative Reasoning-I**	3 (3+0)
7	Quantitative Reasoning-II**	3 (3+0)
8	Islamic Studies** (OR) Religious Education/Ethics in lieu of Islamic Studies only for non-Muslim students	2 (2+0)
9	Ideology and Constitution of Pakistan ** (Constitution of the Islamic Republic of Pakistan concerning the fundamental rights and responsibilities of Pakistani citizens.)	2 (2+0)
10	Applications of Information and Communication Technologies (ICT) **(areas of knowledge within the application of ICT tools, software, and systems as to enhance productivity,	3 (2+1)

	communication, decision-making, and problem-solving across different domains)	
11	Entrepreneurship**(Learning components of ‘Financial Literacy’ and ‘Export Management’ are also included in the learning outcomes of the course to provide students with a holistic understanding of business in priority areas of the economy)	2 (2+0)
12	Civics and Community Engagement **	2 (2+0)
13	Introduction to Pakistan Studies	2 (2+0)
Total		32
* University may offer any course within the specific broader subject domain/cluster to meet the given credits. ** HEC designed model courses may be used by the university.		

List of Allied/Interdisciplinary Courses (I)

Interdisciplinary courses will be offered in allied or complementary disciplines to reinforce the notion of interdisciplinary competency and to support the horizon of the major. All the undergraduate/equivalent degree programs shall be comprised of a mandatory set of minimum 12 credit hours for interdisciplinary/allied courses and is valid for all undergraduate/equivalent degree programs.

Course Code	Title	Credit Hours
ZOOL100	Fundamental of Zoology	3 (2+1)
MIC100	Fundamentals of Microbiology	3 (2+1)
BCH101	Introductory Biochemistry	3 (2+1)
ENV320	Remote Sensing and GIS	3 (2+1)
ENV330	Environmental Management System	3 (2+1)
ENV421	Climate Change	3 (3+0)
ENV432	Natural Resource Management	3 (3+0)
ENV443	Public Health and Environment	3 (3+0)
CHM111	Organic Chemistry	3 (2+1)
CHM112	Inorganic Chemistry	3 (2+1)

**AREA/FIELD SPECIALIZATION CODES AND ASSIGNED COURSE CODES FOR
BOTANY**

CORE COURSES, FOUNDATION COURSES AND ELECTIVE COURSES

Area of Specialization	Specialization Code	Course Code	Subjects Falling in the area	Credit hours
Fungi and Lower Plants	0	BOT201	Plant Diversity I	3(2+1)
		BOT302	Virology and Bacteriology	3(2+1)
		BOT303	Phycology and Bryology	3(2+1)
		BOT304	Mycology and Plant Pathology	3(2+1)
		BOT405	Applied Plant Pathology	3(2+1)
		BOT406	Fresh Water Algae of Pakistan	3(2+1)
		BOT407	Bryophytes Diversity of Pakistan	3(2+1)
Plants Taxonomy Systematics and Anatomy	1	BOT211	Plant Diversity II	3(2+1)
		BOT212	Morphology of vascular plants	3(2+1)
		BOT213	Plant Taxonomy and Anatomy	3(2+1)
		BOT314	Diversity of vascular plants	3(2+1)
		BOT315	Plant Systematics I	3(2+1)
		BOT316	Plant Systematics II	3(2+1)
		BOT317	Anatomy of vascular plants	3(2+1)
		BOT418	Phytogeography	3(2+1)
		BOT419	Dendrochronology	3(2+1)
Cell Biology, Genetics and Biochemistry	2	BOT121	Cell Biology	3(2+1)
		BOT222	Genetics and Evolution	3(2+1)
		BOT323	Genetics I	3(2+1)
		BOT424	Genetics II	3(2+1)
		BOT425	Plant Biochemistry	3(2+1)
		BOT426	Genetic Engineering	3(2+1)
		BOT427	Plant Cell and Tissue Culture	3(2+1)
		BOT428	Bioinformatics	3(2+1)
		BOT429	DNA Barcoding	3(2+1)
Plant Physiology and Ecology	3	BOT100	Ecology	2+0
		BOT231	Plant Physiology and Ecology	3(2+1)
		BOT332	Plant Physiology I	3(2+1)
		BOT433	Plant Physiology II	3(2+1)
		BOT334	Plant Ecology I	3(2+1)
		BOT435	Plant Ecology II	3(2+1)
		BOT436	Vegetation Analysis	3(2+1)
		BOT437	Stress Physiology	3(2+1)
		BOT438	Habitat Restoration and Management	3(2+1)
Applied Botany	4	BOT 441	Conservation Biology	3(2+1)
		BOT 442	Environmental Biology	3(2+1)
		BOT 443	Economic Botany	3(2+1)
		BOT 444	Pharmacognosy	3(2+1)
		BOT 445	Biodiversity Conservation	3(2+1)
		BOT 446	Herbarium Techniques	3(2+1)

		BOT 447	Phytochemistry	3(2+1)
Internship	5	BOT452	Internship	3
Capstone Project/ Thesis	5	BOT451	Capstone project/ Thesis	3

DISCIPLINE SPECIFIC FOUNDATION COURSES

Course Code	Course Title	Credit hours	Pre-Requisite
BOT201	Plant Diversity I	3(2+1)	None
BOT211	Plant Diversity II	3(2+1)	BOT201
BOT212	Morphology of Vascular Plants	3(2+1)	None
BOT213	Plant Taxonomy and Anatomy	3(2+1)	BOT212
BOT 222	Genetics and evolution	3(2+1)	BOT121
BOT231	Plant Physiology and Ecology	3(2+1)	None

DISCIPLINE SPECIFIC CORE COURSES

Course Code	Course Title	Credit hours	Pre-Requisite
BOT302	Virology and Bacteriology	3(2+1)	MIC100, BOT201
BOT303	Phycology and Bryology	3(2+1)	BOT201
BOT304	Mycology and Plant Pathology	3(2+1)	BOT201
BOT314	Diversity of Vascular Plants	3(2+1)	BOT211
BOT315	Plant Systematics I	3(2+1)	BOT211, BOT213
BOT316	Plant Systematics II	3(2+1)	BOT212, BOT213
BOT317	Anatomy of Vascular Plants	3(2+1)	BOT213
BOT323	Genetics I	3(2+1)	BOT121, BOT222
BOT424	Genetics II	3(2+1)	BGE203, BOT222
BOT425	Plant Biochemistry	3(2+1)	BCM 323
BOT332	Plant Physiology I	3(2+1)	BOT231
BOT433	Plant Physiology II	3(2+1)	BOT231
BOT334	Plant Ecology I	3(2+1)	BOT231
BOT435	Plant Ecology II	3(2+1)	BOT231
BOT441	Conservation Biology	3(2+1)	BOT201, BOT,211
BOT442	Environmental Biology	3(2+1)	Core courses

SPECIALIZED/ ELECTIVE COURSES

Course Code	Course Title	Area of Specialization	Credit hours	Pre-Requisite
BOT405	Applied Plant Pathology	Fungi and Lower Plants	3(2+1)	Core Courses
BOT406	Fresh Water Algae of Pakistan		3(2+1)	Core Courses
BOT407	Bryophytes Diversity of Pakistan		3(2+1)	Core Courses
BOT418	Phytogeography	Plant Systematics and Anatomy	3(2+1)	Core Courses
BOT419	Dendrochronology		3(2+1)	Core Courses
BOT426	Genetic Engineering	Cell Biology, Genetics and Biochemistry	3(2+1)	Core Courses
BOT427	Plant Cell and Tissue Culture		3(2+1)	Core Courses
BOT428	Bioinformatics		3(2+1)	Core Courses
BOT429	DNA Barcoding		3(2+1)	Core Courses
BOT436	Vegetation Analysis	Plant Physiology and Ecology	3(2+1)	Core Courses
BOT437	Stress Physiology		3(2+1)	Core Courses
BOT438	Habitat Restoration and Management		3(2+1)	Core Courses
BOT443	Economic Botany	Applied Botany	3(2+1)	Core Courses
BOT444	Pharmacognosy		3(2+1)	Core Courses
BOT445	Biodiversity Conservation		3(2+1)	Core Courses
BOT446	Herbarium Management		3(2+1)	Core Courses
BOT447	Phytochemistry		3(2+1)	Core Courses

FACULTY REQUIRED COURSES

Course Code	Course Title	Credit hours	Pre-Requisite
BOT121	Cell Biology	3(2+1)	None
MIC100	Microbiology	3(2+1)	None
BCH111	Biochemistry	3(2+1)	None
BGE203	Molecular Biology	3(2+1)	None

ACADEMIC MERGING COURSES

Course Code	Course Title	Credit hours	Pre-Requisite
MIC230	General Immunology	3(2+1)	None

BGE323	Genetic Engineering	3(2+1)	None
BGE224	Cell and Tissue Culture	3(2+1)	None
BGE205	Introduction to Biotechnology	3(2+1)	None
BGE101	Principles of Genetics	3(2+1)	None
BI141	Introduction to Bioinformatics	3(2+1)	None
MIC311	Biosafety and Biosecurity	3(2+1)	None

SUPPORTING COURSES

Course Code	Course Title	Credit hours	Pre-Requisite
CHEM151	Inorganic Chemistry	3(2+1)	None
CHEM161	Organic Chemistry	3(2+1)	None
ZOOL112	Diversity of Animals- Invertebrates	3(2+1)	None
ZOOL113	Diversity of Animals Chordates	3(2+1)	None

Item # 03. The Revised general education and supporting curricula for the BS Botany:

Semester-I ENG100 Functional English

Course Title : Functional English

Course Code : ENG100

Offered to : Undergraduate Students at Hazara University

CrHr : 3 (3+0)

Pre-requisite : None

Course Objective:

The course aims at enhancing students' skill and competence in communicating their ideas in writing and speaking in English language. It will primarily focus on four areas of language to help the students achieve proficiency in language use, develop skills in listening comprehension, improve reading efficiency, use the conventions of standard written English with skill and assertion, build-up vocabulary, and clearly and accurately reproduce specific data. It will illustrate the force and effectiveness of simple and direct English.

Course Learning Outcome (CLOs):

- To enable students to know the correct usage of English grammar in writing and speaking
- To enable students to improve their speaking ability in English both in terms of fluency and comprehensibility
- To enable students to increase their reading speed and comprehension of academic articles
- To enable students to improve their reading fluency skills through extensive reading
- To enable students to enlarge their vocabulary by keeping a vocabulary journal

Course Contents:

- Parts of Speech
- Figures of Speech
- Direct/Indirect Narration
- Punctuation
- Reading Comprehension
- Listening Comprehension
- Common Writing Errors
- Writing Techniques
- Paragraph Writing
- Essay Writing

- Storytelling
- Letter Writing • Autobiography

Teaching Methodology:

- Student-centered teaching through communicative approach
- Situational learning through lectures, classroom activities, and practice sessions
- Multimedia-based lectures
- Computer-facilitated lessons and strategies
- Classroom dynamics through maximization of interactive learning
- Field visits to incorporate hands-on experience

General Information:

- Late, missing, or plagiarized work will carry no credit.

Marks Distribution: (existing mark distribution can be used).

- Quizzes - 10%
- Assignments/ Presentation or case study - 10 %
- Midterm Examination - 30%
- Final Examination - 50%

Week-Wise Distribution:

Week #	Topics to be covered
Week 1	Course Orientation/Introduction Session
Week 2	Pronunciation/Parts of Speech
Week 3	Figures of Speech
Week 4	Punctuation/Direct/Indirect Narration
Week 5	Parallel Structure/Subject-Verb agreement
Week 6	Reading Comprehension: Skimming/Scanning/Evaluating/Analysing
Week 7	Reading Comprehension: Reading for gist, theme, and meaning
Week 8	Topic Sentence, Controlling Idea, Supporting Sentences, Concluding Sentence, Thesis Statement, Paragraphing
Week 9	Mid Term Examination
Week 10	Sentence Structure + Paragraph Writing Techniques
Week 11	Creative Writing: Brainstorming, Paragraph Writing (Descriptive)

Week 12	Creative Writing: Brainstorming, Essay Writing (Narrative)
Week 13	Picture Story
Week 14	Informal Letter Writing
Week 15	Vocabulary Building/Extension/ Effective Use of Words Context Clues (Situational and Verbal) Synonyms and Antonyms Suffixes and Prefixes Acronyms and Homonyms
Week 16	Final Examination

Reference Books (latest Editions):

1. Edith Schwager, *Better Vocabulary*, (Latest Edition)
2. Henry Thomas, *Better English Made Easy*, (Latest Edition)
3. John Langan, *College Writing Skills*, 7th Edition
4. Deviato, J., *The Essential Elements of Public Speaking*. Boston: Allyn and Bacon, 2003

CHEM151 Introductory Chemistry

Course Title :	Introductory Chemistry
Course Code :	CHEM151
Offered to :	Undergraduate students at Hazara University
CrHr :	3 (2+1)
Pre-requisite :	None
Course Objective:	

The primary objective of the course is to learn students about the basics concept of Chemical bonding, Acid-Base chemistry and P-block elements as well as using the qualitative and quantitative analysis of inorganic compounds during laboratory work.

Course Learning Outcome (CLOs):

- To enable students to know about the basic of chemistry
- To enable students to understand various parts of bonds, Covalent and Ionic etc.
- To enable students to understand various theories, acid base concept, chemical equilibrium and p-block elements.

Course Contents:

Chemical Bonding:

- Types of chemical bonding,
- Ionic and covalent bonds, localized bond approach,
- Theories of chemical bonding, valence bond theory,
- Hybridization and resonance,
- Prediction of molecular shapes using valence shell pair electrons model,
- Molecular orbital theory applied to diatomic molecules, delocalized approach to bonding, bonding in electron deficient compounds, hydrogen bonding.

Acids and Bases:

- Brief concept of chemical equilibrium,
 - Acids and bases including soft and hard acid and bases,
 - Concept of relative strength of acids and bases, significance of pH, pKa, pKb and buffer solution, theory of indicators, solubility and solubility products, • Common ion effect and their applications.
- ### p-Block elements
- Physical and chemical properties of p-Block elements with emphases with some representative compounds, inter-halogen, pseudo halogen and polyhalides.

Teaching Methodology:

- Student-centered teaching through communicative approach
 - Multimedia-based lectures
 - Classroom dynamics through maximization of interactive learning
 - Labs and industrial visits for hands-on experience

General Information:

- Late, missing, or plagiarized work will carry no credit.

Marks Distribution: (existing mark distribution can be used).

- Quizzes - 10%
- Assignments/ Presentation or case study - 10 %
- Midterm Examination - 30%
- Final Examination - 50% **Week-Wise Distribution:**

Week #	Topics to be covered
Week 1	Types of chemical bonding, Ionic and covalent bonds
Week 2	Localized bond approach, theories of chemical bonding,

Week 3	Valance bond theory, hybridization and resonance
Week 4	Prediction of molecular shapes using valance shell pair electrons model
Week 5	Molecular orbital theory applied to diatomic molecules,
Week 6	Delocalized approach to bonding, bonding in electron deficient compounds, hydrogen bonding.
Week 7	Brief concept of chemical equilibrium,
Week 8	acids and bases including soft and hard acid and bases
Week 9	Mid Term Examination
Week 10	Significance of pH, pK_a , pK_b and buffer solution
Week 11	Theory of indicators, solubility and solubility products
Week 12	Common ion effect and their applications
Week 13	Physical and chemical properties of p-Block elements with emphases with some representative compounds,
Week 14	Inter-halogen
Week 15	Pseudo halogen and polyhalides
Week 16	Final Examination

Recommended Books

BGE102 Cell Biology

Course Title : Cell Biology
 Course Code : BGE102
 Offered to : Undergraduate Students at Hazara University
 CrHr : 3 (2+1)
 Pre-requisite : None

Course Objective:

- To explain the basic concept of cell biology.

- To understand cellular structure, composition of the organelles, cell growth and cellular division.
- To explain how macromolecules and organelles govern the dynamic organization, function of living cell.

Course Learning Outcome (CLOs):

- Upon successful completion of the course, the students will be able to; ● Acquaint the students with the basic concepts of cell biology.
- Understand the metabolic processes of cell in terms of cellular organelles, membranes, and biological molecules.
- Understand the role of macromolecules regulating cellular processes.
- Formulate the critical thinking skills and knowledge on cell.

Course Contents:

INTRODUCTION TO CELL STRUCTURE AND FUNCTION

- Introduction and brief history of cell biology
- Cell theory
- Comparison of plant and animal cells
- Comparison of prokaryotic and eukaryotic cells
- Cell wall structure and composition in prokaryotic and eukaryotic cells

CELL MEMBRANE

- Structural model
- Chemical composition and function

CELL ORGANELLES (structure and function)

- Endoplasmic reticulum
- Golgi Bodies
- Mitochondria
- Lysosome
- Microbodies (Peroxisomes and Glyoxisomes)
- Ribosome
- Plastids
- Dictyosomes

NUCLEUS

- Structure and function
- Nuclear membrane
- Ultrastructure and morphology of chromosomes.

CYTOSKELETON

- Structure and types

- Function of cytoskeleton

CELLULAR REPRODUCTION

- Cell cycle and apoptosis
- Mitosis
- Meiosis

Lab Practicals:

- Study of prokaryotic and eukaryotic cell.
- Study of different cell organelles by staining.
- Study of Mitosis in onion roots
- Study of Meiosis in pollens

Teaching Methodology:

- Student-centered teaching through communicative approach
- Situational learning through lectures and real-life examples
- Multimedia-based lectures
- Classroom dynamics through maximization of interactive learning

General Information:

- Late, missing, or plagiarized work will carry no credit.

Marks Distribution: (existing mark distribution can be used).

- Quizzes - 10%
- Assignments/ Presentation or case study - 10 %
- Midterm Examination - 30%
- Final Examination - 50%

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Week-Wise Distribution:

Week #	Topics to be covered
Week 1	Introduction and brief history of cell biology, Cell theory
Week 2	Comparison of plant and animal cells
Week 3	Comparison of prokaryotic and eukaryotic cells
Week 4	Cell membrane
Week 5	Structural models

Week 6	Chemical composition and function
Week 7	Cell organelles (structure and function)
Week 8	a. Endoplasmic reticulum b. Golgi Bodies c. Mitochondria d. Lysosome
Week 9	Mid Term Examination
Week 10	a. Microbodies (Peroxisomes and Glyoxisomes) b. Ribosome c. Plastids d. Dictyosomes
Week 11	Nucleus, Structure, and function
Week 12	Nuclear membrane, Ultrastructure, and morphology of chromosomes.
Week 13	Cytoskeleton, Structure and types, Function of cytoskeleton
Week 14	Cellular reproduction, Cell cycle, and apoptosis.
Week 15	Mitosis and Meiosis
Week 16	Final Examination

Recommended Books:

Latest editions of following books will be followed.

1. De. Robertis, E.D.P and De. Robertis jr, E.M.F. Cell and Molecular Biology, CCH, a Wolters Kluwer Business, New York.
2. Alberts. B. Molecular Biology of the Cell Taylor and Francis, Inc.
3. Karp, G. Cell and Molecular Biology, Study Guide: Concepts and Experiments. Wiley, John and Sons Inc.
4. Lodish, H., Berk, A., Kaiser, C. A., M Krieger; Bretscher, A., Ploegh, H; Amon, A., Scott, M. Molecular Cell Biology. 7th Edition. W. H. Freeman Company, New York.
5. James, D. W. Molecular Biology of Gene Benjamin Cumming

BGE100 Introduction to Biotechnology

Course Title : Introduction to Biotechnology
Course Code : BGE100
Offered to : Undergraduate students at Hazara University
CrHr : 3 (3+0)
Pre-requisite : None

Course Objectives:

- The outline provides a comprehensive introduction to the field of biotechnology and prepares students to engage with advanced topics in the field to learn about the science behind biotechnology while also looking at how to succeed.
- To acquaint students with the basic concepts and significance of biotechnology as it stands today.

Course Learning Outcome (CLOs):

- The course aims to inspire innovation and creativity in students, fostering a strong research-oriented mindset.
- As a foundational introduction to biotechnology, it provides students with a solid understanding of its core principles and explores its diverse applications across fields such as healthcare, agriculture, industry and the environment.

Course Contents:

- Introduction, concepts and historical background and its importance in modern science and industry.
- Major branches/elements of biotechnology. Basic concept of tissue culture and Genetic engineering.
- Environmental biotechnology (bioremediation, bio-mining, gene environment interaction, gene function).
- Microbial biotechnology: Microbes as a tool in biotechnology, Role of microorganism in biotechnology. Plasmids its types and classification on the basis of characteristics which they code.
- Plant biotechnology: Role of biotechnology for plant improvement. Biotechnological products transgenic plants. Totipotency, differentiation, de-differentiation and redifferentiation. Biological mechanisms and biotechnological approaches of nitrogen fixation.
- Animal and health biotechnology: Application of biotechnological techniques to improve the breeding, health, and productivity of animals. Basic concept of gene therapy, in-vivo and ex-vivo gene therapy, somatic and germ line gene. Genetically modified organisms (GMOs). Potential benefits and risks of GMOs.
- Introduction to DNA Manipulative enzymes. Gene for gene concept. Role of biotechnology in cross tolerance and co-tolerance pathways for stresses.
- Safety in biotechnology; public perception of biotechnology; biotechnology and ethics.

Teaching Methodology:

- Student-centered teaching through communicative approach
- Situational learning through lectures and real-life examples
- Multimedia-based lectures
- Classroom dynamics through maximization of interactive learning **General**

Information:

- Late, missing, or plagiarized work will carry no credit.

Marks Distribution: (existing mark distribution can be used).

- Quizzes - 10%
- Assignments/ Presentation or case study - 10 %
- Midterm Examination - 30%
- Final Examination - 50%

Week-Wise Distribution:

Week #	Topics to be covered
Week 1	Introduction, concepts and historical background and its importance in modern science and industry.
Week 2	Major branches/elements of biotechnology. Basic concept of tissue culture and genetic engineering.
Week 3	Environmental biotechnology (bioremediation, bio-mining, gene environment interaction, gene function
Week 4	Microbial biotechnology: Microbes as a tool in biotechnology, Role of microorganism in biotechnology.
Week 5	Plasmids its types and classification on the basis of characteristics which they code. Role of biotechnology for plant improvement.
Week 6	Biotechnological products transgenic plants.
Week 7	Totipotency, differentiation, de-differentiation and re-differentiation
Week 8	Biological mechanisms and biotechnological approaches of nitrogen fixation
Week 9	Mid Term Examination
Week 10	Application of biotechnological techniques to improve the breeding, health, and productivity of animals
Week 11	Basic concept of gene therapy, in-vivo and ex-vivo gene therapy, somatic and germ line gene.
Week 12	Genetically modified organisms (GMOs). Potential benefits and risks of GMOs.
Week 13	Introduction to DNA Manipulative enzymes. Gene for gene concept.

Week 14	Role of biotechnology in cross tolerance and co-tolerance pathways for stresses.
Week 15	Safety in biotechnology; public perception of biotechnology; biotechnology and ethics.
Week 16	Final Examination

Recommended Books:

1. Bernard R. Glick and Jack J Pasternak (ASM Press). Molecular Biotechnology. 2003.
2. Attridge, C. R. and B. Kristiansen. 2001. Basic Biotechnology, Cambridge University, Press UK.
3. William J. Thieman, Michael A. Palladino, Introduction to Biotechnology (3rd Edition); January, 2012.
4. Ray V Herren , Introduction to Biotechnology ;Jan , 2012.
5. Saini, B. L. Introduction to Biotechnology, Laxmi Publications, Ltd., Feb-2010.
6. Brown T. A., Gene Cloning and DNA Analysis: An Introduction 4th edition, Blackwell Science Inc 2001.

Semester-II	Expository Writing
Course Title :	Expository Writing
Course Code :	XXX
Offered to :	Undergraduate Students at Hazara University
CrHr :	3 (3+0)
Pre-requisite :	None

Course Objectives:

Enable the students to meet their real-life communication needs.

Course Contents:

- Paragraph writing: Practice in writing a good, unified and coherent paragraph
- Essay writing: Introduction
- Translation skills, Urdu to English
- Study skills: Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension
- Academic skills: Letter writing, CV and job application
- Presentation skills Personality development (emphasis on content, style and pronunciation)
- Academic writing How to write a proposal for research paper/term paper, how to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)

- Technical Report writing

Note: Documentaries to be shown for discussion and review

Teaching Methodology:

- Student-centered teaching through communicative approach
- Situational learning through lectures, classroom activities, and practice sessions
- Multimedia-based lectures
- Computer-facilitated lessons and strategies
- Classroom dynamics through maximization of interactive learning
- Field visits to incorporate hands-on experience

General Information:

- Late, missing, or plagiarized work will carry no credit.

Marks Distribution: (existing mark distribution can be used).

- Quizzes - 10%
- Assignments/ Presentation or case study - 10 %
- Midterm Examination - 30%
- Final Examination - 50%

Week-Wise Distribution:

Week #	Topics to be covered
Week 1	Paragraph writing: Practice in writing a good, unified and coherent paragraph
Week 2	Essay writing: Introduction
Week 3	Translation skills, Urdu to English
Week 4	Translation skills, Urdu to English
Week 5	Study skills: Skimming and scanning, intensive and extensive,
Week 6	Study skills: Speed reading, summary and précis writing and comprehension
Week 7	Academic skills: Letter writing, CV and job application
Week 8	Academic skills: Letter writing, CV and job application
Week 9	Mid Term Examination
Week 10	Presentation skills Personality development (emphasis on content, style and pronunciation)

Week 11	Presentation skills Personality development (emphasis on content, style and pronunciation)
Week 12	Academic writing How to write a proposal for research paper/term paper
Week 13	Academic writing How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)
Week 14	Technical report writing
Week 15	Technical report writing
Week 16	Final Examination

Recommended Books

Communication Skills

a) Grammar

1. Practical English Grammar by A. J. Thomson and A. V. Martinet. Exercises 2. 3rd Edition. Oxford University Press 1986. ISBN 019 4313506.

b) Writing

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0194354057, Pages 45-53 (note taking).
2. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0194354065 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).

c) Reading

1. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0194534030.
2. Reading and Study Skills by John Langan 3. Study Skills by Riachard Yorky.

ISL100 Islamic Studies

Course Title : Islamic Studies

Course Code : ISL100

Offered to : Undergraduate Students at Hazara University

CrHr : 3 (3+0) Pre-
requisite : None **Course**

Objective:

This course will provide students with basic information about Islam. It will enhance understanding of the students about Islamic Civilization and their understanding of issues related to faith and religious life.

Course Learning Outcome (CLOs):

- At the end of the course, students will get the following abilities:
- Each week students will learn about fundamental aspects of Islam
- At the end they will be able to acquire advanced knowledge about Islamic history and Civilization
- Their skills to perform prayers and other worships will become improved

Course Contents:

- Introduction to Quran studies, Basic concepts of Quran
- History of Quran, Uloom-ul-Quran **Study of Selected Text of Holly Quran**
- Verses of Surah Al-Baqra Related to Faith (Verse No-284-286)
- Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
- Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
- Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
- Verses of Surah Al-Inam Related to Ihkam(Verse No-152-154) **Study of Selected Text of Holly Quran**
- Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6, 21,40,56,57,58)
- Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
- Verses of Surah Al-Saf Related to Tafakar,Tadabar (Verse No-1,14) **Seerat of Holy Prophet (S.A.W) I**
- Life of Muhammad Bin Abdullah (Before Prophet Hood)
- Life of Holy Prophet (S.A.W) in Makkah
- Important Lessons Derived from the life of Holy Prophet in Makkah **Seerat of Holy Prophet (S.A.W) II**
- Life of Holy Prophet (S.A.W) in Madina
- Important Events of Life Holy Prophet in Madina
- Important Lessons Derived from the life of Holy Prophet in Madina **Introduction to Sunnah**
- Basic Concepts of Hadith, History of Hadith, Kinds of Hadith, Uloom –ul-Hadith
- Sunnah & Hadith, Legal Position of Sunnah **Selected Study from Text of Hadith**
- **Introduction to Islamic Law & Jurisprudence**
- Basic Concepts of Islamic Law & Jurisprudence

- History & Importance of Islamic Law & Jurisprudence
- Sources of Islamic Law & Jurisprudence
- Nature of Differences in Islamic Law, Islam and Sectarianism **Islamic Culture & Civilization**
- Basic Concepts of Islamic Culture & Civilization
- Historical Development of Islamic Culture & Civilization
- Characteristics of Islamic Culture & Civilization
- Islamic Culture & Civilization and Contemporary Issues **Islam & Science**
- Basic Concepts of Islam & Science
- Contributions of Muslims in the Development of Science
- Quran & Science
- Islamic Economic System**
- Basic Concepts of Islamic Economic System
- Means of Distribution of wealth in Islamic Economics
- Islamic Concept of Riba, Islamic Ways of Trade & Commerce **Political System of Islam**
- Basic Concepts of Islamic Political System
- Islamic Concept of Sovereignty
- Basic Institutions of Govt. in Islam **Islamic History**
- Period of Khlaft-E-Rashida
- Period of Ummayyads ● Period of Abbasids
- Social System of Islam**
- Basic Concepts Of Social System Of Islam
- Elements Of Family
- Ethical Values Of Islam

Teaching Methodology:

- Student-centered teaching through communicative approach
- Situational learning through lectures, classroom activities, and practice sessions
- Multimedia-based lectures
- Computer-facilitated lessons and strategies
- Classroom dynamics through maximization of interactive learning
- Field visits to incorporate hands-on experience

General Information:

- Late, missing, or plagiarized work will carry no credit.

Marks Distribution: (existing mark distribution can be used).

- Quizzes - 10%
- Assignments/ Presentation or case study - 10 %
- Midterm Examination - 30%
- Final Examination - 50%

Week-Wise Distribution:

Week #	Topics to be covered
Week 1	Introduction to Quran studies, Basic concepts of Quran, History of Quran, Uloom-ul-Quran
Week 2	Study of Selected Text of Holly Quran Verses of Surah Al-Baqra Related to Faith (Verse No-284-286) Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
Week 3	Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11). Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77) Verses of Surah Al-Inam Related to Ihkam(Verse No-152-154)
Week 4	Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6, 21,40,56,57,58)
Week 5	Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment Verses of Surah Al-Saf Related to Tafakar,Tadabar (Verse No-1,14)
Week 6	Seerat of Holy Prophet (S.A.W) I Life of Muhammad Bin Abdullah (Before Prophet Hood). Life of Holy Prophet (S.A.W) in Makkah. Important Lessons Derived from the life of Holy Prophet in Makkah
Week 7	Seerat of Holy Prophet (S.A.W) II Life of Holy Prophet (S.A.W) in Madina. Important Events of Life Holy Prophet in Madina. Important Lessons Derived from the life of Holy Prophet in Madina
Week 8	Introduction to Sunnah Basic Concepts of Hadith, History of Hadith, Kinds of Hadith, Uloom –ul-Hadith, Sunnah & Hadith, Legal Position of Sunnah
Week 9	Mid Term Examination
Week 10	Selected Study from Text of Hadith Introduction to Islamic Law & Jurisprudence Basic Concepts of Islamic Law & Jurisprudence, History & Importance of Islamic Law & Jurisprudence, Sources of Islamic Law & Jurisprudence, Nature of Differences in Islamic Law, Islam and Sectarianism
Week 11	Islamic Culture & Civilization Basic Concepts of Islamic Culture & Civilization, Historical Development of Islamic Culture & Civilization, Characteristics of Islamic Culture & Civilization, Islamic Culture & Civilization and Contemporary Issues

Week 12	Islam & Science Basic Concepts of Islam & Science, Contributions of Muslims in the Development of Science, Quran & Science Islamic Economic System Basic Concepts of Islamic Economic System, Means of Distribution of wealth in Islamic Economics, Islamic Concept of Riba, Islamic Ways of Trade & Commerce
Week 13	Political System of Islam Basic Concepts of Islamic Political System, Islamic Concept of Sovereignty, Basic Institutions of Govt. in Islam
Week 14	Islamic History Period of Khlaft-E-Rashida, Period of Ummayyads, Period of Abbasids
Week 15	Social System of Islam Basic Concepts of Social System Of Islam, Elements Of Family, Ethical Values Of Islam
Week 16	Final Examination

Reference Books (latest Editions):

1. Hameed Ullah Muhammad, "Emergence of Islam", IRI, Islamabad
2. Hameed Ullah Muhammad, "Muslim Conduct of State"
3. Hameed Ullah Muhammad, 'Introduction to Islam
4. Hussain Hamid Hassan, "An Introduction to the Study of Islamic Law" leaf Publication Islamabad, Pakistan.
5. Ahmad Hasan, "Principles of Islamic Jurisprudence" Islamic Research Institute, International Islamic University, Islamabad (1993)
6. Mir Waliullah, "Muslim Jurisprudence and the Quranic Law of Crimes" Islamic Book Service (1982)
7. H.S. Bhatia, "Studies in Islamic Law, Religion and Society" Deep & Deep Publications New Delhi (1989)
8. Dr. Muhammad Zia-ul-Haq, "Introduction to Al Sharia Al Islamia" 9. Allama Iqbal Open University, Islamabad (2001).

ZOOL100 Fundamentals of Zoology

Course Title : Fundamentals of Zoology
Course Code : ZOOL100
Offered to : BS Students at Hazara University
CrHr : 3 (2+1)
Pre-requisite : None

Course Objectives:

Fundamentals of zoology will enable students to understand the Taxonomic characteristics of chordates. It will impart knowledge about the phylogenetic relationship of protochordates and various classes of chordates. It will also develop critical thinking about phylogeny of chordates with respect to their physiological adaptation, behavior, and ecology

Course Learning Outcomes (CLOs):

Upon successful completion of the course, the students will be able to;

- To acquire the basic knowledge of taxonomic characteristics of chordates.
- To understand the phylogenetic relations and diversity of pisces, amphibians, reptiles and mammals.
- To analyse the process of microevolution within chordates.
- To demonstrate individually phylogenetic relationships of chordates and their diversity.

Course Contents:

PROTOCHORDATES

- Classification of protochordates.
- Structure, anatomy and organ system of Acorn worms, Urochordates and Cephalochordate.
- Reproduction; life histories and metamorphosis of prochordates.
- Phylogenetic relationship.

FISHES:

- Vertebrate success in water.
- Phylogenetic relationships of pisces.
- Classification of chondrichthyes, osteichthyes, Dipnoi and Holocephali.
- Locomotory adaptations, nutrition and the digestive system, circulation, gas exchange, nervous and sensory functions, excretion and osmoregulation, reproduction/and development of Chondrichthyes (Scoliodon) and Osteichthyes (Cyprinus carpio and Wallago attu).

AMPHIBIANS:

- The first terrestrial vertebrates. Characteristics of amphibians
- phylogenetic relationship
- Classification of amphibians and characteristics of order Caudata, Gymnophiona and Anura.
- Structure and locomotory adaptation, nutrition and the digestive system, circulation, gas exchange, temperature regulation, nervous and sensory functions, excretion.
- Osmoregulation, reproduction, development and metamorphosis of Caudata, Anura and Gymnophiona.

REPTILE:

- The first Amniotes and cladistic interpretation of the amniotic lineage. General characteristics of reptiles.
- Characteristics of order Testudines or Chelonia, Rynchocephelia, Squamata and Crocodilian.
- Adaptations in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange and temperature osmoregulation, reproduction and development of helonia, squamata, Rhynchocephalia and crocodilian.
- Further phylogenetic consideration.

BIRDS:

- Classification, Feathers, Flight and endothermy.
- Phylogenetic relationship; ancient birds and the evolution of flight.
- Diversity of modern birds.
- Adaptations in external structure and locomotion , nutrition and the digestive system ,circulation, gas exchange and regulation, nervous and sensory functions, excretion and osmoregulation, reproduction and development.
- Migration and navigation.

MAMMALS

- Classification, specialized teeth, endothermy, hair and viviparity.
- Diversity of mammals.
- Adaptations in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange and temperature regulation , nervous and sensory function, excretion and osmoregulation, behavior, reproduction and development.

Teaching Methodology:

- Student-centered teaching through communicative approach
- Multimedia-based lectures
- Situation learning through lectures, classroom activities, and practice sessions
- Classroom dynamics through maximization of interactive learning
- Field visits to incorporate hands-on experience

General Information:

- Late, missing, or plagiarized work will carry no credit.

Marks Distribution: (existing mark distribution can be used).

- Quizzes - 10%
- Assignments/ Presentation or case study - 10 %
- Midterm Examination - 30%
- Final Examination - 50%

Week-Wise Distribution:

Week #	Topics to be covered
Week 1	Protochordates 1 (classification, structure)
Week 2	Protochordates 2 (reproduction, phylogenetic relationship)
Week 3	Fishes 1 (classification, structure)
Week 4	Fishes 2 (reproduction, phylogenetic relationship)
Week 5	Amphibians 1 (classification, structure)
Week 6	Amphibians 2 (reproduction, phylogenetic relationship)
Week 7	Reptiles 1 (classification, structure)
Week 8	Reptiles 2 (reproduction, phylogenetic relationship)
Week 9	Mid Term Examination
Week 10	Birds 1 (classification, structure)
Week 11	Birds 2 (reproduction, phylogenetic relationship)
Week 12	Mammals 1 (classification, structure)
Week 13	Mammals 2 (reproduction, phylogenetic relationship)
Week 14	Mammals 3 (Diversity of mammals)
Week 15	Mammals 4 (Adaptation)
Week 16	Final Examination

Reference Books (latest Editions):

1. Campbell, N.A Biology. 9th Ed 2011. Menlo park, California Benjamin/Cummings Publishing Company, inc
2. Miller, S.A and Harley, J.B. 2010. Zoology, 8th Edition (International) Singapore: McGraw Hill.

3. Miller, M.A 2002. General Zoology Laboratory Manual 5th Ed. (International), Singapore: McGraw Hill.
4. Hickman, C.P, Roberts, L.S and Larson, A. Integrated principles of Zoology, 14th Edition (international), 2009. Singapore: McGraw Hill.
5. Pechenik, J.A. Biology of Invertebrates, 4th Edition (International), 2000. Singapore: McGraw Hill.

MIC100 Fundamentals of Microbiology

Course Title : Fundamentals of Microbiology
 Course Code : MIC100
 Offered to : Undergraduate Students at Hazara University
 Cr Hr. : 3(2+1)
 Pre-requisite : None

Course Objectives:

- To become familiar with the foundation concepts of Microbiology
- To gain the knowledge of microscopy, culturing and staining concepts
- To understand the structure and functions of microorganisms
- To understand the concept of microbial control

Course Learning Outcome (CLOs)

At the end of the course, students should be able to:

- Demonstrate basic knowledge of the main microbiological techniques to be applied in the laboratory
- Demonstrate and follow the basic techniques of sterilization, isolation, and culturing
- Work with microorganisms and follow the safety measures while handling microbes

Course Contents:

- Introduction to Microbiology
- Microorganisms and their Respective place in the World
- Differentiation Between Pro and Eukaryotic Cells
- Historical Development of Microbiology and its Scope
- Microscopy; Types, Principles and Staining Techniques
- Bacterial Cell Morphology and Arrangements
- Detailed Anatomy of Bacterial Cell (Glycocalyx, Flagella, Fimbriae, Pili, Cell Wall, Plasma Membrane, Cytoplasm, Nucleoid, Ribosomes, Inclusion Bodies, Endospore)
- Growth, Nutrition (physical and nutritional requirement and nutritional types; sources of energy, C, N, H, O, S, P, H₂O, trace elements, growth factors) and Reproduction
- Bacterial Taxonomy and nomenclature, basis of classification of bacteria

- Measurement of Bacterial Growth by Direct & Indirect Methods
- Culture Media and its Types
- Basic properties of fungi, protozoa and algae
- An introduction to structure, size range, and propagation of viruses
- Control of microorganisms by physical and chemical methods

Practical

- Laboratory Safety Procedures: Containment and decontamination.
- An introduction to microscopy
- Principles of Staining Procedures: Simple staining, Gram's staining, Acid-fast staining, Cell Wall Staining, Capsule staining and Endospore staining.
- Study of cell motility by hanging drop preparation.
- Preparation and sterilization of bacteriological media and glassware.
- Inoculation techniques and culture media

Teaching Methodology:

- Student-centered teaching through communicative approach
- Situational learning through lectures, classroom activities, and practice sessions
- Multimedia-based lectures
- Computer-facilitated lessons and strategies
- Classroom dynamics through maximization of interactive learning
- Field visits to incorporate hands-on experience

General information:

- Late, missing, or plagiarized work will carry no credit.

Marks Distribution: (existing mark distribution can be used).

- Quizzes - 10%
- Assignments/ Presentation or case study - 10 %
- Midterm Examination - 30%
- Final Examination - 50%

Week-Wise Distribution:

Week#	Topic to be covered
Week 1	Introduction to Microbiology
Week 2	Microorganisms and their Respective place in the World
Week 3	Differentiation Between Pro and Eukaryotic Cells
Week 4	Historical Development of Microbiology and its Scope
Week 5	Microscopy; Types, Principles and Staining Techniques
Week 6	Bacterial Cell Morphology and Arrangements

Week 7	Detailed Anatomy of Bacterial Cell
Week 8	Growth, Nutrition and Reproduction of bacteria (Continued)
Week 9	Midterm Examination
Week 10	Growth, Nutrition and Reproduction of bacteria
Week 11	Bacterial Taxonomy and nomenclature, basis of classification of bacteria
Week 12	Culture Media and its Types
Week 13	Measurement of Bacterial Growth by Direct & Indirect Methods Culture Media and its Types
Week 14	Basic properties of fungi, protozoa and algae
Week 15	Control of microorganisms by physical and chemical methods
Week 16	Final Examination

Reference Books (Latest Editions):

1. Talaro, K. P. Foundations in Microbiology: Basic Principles, McGraw-Hill Companies, N.Y.
2. Tortora, G. J., Funke, B. R. and Case, C. L. Microbiology: An Introduction, Benjamin Cummings Publishing Company, U.S.A.
3. Black, J. G. Microbiology: Principles & Explorations, John Wiley and Sons, N.Y.
4. Parker, N., Scheegurt, M., Tu, A. T., Forster. B. M. and Lister, P. Microbiology. Openstax.
5. Prescott et al., Microbiology. McGraw- Hill Medical Publishing.
6. Cappuccino JG and Sherman N, Microbiology: a laboratory manual, Pearson Education.

BGE101 Principles of Genetics

Course Title : Principles of Genetics
 Course Code : BGE101
 Offered to : Undergraduate Students at Hazara University
 Cr. Hr. : 3 (3+0)
 Pre-requisite : Cell Biology

Course Objective:

The course is designed to provide basic concepts of the subject of genetics with special emphasis on Mendelian and Non-Mendelian Inheritance.

Course Learning Outcome (CLOs):

This course will enable students to comprehend:

- Basic principles of inheritance at molecular, cellular, and organismal levels.
- Causal relationships between molecular/cellular processes and organismal patterns of heredity
- Application of this knowledge in a variety of problem-solving situations

Course Contents:

Introduction and history of genetics.

Heredity and variation.

Mendel's laws of inheritance.

Chromosomal theory of inheritance.

Non-Mendelian inheritance (epistasis and its types, lethality and pleiotropism).

Multiple alleles (ABO blood group system) and polygenic traits (Rh factor).

Linkage and crossing over.

Gene mapping.

Sex linkage, sex determination and sex-linked inheritance, sex influenced, sex limited, genomic imprinting and holandric genes.

Qualitative and quantitative inheritance.

Gene and environment: penetrance, expressivity, pleiotropism and phenocopies.

Twin studies. Mutations. Extra-nuclear inheritance: maternal inheritance. Pedigree analysis.

Teaching Methodology:

- Student-centered teaching through communicative approach.
- Situational learning through lectures, classroom activities, and practice sessions.
- Multimedia-based lectures.
- Computer-facilitated lessons and strategies.
- Classroom dynamics through maximization of interactive learning.

General Information:

- Late, missing, or plagiarized work will carry no credit.

Marks Distribution: (existing mark distribution can be used).

- Quizzes - 10%
- Assignments/ Presentation or case study - 10 %
- Midterm Examination - 30%
- Final Examination - 50%

Week-Wise Distribution:

Week #	Topics to be covered
Week 1	Orientation, Introduction and history of genetics
Week 2	Basic concepts, Heredity and variation.
Week 3	Mendel's laws of inheritance. Chromosomal theory of inheritance.
Week 4	Non-Mendelian inheritance, Epistasis and its types
Week 5	Lethality and pleiotropism, Multiple alleles
Week 6	ABO blood group system, Polygenic traits (Rh factor)
Week 7	Linkage, Crossing over
Week 8	Gene mapping, Sex linkage
Week 9	Mid Term Examination
Week 10	Sex determination, Sex-linked inheritance
Week 11	Sex influenced, Sex limited
Week 12	Genomic imprinting, Holandric genes, Qualitative, Quantitative inheritance
Week 13	Gene and environment: penetrance, Expressivity
Week 14	Pleiotropism and phenocopies, Twin studies. Mutations
Week 15	Extra-nuclear inheritance: maternal inheritance, Pedigree analysis
Week 16	Final Examination

Recommended Books:

1. Principles of Genetics, 7th Edition. D. Peter Snustad, Michael J. Simmons published by Wiley, 2016.
2. Molecular Biology of the Cell, 6th Edition. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Publisher by Garland Science 2014.
3. Histology and Cell Biology: An Introduction to Pathology 3rd Edition by Abraham L Kierszenbaum, Laura L. Tres. Published by Elsevier, 2011.
4. Lewin's GENES XI by Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick. Published by Jones & Bartlett Learning, 2013.
5. Genetics and Cytology: with an Introduction to Evolution. Baquar, R. Published by National Book Foundation. 2007.
6. Genetics: A conceptual approach, 4th Edition. Benjamin Pearce, Published by Freeman and Company. 2012.

7. Genetics: Analysis and Principles. 4th Edition. Brooker R. J. McGraw-Hill Book Co. Bostan. USA. 2011.
8. Introduction to Genetic Analysis. Griffiths, A. J. F, J. H. Miller, D. T. Suzuki, R. C. Lewontin and M. W. Gelbart. Published by Freeman Company, 2005.
9. Essential Genetics: a genomic perspective. 5th edition. Hartl Daniel L. Published by Jones and Bartlett, USA. 2011.

Civics and Community Engagement

Course Title : Civics and Community Engagement
 Course Code : XXX
 Offered to : Undergraduate students at Hazara University
 CrHr : 2 (2+0)
 Pre-requisite : None

Course Objectives:

- This course will serve as an introduction to social ethics, Morals, and Values.
- It will help to enhance sensitization regarding the values of volunteering, global justice, and human rights.
- This course will help to understand the concept of social righteousness, civil rights, religion, and ethics.

Course Learning Outcome (CLOs):

- This course provides an introductory foundation for students' orientation to civic engagement, social action, and the relationship between learning and engaged citizenship.
- The course also introduces students to the contexts, issues, skills, and experiences of citizenship and civic leadership in a democratic society.
- Finally, the course assists students with developing students' readiness to accept personal and social responsibility, as well as their preparation for responsible citizenship.

Course Contents:

Global Ethics: Conceptual Definitions, Historical Origins

And Present Challenges

- Introduction to the course
- Ethics, Morals and Values
- Cultural Relativism vs Universalism **Ethical Theories**
- Principles of Social Ethics
- Kant's theory and Moral agents
- A theory of Moral Justice
- Utilitarianism

- Principlism/Applied Ethics

Social Ethics Norms

- Ethical Decision-making
- Ethical Dilemmas in Practice
- Ethics of Care and Responsibility
- Postmodern ethics
- Religion and ethics

Justice System and Social Ethics

- Human Rights and Social Justice ● Anti-Oppressive Practice

Civic Engagement Process

- Citizenship and Participation ● The Civic Domain
- The practice of Local Culture
- Youth Motivation
- Youth Civic Involvement

Teaching Methodology:

- Student-centered teaching through communicative approach.
- Situational learning through lectures, classroom activities, and practice sessions.
- Multimedia-based lectures.
- Computer-facilitated lessons and strategies.
- Classroom dynamics through maximization of interactive learning.

General Information:

- Late, missing, or plagiarized work will carry no credit.

Marks Distribution: (existing mark distribution can be used).

- Quizzes - 10%
- Assignments/ Presentation or case study - 10 %
- Midterm Examination - 30%
- Final Examination - 50%

Week-Wise Distribution:

Week #	Topics to be covered
1 to 2	Global Ethics: Conceptual Definitions, Historical Origins And Present Challenges ● Introduction to the course ● Ethics, Morals and Values
	● Cultural Relativism vs Universalism

3 to 5	Ethical Theories • Principles of Social Ethics • Kant's theory and Moral agents • A theory of Moral Justice • Utilitarianism • Principlism/Applied Ethics
6 to 8	Social Ethics Norms • Ethical Decision-making • Ethical Dilemmas in Practice • Ethics of Care and Responsibility • Postmodern ethics • Religion and ethics
9	Mid Term Examination
10 to 12	Justice System and Social Ethics • Human Rights and Social Justice • Anti-Oppressive Practice
13 to 15	Civic Engagement Process • Citizenship and Participation • The Civic Domain • The practice of Local Culture • Youth Motivation • Youth Civic Involvement
16	Final Examination

Recommended Books:

1. Anand, S., Peter, F., & Sen, A. (Eds.). (2009). Public health, ethics, and equity. New York: Oxford University Press (Reprinted).
2. Banks, S. (2012). *Ethics and values in social work*. Macmillan International Higher Education.
3. Beauchamp T.L., DeGrazia D. (2004) Principles and Principlism. In: Khush f G. (eds) Handbook of Bioethics. Philosophy and Medicine, vol 78. Springer, Dordrecht.
4. Crocetti, E., Erentaitė, R., & Žukauskienė, R. (2014). Identity styles, positive youth development, and civic engagement in adolescence. *Journal of youth and adolescence*, 43(11), 1818-1828.
5. Flanagan, C., Martinez, M. L., & Cumsille, P. (2009). Civil societies as developmental and cultural contexts for civic identity formation. In L. Arnett Jensen (Ed.), *Bridging cultural and developmental psychology: New syntheses in theory, research and policy*. New York: Oxford University Press.
6. Gillon, R. (2003). Ethics needs principles—four can encompass the rest—and respect for autonomy should be “first among equals”. *Journal of Medical Ethics*, 29, 307–312.

7. Haker, H. (2013). Synthetic Biology–An Emerging Debate in European Ethics–Part Two. In *Ethics for Graduate Researchers* (pp. 227-239). Elsevier.
8. Hamilton, S. F., & Hamilton, M. A. (2009). The transition to adulthood: Challenges of poverty and structural lag. In R. M. Lerner and L. Steinberg (Eds.), *Handbook of adolescent psychology* (3rd ed.). Volume 2, *Contextual influences on adolescent development* (pp. 492–526). New York: Wiley.
9. Sherrod, L. R., Torney-Purta, J., & Flanagan, C. A. (2010). *Handbook of research on civic engagement in youth*. John Wiley & Sons.

PSY100 Introduction to Psychology

Course Title :	Introduction to Psychology
Course Code :	PSY100
Offered to :	Undergraduate Students at Hazara University
CrHr :	2 (2+0)
Pre-requisite :	None

Course Objective:

- To familiarize the students with history, main concepts, methods and theoretical frameworks in psychology.
- To provide students insight about their mental and emotional processes.
- To develop understanding of learning, perception, motivation and sensations.
- To help students to know what role our environment and our emotions play in our memory enhancement

Course Learning Outcome (CLOs):

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

- Explain the basic concepts, and theoretical contributions.
- Have a grasp over basic concepts and theoretical perspectives explaining human behavior.
- Appreciate the complexity of human behavior and relationships.
- Illustrate some major cognitive functions.
- Correlate biological influences with human personality and behavior.
- Describe scientific research methods their strengths and weaknesses.

Course Contents:

UNDERSTANDING PSYCHOLOGY

- Psychology: Scientific perspective
- Historical perspective
- Schools of psychology
- Methods of psychology

- Ethical issues
- Fields of psychology and their application

BIOLOGICAL BASIS OF BEHAVIOR

- Neuron and its function
- Central nervous system
- Peripheral nervous system
- Endocrine system

SENSATION AND PERCEPTION

- Senses: Vision, audition, smell, taste and kinesthetic
- Introduction to perception
- Gestalt principles
- Binocular and monocular cues
- Illusions and extra sensory perception

LEARNING

- Definition of learning
- Types of learning: Classical and operant conditioning
- Punishment and its effects
- Latent and observational learning

MEMORY

- Definition and types of memory
- Processes and techniques of improving memory
- Forgetting: Nature and causes

COGNITION AND LANGUAGE

- Concept of cognition
- Problem solving
- Judgment and decision making
- Language development
- Language and cognition
- Language and culture

INTELLIGENCE AND CREATIVITY

- Concept of intelligence
- Theories of intelligence
- Assessment of intelligence
- Mental retardation
- Concept of creativity and its stages

MOTIVATION AND EMOTION

- Introduction to motivation
- Factors affecting motivation

- Introduction to emotions
- Types of emotions
- Physiology and emotion
- Theories of emotion

PERSONALITY

- Defining personality
- Theories of personality
- Personality assessment

SOCIAL THINKING AND SOCIAL INFLUENCE

- Social facilitation
- Attribution theory
- Crowd behavior
- Conformity, Obedience
- Helping behavior

Teaching Methodology:

- Student-centered teaching through communicative approach
- Situational learning through lectures, classroom activities, and practice sessions
- Multimedia-based lectures
- Computer-facilitated lessons and strategies
- Classroom dynamics through maximization of interactive learning **General**

Information:

- Late, missing, or plagiarized work will carry no credit.

Marks Distribution: (existing mark distribution can be used).

- Quizzes - 10%
- Assignments/ Presentation or case study - 10 %
- Midterm Examination - 30%
- Final Examination - 50%

Week-Wise Distribution:

Week #	Topics to be covered
Week 1	Course Orientation/Introduction Session General course Introduction

Week 2	UNDERSTANDING PSYCHOLOGY Psychology: Scientific perspective Historical perspective Schools of psychology Methods of psychology Ethical issues Fields of psychology and their application
Week 3	BIOLOGICAL BASIS OF BEHAVIOR Neuron and its function Central nervous system Peripheral nervous system Endocrine system
Week 4	SENSATION AND PERCEPTION Senses: Vision, audition, smell, taste and kinesthetic Introduction to perception Gestalt principles Binocular and monocular cues Illusions and extra sensory perception
Week 5	LEARNING Definition of learning Types of learning: Classical and operant conditioning Punishment and its effects Latent and observational learning
Week 6	MEMORY Definition and types of memory Processes and techniques of improving memory Forgetting: Nature and causes
Week 7	COGNITION AND LANGUAGE Concept of cognition Problem solving Judgment and decision making
Week 8	Language development Language and cognition
	Language and culture
Week 9	Mid Term Examination
Week 10	INTELLIGENCE AND CREATIVITY Concept of intelligence Theories of intelligence

Week 11	Assessment of intelligence Mental retardation Concept of creativity and its stages
Week 12	MOTIVATION AND EMOTION Introduction to motivation Factors affecting motivation Introduction to emotions
Week 13	Types of emotions Physiology and emotion Theories of emotion
Week 14	PERSONALITY Defining personality Theories of personality Personality assessment
Week 15	SOCIAL THINKING AND SOCIAL INFLUENCE Social facilitation Attribution theory Crowd behavior Conformity, Obedience Helping behavior
Week 16	Final Examination

Reference Books (latest Editions):

1. Atkinson R. C., & Smith, E. E. (2000). *Introduction to psychology* (13th ed.). NY: Harcourt Brace College Publishers.
2. Coon, D., & Mitterer, J. (2008). *Introduction to psychology: Gateways to mind and behaviour* (12th ed.). USA: Wadsworth Cengage Learning.
3. Fredrickson, B., Nolen-Hoeksema, S., Loftus, G., & Wagenaar, W. (2009). *Atkinson & Hilgard's introduction to psychology* (15th ed.). USA: Wadsworth.
4. Glassman, W.E. (2000). *Approaches to psychology*. Open University Press.
5. Hayes, N. (2000). *Foundation of psychology* (3rd ed.). UK: Thomson Learning.
6. Myers, D. G. (2011). *Psychology* (10th ed.). USA: Wadsworth Publishers.
7. Ormrod, J. E. (1995). *Educational psychology: Developing learners*. USA: Prentice Hall, Inc.
8. Rathus, S. (2011). *Psychology: Concepts and connections* (10th ed.). USA: Wadsworth Cengage Learning

Ideology and Constitution of Pakistan

Course Title :	Ideology and Constitution of Pakistan
Course Code :	XXX
Offered to :	Undergraduate Students at Hazara University
CrHr :	2 (2+0)
Pre-requisite :	None

Course Objective:

- 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 aspiration that have been instrumental in shaping the creation and development of Pakistan as 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 society responsible manner.

Course Learning Outcome (CLOs):

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

- Demonstrate enhanced knowledge of the basis of the ideology of Pakistan with special reference to the contributions of the founding fathers of Pakistan.
- Demonstrate fundamental knowledge about the Constitution of Pakistan 1973 and its evolution with special reference to state structure.
- Explain about the guiding principles on rights and responsibilities of Pakistani citizens as enshrined in the Constitution of Pakistan 1973.

Course Contents:

Introduction to the ideology of Pakistan

- Definition and significance of ideology.
- Historical context of the creation of Pakistan (with emphasis on socio-political, religious, and cultural dynamics of British India between 1857 till 1947)
- Contributions of the founding fathers of Pakistan in the freedom movement including but not limited to Allama Muhammad Iqbal, Muhammad Ali Jinnah etc.
- Contribution of women and students in the freedom movement for separate homeland for Muslims of British India.
- **Two Nation Theory:**

- Evolution of the two Nation Theory (Urdu-Hindi controversy, partition of Bengal, Simla Deputation 1906, Allama Iqbal's Presidential Address 1930, Congress ministries 1937 Lahore Resolution 1940)
- Role of communalism and religious differences. **Introduction to the Constitution of Pakistan:**
- Definition and importance of a constitution
- Ideological factors that shaped the Constitution(s) of Pakistan (Objective Resolution 1949)
- Overview of constitutional developments in Pakistan.
- **Constitutional and State Structure:**
- Structure of Government (executive, legislature, and judiciary) • Distribution of Powers between federal and provincial governments.
- 18th amendment and its impact on federalism.
- **Fundamental Rights, Principles of Policy and Responsibilities.**
- Overview of fundamental rights guaranteed to citizens by the Constitution of Pakistan 1973 (Articles 8-28)
- Overview of Principles of Policy (Articles 29-40)
- Responsibilities of Pakistani citizens (Article 5)
- **Constitutional Amendments:**
- Procedures for amending the Constitution
- Notable constitutional amendments and their implications

Teaching Methodology:

- Student-centered teaching through communicative approach
- Situational learning through lectures, classroom activities, and practice sessions
- Multimedia-based lectures
- Computer-facilitated lessons and strategies
- Classroom dynamics through maximization of interactive learning **General**

Information:

- Late, missing, or plagiarized work will carry no credit.

Marks Distribution (existing marks distribution can also be used):

- Quizzes - 10%
- Assignments - 10 %
- Midterm Examination - 30%
- Final Examination - 50%

Week Wise Distribution:

Week #	Topics to be covered
Week 1	Introduction to the ideology of Pakistan: Definition and significances of ideology. Historical context of the creation of Pakistan (with emphasis on sociopolitical, religious, and cultural dynamics of British India between 1857 till 1947)
Week 2	Introduction to the ideology of Pakistan: Contributions of the founding fathers of Pakistan in the freedom movement including but not limited to Allama Muhammad Iqbal, Muhammad Ali Jinnah etc.
Week 3	Contribution of women and students in the freedom movement for separate homeland for Muslims of British India.
Week 4	Two Nation Theory: Evolution of the two Nation Theory (Urdu-Hindi controversy, partition of Bengal, Simla Deputation 1906, Allama Iqbal's Presidential Address 1930, Congress ministries 1937 Lahore Resolution 1940)
Week 5	Two Nation Theory: Role of communalism and religious differences.
Week 6	Introduction to the Constitution of Pakistan: Definition and importance of a constitution
Week 7	Ideological factors that shaped the Constitution(s) of Pakistan (Objective Resolution 1949)
Week 8	Overview of constitutional developments in Pakistan
Week 9	Mid Term Examination
Week 10	Constitutional and State Structure: Structure of Government (executive, legislature, and judiciary)
Week 11	Distribution of Powers between federal and provincial governments. 18th amendment and its impact on federalism.
Week 12	Fundamental Rights, Principles of Policy and Responsibilities. Overview of fundamental rights guaranteed to citizens by the Constitution of Pakistan 1973 (Articles 8-28)
Week 13	Overview of Principles of Policy (Articles 29-40) Responsibilities of Pakistani citizens (Article 5)
Week 14	Constitutional Amendments: Procedures for amending the Constitution
Week 15	Notable constitutional amendments and their implications
Week 16	Final Examination

Reference Books:

1. The idea of Pakistan: by Stephn P. Cohen
2. Ideology of Pakistan: by Javed Iqbal
3. The struggle for Pakistan: by I.H. Qureshi
4. Pakistan the Formative Phase: by Khalid Bin Sayeed
5. Pakistan Political Roots and Development: by Safdar Mahmood
6. Ideology of Pakistan: by Sharif ul Mujahid
7. The struggle for Pakistan: A Muslim Homeland and Global Politics: by Ayesha Jalal
8. Jinnah Pakistan Islamic Identity: The search for Saladin: by Akbar S. Ahmed
9. The Making of Pakistan: A study in Nationalism: by K. K Aziz
10. Pakistan: A New History: by Ian Talbot
11. Pakistan in the Twentieth Century: A Political History: by Lawrence Ziring
12. The Constitution of Pakistan 1973: by Original
13. Constitutional and Political Development of Pakistan: by Hamid Khan
14. The Parliament of Pakistan: by Mahboob Hussain
15. Constitutional Development if Pakistan: by G.W Choudary
16. Constitution Making in Pakistan: The Dynamics of Political Order: by G.W Choudary

BCH101 Introductory Biochemistry

Course Title: Introductory Biochemistry

Course Code: BCH101

Offered to: Undergraduate Students at Hazara University

Credit hours: 3 (2+1)

Course Objectives:

- The course is designed to groom students for acquiring the knowledge of molecules of life and their functions.
- To understand the details of metabolic processes.

Course Learning Outcome (CLOs):

To learn

- Structure and functions of macromolecules
- Nomenclature and functioning of enzymes
- Metabolic pathways (Anabolism: Photosynthesis and Catabolism: Respiration)

Course Contents:

Introduction to biochemistry

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; coenzymes

Vitamins

Nucleic acids- structure and function

Metabolism and basic aspects of bioenergetics and biochemical thermodynamics

Oxidation-reduction reactions

Respiration (glycolysis, citric acid cycle, electron transport chain, oxidative phosphorylation)

Photosynthesis (Light reaction and Calvin Cycle)

Teaching Methodology:

- Student-centered teaching through communicative approach.
- Situational learning through lectures, classroom activities, and practice sessions.
- Multimedia-based lectures.
- Computer-facilitated lessons and strategies.
- Classroom dynamics through maximization of interactive learning.

General Information:

- Late, missing, or plagiarized work will carry no credit.

Marks Distribution: (existing mark distribution can be used).

- Quizzes - 10%
- Assignments/ Presentation or case study - 10 %
- Midterm Examination - 30%
- Final Examination - 50%

Week Wise Distribution:

Week #	Topics to be covered
Week 1	Introduction to biochemistry
Week 2	Carbohydrates - structure and classification
Week 3	Proteins- overview with emphasis on their composition and structure classification and function
Week 4	Lipids- structure, classification and biological significance
Week 5	Enzymes - properties, nomenclature, classification, and factors affecting enzyme activity; coenzymes
Week 6	Vitamins
Week 8	Nucleic acids- structure and function

Week 9	Mid Term Examination
Week 10	Metabolism and basic aspects of bioenergetics
Week 11	Oxidation-reduction reactions
Week 12	Respiration, glycolysis, citric acid cycle, electron transport chain
Week 13	Oxidative phosphorylation)
Week 14	Photosynthesis (Light reaction and Calvin Cycle)
Week 15	Biochemical thermodynamics
Week 16	Final Examination

Textbook/Reference

1. Nelson DL and Cox MM, 2012. Lehninger Principles of Biochemistry. 6th Edition; WH Freeman, New York. (available at www.ncbi.nlm.nih.gov)
2. Stryer et al., 2006. Biochemistry. 6th Edition; WH Freeman, New York. (available at www.ncbi.nlm.nih.gov)
3. Voet D and Voet TG, 2008. Biochemistry. 4th Edition; John Wiley and Sons, New York.
Murray et al., 2012. Harper's Illustrated Biochemistry. 29th Edition; McGraw-Hill Medical Publishing.
4. FerrierDR, 2013. Lippincott's Biochemistry. 6th Edition; Lippincott Williams & Wilkin Publishing Company.
5. Schantz JT, 2007. A Manual for Biochemistry Protocols. World Scientific Publishing. (available online)

BOT212 Fundamentals of Botany

Course Title : Fundamentals of Botany
 Course Code : BOT212
 Offered to : Undergraduate students at Hazara University
 CrHr : 3 (2+1)
 Pre-requisite : None

Course Objective:

The primary objective of the course is to learn students about the basics characteristics of various parts of plants belonging to different groups, especially of flowering plants. These may include the basic terminologies, morphology and functions of various parts of plants. The overall objective of the course is to develop a basic concept and background of the students with respect to plants.

Course Learning Outcome (CLOs):

- To enable students to know about plants and their significance
- To enable students to understand various parts of plants and their functions.
- To enable students to understand various botanical terminologies related to various parts of plants.
- To enable students to understand the significance and contribution of plants to human population.

Course Contents:

- Seed, its types and structure, Germination of Seeds, Conditions for germination and kinds of germination.
- Root, properties, Root system, modification of tap roots. Adventitious roots and its major modifications.
- Stem, its characteristics, types of stem, branching of the stem, forms of stem, modifications of stem (major modification of sub aerial, underground and aerial stem), Annual, Biennials and Perennials.
- Leaf: Types of leaves. Parts of a Leaf. Phyllotaxis, Venation and its types, simple and compound leaf.
- Flower: Different parts of flower. Bracts, Kinds of bracts. Descriptive terms of flowers, Thalamus, insertion of floral leaves. Placentation and its types. Briefly describe that flower is a modified shoot.
- Inflorescence: Main types of inflorescence.
- Vegetative propagation: Cuttings, Grafting, Budding, and Layering. Pollination and its major types , Fruits and its major types.
- Algae: Spirogyra
- Fungi: Penicillium
- Lichens: General characteristics
- Bryophytes: Funaria
- Pteridophytes: Dryopteris

Teaching Methodology:

- Student-centered teaching through communicative approach
- Multimedia-based lectures
- Classroom dynamics through maximization of interactive learning
- Field visits for hands-on experience

General Information:

- Late, missing, or plagiarized work will carry no credit.

Marks Distribution: (existing mark distribution can be used).

- Quizzes - 10%
- Assignments/ Presentation or case study - 10 %

- Midterm Examination - 30%
- Final Examination - 50%

Week-Wise Distribution:

Week#	Topics to be covered
Week 1	Introduction and discussion on a typical flowering plant
Week 2	Seed, its types, germination and conditions for germination
Week 3	Root and its types, root system and modification of tap roots
Week 4	Adventitious root and its modifications
Week 5	Stem and its types, classification of plants on the basis of their life duration
Week 6	Classification of plants on the basis of their size & growth habits etc
Week 7	Underground modification of stem and aerial modification of stem
Week 8	Sub-aerial modification of stem, Leaf, parts and its types
Week 9	Mid Term Examination
Week 10	Phyllotaxis, Venation , insertion
Week 11	The flower, perianth and symmetry of flower
Week 12	Insertion of floral parts on the thalamus, Placentation and its types
Week 13	Flower is a modified shoot; vegetative propagation
Week 14	Inflorescence and its types
Week 15	Fruit and its types, Introduction to Algae, fungi and lichens
Week 16	Final Examination

Recommended Books:

BGE202 Microbial Genetics

Course Title :	Microbial Genetics
Course Code :	BGE202
Offered to :	Undergraduate Students at Hazara University
CrHr :	3 (2+1)
Pre-requisite :	None

Course Objective:

Understanding microbial genes, genomes, and gene expression is essential for understanding the biology and evolution of microorganisms and their interactions with the environment. The objectives of this course are to introduce students to genetics of microbes, teach students various techniques used in microbial genetics and enable students to understand the relevance of microbial genetics in biotechnology. The course will cover the structure, function, expression, and evolution of microbial genes and methods for their study and manipulation. The course will also inspect the transmission of heritable traits by microbes and the methods and principles used to study inheritance.

Course Learning Outcomes (CLOs):

At the end of the course, students will get the following abilities to:

Understand the importance of microbial genetics.

- Explain how microorganisms are used to understudy the genetic mechanisms of other organisms (plants and animals); and
- Relate microbial genetics to biotechnology.
- Carry out basic experiments to manipulate gene/s to modify or produce trait; isolate DNA and gene products; and demonstrate genetic engineering.
- Conduct literature search on the internet and libraries.

Course Contents:

Why study Prokaryotic genetics? Introduction and overview
DNA and RNA structure and functions
DNA replication
Virulent and a-virulent phages
Genetic recombination: generalized recombination, site specific recombination and illegitimate recombination
Gene transfer mechanisms: Transformation, Transduction, Conjugation
Extrachromosomal elements: Plasmids, Bacteriophage, Transposable elements
Regulation of Gene expression
Gene Mapping
DNA Repair and mutagenesis
Genetically modified organisms (GMOs)
Technological advances in microbial genetics

Lab Practicals:

- Isolation and screening of potential microbes from different environmental sources
 - Growth curve of bacteria.
- Observation of plaque formation on lawn of Bacterial culture
- Chromosomal DNA extraction
- Detection of plasmids in bacterial strains (plate method/gel electrophoresis)

Teaching Methodology:

- Student-centered teaching through communicative approach
- Situational learning through lectures, classroom activities, and practice sessions
- Multimedia-based lectures
- Classroom dynamics through maximization of interactive learning
- Field visits to incorporate hands-on experience

General Information:

- Late, missing, or plagiarized work will carry no credit.

Marks Distribution: (existing mark distribution can be used).

- Quizzes - 10%
- Assignments/ Presentation or case study - 10 %
- Midterm Examination - 30%
- Final Examination - 50%

Week-Wise Distribution:

Week#	Topics to be covered
Week 1	Why study Prokaryotic genetics? Introduction and overview
Week 2	DNA and RNA structure and functions
Week 3	DNA replication
Week 4	Virulent and A-virulent phages
Week 5	Genetic recombination: generalized recombination, site specific recombination and illegitimate recombination
Week 6	Gene transfer mechanisms: Transformation
Week 7	Transduction
Week 8	Conjugation

Week 9	Mid Term Examination
Week 10	Extrachromosomal elements: Plasmids, Bacteriophage, Transposable elements
Week 11	Regulation of Gene expression
Week 12	Gene Mapping
Week 13	DNA Repair and mutagenesis
Week 14	Genetically modified organisms (GMOs)
Week 15	Technological advances in microbial genetics
Week 16	Final Examination

Reference Books (Latest editions):

1. A text book of Microbiology by R. C. Dubey and D. K. Maheshwari. S. Chand Publishing
2. Microbial Gene Techniques (Methods in Molecular Genetics), Vol. 6. Adolph K. W., Academic Press.
3. Bacterial and Bacteriophage Genetics. 5th Edition, Birge, E. A. Springer.
4. Molecular Genetics of Bacteria, 3rd Edition, Dale J., John Wiley and Sons Ltd.
5. Snyder, L. and Champness, W. Molecular Genetics of Bacteria, 3rd edition, American Society for Microbiology, Washington, D. C.
6. Microbial Genetics, 3rd Edition, Maloy S. R., J. Jr Cronan. Jones and Bartlett Pub.
7. Modern Microbial Genetics 2nd Edition, Streips U. N., R. E. Yasbin, John Wiley and Sons.
8. Fundamental bacteria genetics. Trun, N. and J. Trempy. Blackwell Pub Co.

BGE231 Genetic Resources and Conservation

Course Title : Genetic Resources and Conservation

Course Code : BGE231

Offered to : Undergraduate students at Hazara University

CrHr : 3 (2+1)

Pre-requisite : None

Course Objectives:

- To enable students about genetic resources conservation, especially threatened species.
- To equip students about cutting edge genetic methods and techniques using for conservation and restoration of genetic resources, especially threatened species.

Course Learning Outcome (CLOs):

- The primary objective of the course is to learn students about the Genetic resources and their significance in the present and in the future.
- The student will be able to understand various threats and causes of extinction facing by genetic resources.
- The student will understand various tools and techniques used for conservation of threatened species.

Course Contents:

- History of genetic resources conservation/Conservation genetics.
- Threatened species, why conserve biodiversity/genetic diversity.
- Strategies for conservation of threatened species (Ex-Situ & In-Situ).
- Extinction: causes of extinction, sixth extinction, introduction to the major extinctions of the geological record.
- IUCN criteria & categorization for assessment of threatened species.
- Roles of molecular analysis in conservation of threatened species *i.e* Non-intrusive sampling method, correct identification, level of GD, fragmentation in populations, sex differentiation, control of illegal hunting & trade, defining potential site and population for reintroduction, aspect of species biology.
- Factors Contributing to the extinction; Genetics and the fate of endangered species,
- Inbreeding and out breeding depressions, Relationship between inbreeding and extinction, loss of genetic diversity and extinction.
- Genetic diversity: importance, Hardy & Weinberg equilibrium and the factors affecting gene frequencies in populations, extent of genetic diversity, assessment of genetic diversity in threatened species:
- Protein analysis, allozyme analysis.
- DNA analysis: Microsatellite, Minisatellite, *mtDNA*, DNA sequencing, used barcoding and identification of threatened/biological species.

- Brief introduction: gene bank, biosphere reserve, national parks, botanic gardens, Zoological garden, game reserves, sanctuaries, arboreta and herbaria.

Teaching Methodology:

- Student-centered teaching through communicative approach
- Multimedia-based lectures
- Classroom dynamics through maximization of interactive learning
- Visits to various Botanical Gardens, Zoos and National parks **General**

Information:

- Late, missing, or plagiarized work will carry no credit.

Marks Distribution: (existing mark distribution can be used).

- Quizzes - 10%
- Assignments/ Presentation or case study - 10 %
- Midterm Examination - 30%
- Final Examination - 50%

Week-Wise Distribution:

Weeks #	Topics to be covered
Week 1	History of genetic resources conservation/Conservation genetics. Threatened species, why conserve biodiversity
Week 2	Strategies for conservation of threatened species (Ex-Situ & InSitu). Extinction: causes of extinction, sixth extinction, introduction to the major extinctions of the geological record.
Week 3	IUCN criteria & categorization for assessment of threatened species Non-intrusive sampling method, correct identification
Week 4	Fragmentation in populations, sex differentiation, control of illegal hunting & trade
Week 5	Defining potential site and population for reintroduction, aspect of species biology
Week 6	Level of GD of threatened organism
Week 8	Inbreeding and out breeding depressions,
Week 9	Mid Term Examination
Week 10	Relationship between inbreeding and extinction, loss of genetic diversity and extinction
Week 11	Genetic diversity: importance, Hardy & Weinberg equilibrium

Week 12	Factors affecting gene frequencies in populations, extent of genetic diversity
Week 13	Assessment of genetic diversity: Protein analysis, allozyme analysis
Week 14	DNA analysis: Microsatellite, Minisatellite, <i>mtDNA</i> , DNA sequencing.
Week 15	Brief introduction: gene bank, biosphere reserve, national parks, botanic gardens, Zoological garden, game reserves, sanctuaries, arboreta and herbaria
Week 16	Final Examination

Recommended Books:

1. Richard Frankham, J.D. Ballou, D.A. Briscoe and K.H. Mclinnnes. 2004. A Primer of Conservation Genetics. Cambridge University Press. ISBN-13 978-0-511-18661-5.
2. Muhammad, A., R. Aksel and R.C. Vonborstel. Genetic Diversity in Plants. Plenum Press NY, USA. 1977.
3. Brown, A.H.D., O.H. Frankel, D.R. Marshall, and J.T. Williams. The use of Plant Genetic Resources. Cambridge University Press, UK. 1989.
4. Bhillon, B.S., R.K. Tyagi and A. Lal. Plant Genetic Resources Management, Narosa, N. Delhi, India. 2004.
5. Walter Simon De Boef, Abishkar Subedi, Nivaldo Peroni and Marja Thijssen, Community Biodiversity Management: Promoting Resilience and the Conservation of Plant Genetic Resources; May 2012
6. V. Ramanatha Rao, P.J. Matthews, P.B. Eyzaguirre, D. Hunter (eds.) The Global Diversity of Taro: Ethnobotany and Conservation; 2010
7. George Amato, Rob DeSalle, Oliver A. Ryder, and Howard C. Rosenbaum Conservation Genetics in the Age of Genomics; 2009
8. Takhtajan A. Floristic Regions of the world, University of California press Berkeley and Los Angeles USA 1986.
9. Takhtajan A. Diversity and classification of flowering plants. Columbia University Press New York 1997.

PHI102 Introduction to Philosophy

Course Title : Introduction to Philosophy
Course Code : PHI102
Offered to : Undergraduate students at Hazara University
CrHr : 2 (2+0)
Pre-requisite : None

Course Objectives:

Course Learning Outcomes:

Course Contents:

- Meaning and Importance of Philosophy
- What is Philosophy
- Importance of Philosophy
- Function and Scope of Philosophy
- Branches of Philosophy
- Metaphysics
- Reality of Universe
- Reality of Man
- Reality of God
- Reality of Existence
- Number of Reality
- Epistemology
- Nature of knowledge
- Sources of knowledge
- Validity of knowledge
- Ethics & Aesthetics (Axiology)
- Nature of values
- Classification of values
- Moral Philosophy
- Schools of thought in Ethics
- Hedonism
- Utilitarianism
- Deontological System
- Logic
- Nature & Scope of logic
- Inductive/deductive logic
- Usefulness of logic
- Language & its basic functions
- Emotive & Neutral Language Fallacies

Teaching Methodology:

- Student-centered teaching through communicative approach
- Multimedia-based lectures
- Classroom dynamics through maximization of interactive learning

- Visits to various Botanical Gardens, Zoos and National parks

General Information:

- Late, missing, or plagiarized work will carry no credit.

Marks Distribution: (existing mark distribution can be used).

- Quizzes - 10%
- Assignments/ Presentation or case study - 10 %
- Midterm Examination - 30%
- Final Examination - 50%

Week-Wise Distribution:

Weeks #	Topics to be covered
Week 1	Meaning and Importance of Philosophy, What is Philosophy
Week 2	Importance of Philosophy, Function and Scope of Philosophy
Week 3	Branches of Philosophy, Metaphysics
Week 4	Reality of Universe, Reality of Man
Week 5	Reality of God, Reality of Existence
Week 6	Number of Reality, Epistemology
Week 8	Nature of knowledge, Sources of knowledge, Validity of knowledge
Week 9	Mid Term Examination
Week 10	Ethics & Aesthetics (Axiology), Nature of values, Classification of values
Week 11	Ethics & Aesthetics (Axiology), Nature of values, Classification of values
Week 12	Moral Philosophy, Schools of thought in Ethics, Hedonism
Week 13	Utilitarianism, Deontological System
Week 14	Logic, Nature & Scope of logic, Inductive/deductive logic, Usefulness of logic
Week 15	Language & its basic functions, Emotive & Neutral Language Fallacies
Week 16	Final Examination

Recommended Readings.

1. Russell, B. History of Western Philosophy.
2. Stace, WT. A critical history of Greek philosophy. NBF Lahore. 1996
3. Copi, I. Introduction to Logic.
4. Sahakian, SW. and Sahakian, ML. Ideas of the Great Philosophers.

5. Durant, Will. The Pleasures of Philosophy.

MGT400 Entrepreneurship

Course Title :	Entrepreneurship
Course Code :	MGT400
Offered to :	Undergraduate Students at Hazara University
CrHr :	2 (2+0)
Pre-requisite :	None

Course Objectives:

The Marketing introduces students to the business activities that are designed to plan, price, promote, and place goods/services for current and potential customers. This course acquaints students with the present-day challenges of marketing professionals and introduces students to the tools and methods marketing professionals use to make decisions.

Course Learning Outcomes (CLOs):

Course Contents:

- The Marketing Concept: Use primary resources to research and analyze data-driven business decisions, Compare and contrast the interrelationships of product, price, promotion, and place decisions in determining a firm's marketing plan
- Market Analysis; basic differences in communication styles
- Market Research; annual reports and company profiles, relevant resources on marketing and communications, Research and report on an "infant" company
- Marketing Environment; Evaluation of secondary research with respect to the marketing environment, verification of information from a variety of sources, expository reports evaluation encompassing local, regional, national, and global levels, aspect of ethics within business
- Marketing Communication and Branding; major corporate marketing communications campaigns
- Career Planning; Exploration of careers in marketing

Teaching Methodology:

- Student-centered teaching through communicative approach
- Situational learning through lectures, classroom activities, and practice sessions
- Multimedia-based lectures
- Computer-facilitated lessons and strategies
- Classroom dynamics through maximization of interactive learning

General Information:

- Late, missing, or plagiarized work will carry no credit.

Marks Distribution: (existing mark distribution can be used).

- Quizzes - 10%
- Assignments/ Presentation or case study - 10 %
- Midterm Examination - 30%
- Final Examination - 50%

Week-Wise Distribution:

Week #	Topics to be covered
Week 1	The Marketing Concept; Use primary resources to research and analyze datadriven business decisions
Week 2	Compare and contrast the interrelationships of product, price, promotion, and place decisions in determining a firm's marketing plan
Week 3	Market Analysis; basic differences in communication styles
Week 4	Market Research; annual reports and company profiles, relevant resources on marketing and communications
Week 5	Research and report on an "infant" company
Week 6	Marketing Environment;
Week 7	Evaluation of secondary research with respect to the marketing environment
Week 8	Verification of information from a variety of sources
Week 9	Mid Term Examination
Week 10	Expository reports evaluation encompassing local, regional, national, and global levels
Week 11	Aspect of ethics within business
Week 12	Marketing Communication and Branding
Week 13	Major corporate marketing communications campaigns
Week 14	Career Planning
Week 15	Exploration of careers in marketing

Recommended Books:

1. Seth, G (2018). This is marketing. Portfolio publishers
2. Carlos G (2019). The End of Marketing. *Humanizing Your Brand in the Age of Social Media and AI*

PS100 Introduction to Pakistan Studies

Course Title : Introduction to Pakistan Studies
Course Code : PS100
Offered to : Undergraduate Students at Hazara University
CrHr : 2 (2+0)
Pre-requisite : None

Course Objective:

- 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 landscape, ancient civilization, 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 interventions.
- 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, student will be able to:

- Have enhanced knowledge of the geographical, historical, and political aspects of Pakistan • Understand the society and culture of Pakistan.
- Understand and explain the socio-economics developments in Pakistan.
- Explore contemporary issues and challenges faced by Pakistan and their implications for the future.

Course Contents:**Introduction to Pakistan**

- Geographical location and significance.
- Historical background: Ancient civilization in the region.
- Factors leading to the creation of Pakistan.
- **Political History of Pakistan**
- Formative Phase

- Military interventions and democratic transitions.
- **Geography of Pakistan**
- Physiography: Mountain, plains, plateaus, deserts, valleys and costal areas.
- River System: Indus River and its tributaries.
- Climate regions of Pakistan.
- Society and Culture of Pakistan:
- Socio-cultural diversity,
- Languages and literature of Pakistan.
- Economics Development of Pakistan.
- Agriculture and industrial sectors of Pakistan.
- Economic challenges of Pakistan.
- **Contemporary Issues:**
- Foreign Relations of Pakistan
- Security challenges: terrorism, extremism, and regional conflicts.

General Information:

- Late, missing, or plagiarized work will carry no credit.

Marks Distribution (existing marks distribution can also be used):

- Quizzes - 10%
- Assignments - 10 %
- Midterm Examination - 30%
- Final Examination - 50%

Week Wise Distribution:

Week #	Topics to be covered
Week 1	Introduction to Pakistan Geographical location and significance.
Week 2	Historical background: Ancient civilization in the region. Factors leading to the creation of Pakistan.
Week 3	Political History of Pakistan Formative Phase
Week 4	Military interventions and democratic transitions.
Week 5	Geography of Pakistan Physiography: Mountain, plains, plateaus, deserts, valleys and costal areas. River System: Indus River and its tributaries.
Week 6	Climate regions of Pakistan.
Week 7	Society and Culture of Pakistan: Socio-cultural diversity,

Week 8	Languages and literature of Pakistan.
Week 9	Mid Term Examination
Week 10	Economics Development of Pakistan.
Week 11	Agriculture and industrial sectors of Pakistan.
Week 12	Economic challenges of Pakistan.
Week 13	Contemporary Issues: Foreign Relations of Pakistan
Week 14	Security challenges: terrorism,
Week 15	Extremism, and regional conflicts
Week 16	Final Examination

Reference Books:

1. Jinnah of Pakistan” by Stanley Wolpert
2. The sole of Spokesman: Jinnah, the Muslim League, and Demand for Pakistan
3. The struggle for Pakistan” by Ishtiaq Hussain Qureshi
4. Pakistan the formative phase, 1857-1948 by Khalid B. Sayeed
5. Pakistan Studies: A Book of Readings by Sikandar Hayat
6. Constitutional and Political History by Ian Talbot
7. Trek to Pakistan by Ahmed Saeed and Kh Mansur Sarwar.
8. Pakistan: A Modern History by Ian Talbot
9. Politics in Pakistan: The Nature and Direction of Change by Khalid B. Sayeed
10. Physical Geography of Pakistan by Umar Jahangir
11. A Geography of Pakistan: Environment People, and economy by Fazle Karim Khan
12. Pakistan’s Foreign Policy; An Historical Analysis by S.M. Burke
13. Separatism in East Pakistan: by Rizwan Ullah Kokab
14. Being Pakistani: Society, Culture and the Arts: by Raza Rumi
15. Pakistan’s Cultural Heritage: Socio-Economic and Technological Aspects: edited by Abdul Jabbar Khan
16. Language and Politics in Pakistan: Tariq Rehman
17. Sociology: by Horton and Hunt.
18. Pakistan in the Twentieth Century: A Political History: by Lawrence Ziring
19. Economic Development if Pakistan: by Ishrat Hussain
20. Issues in Pakistan Economy: by S. Zaidi

BGE203 Molecular Biology

Course Title : Molecular Biology
Course Code : BGE203
Offered to : Undergraduate Students at Hazara University
CrHr : 3 (3+0)
Pre-requisite : None

Course Objectives:

- To provide students with foundational knowledge of molecular genetics.
- To develop understanding of basic cellular processes including gene expression, gene regulation, genome replication etc. and holistically the operation of cell, their communications and control of activities
- To familiarize students with experimental approaches used in molecular biology.

Course Learning Outcome (CLOs):

Upon successful completion of the course, the students will be able to;

- Recognize the importance of molecular biology in the discipline of life sciences.
- Explain how DNA and RNA works.
- Differentiate between the gene organization of prokaryotic and eukaryotic genome.
- Compare the basic cellular processes in different cell types (Bacteria, archaea, and Eukaryotes).
- Demonstrate the working of cellular components and processes at molecular level.
- Apply the knowledge of course to what happens when cell functioning is impaired.
- Consider different experimental approaches to achieve research objectives.

Course Contents:

- Introduction to molecular biology
- The “central dogma” of molecular biology
- Salient features of DNA and RNA
- Structural organization and properties of nucleic acids
- DNA Double-Helix structure, types of DNA Helix
- Key experiments that DNA is the genetic material
- Genome organization in prokaryotes and eukaryotes
- Gene families
- DNA replication in prokaryotes and eukaryotes
- The process of transcription, types of RNA
- Transcription in prokaryotes and eukaryotes
- Post transcriptional modifications
- Pathways for non-specific mRNA turnover
- Structure and processing of precursor tRNAs and rRNAs molecules
- Translation in prokaryotes and eukaryotes
- The Genetic Code

- Role of ribosomes in protein synthesis
- Post translational modification of protein
- Protein degradation
- Types of DNA damage and DNA repair

Teaching Methodology:

- Board Lectures, PowerPoint Lectures, Class Discussion
- Computer-facilitated lessons and strategies
- Field visits to incorporate hands-on experience

General Information:

- Late, missing, or plagiarized work will carry no credit.

Marks Distribution: (existing mark distribution can be used).

- Quizzes - 10%
- Assignments/ Presentation or case study - 10 %
- Midterm Examination - 30%
- Final Examination - 50%

Week-Wise Distribution:

Week#	Topics to be covered
Week 1	Introduction to molecular biology The “central dogma” of molecular biology
Week 2	Salient features of DNA and RNA Structural organization and properties of nucleic acids
Week 3	DNA Double-Helix structure, types of DNA Helix Key experiments that DNA is the genetic material
Week 4	Genome organization in prokaryotes and Eukaryotes Gene families
Week 5	DNA replication in prokaryotes and eukaryotes
Week 6	DNA replication in prokaryotes and eukaryotes
Week 7	The process of transcription, types of RNA Transcription in prokaryotes and eukaryotes
Week 8	Transcription in prokaryotes and eukaryotes
Week 9	Mid Term Examination

Week 10	Post transcriptional modifications
Week 11	Pathways for non-specific mRNA turnover Structure and processing of precursor tRNAs and rRNAs molecules
Week 12	Translation in Prokaryotes and Eukaryotes
Week 13	The Genetic Code Role of ribosomes in protein synthesis
Week 14	Post translational modification of protein Protein degradation
Week 15	Types of DNA damage and DNA Repair
Week 16	Final Examination

Reference Books (latest Editions):

Latest editions of following books, revised/published time to time or any other relevant book as deemed fit by the course instructor, are recommended and will be followed.

1. Lodish et al. Molecular Cell Biology. WH Freeman, New York
2. Nelson D and Cox MM. Lehninger Principles of Biochemistry. 7th Edition; WH Freeman, New York.
3. David Clark Nanette Pazdern. Molecular Biology
4. Berg et al. Biochemistry. WH Freeman, New York.
5. Alberts et al. Molecular Biology of the Cell. Garland Science
6. Weaver R. Molecular Biology. McGraw-Hill
7. Brown T.A. Introduction to Genetics: A molecular Approach. Garland Science

BGE204 Principles of Breeding

Course Title : Principles of Breeding
 Course Code : BGE204
 Offered to : Undergraduate Students at Hazara University
 CrHr : 3 (3+0)
 Pre-requisite : None

Course Objective:

- The course is designed to groom students for acquiring the knowledge and competence that will enable them to understand basic principle and procedures of varietal development in crop plants.

- To know the application of different breeding techniques/process of testing and release of commercial varieties.

Course Learning Outcome (CLOs):

- Design breeding program for improvement of crop plants
- Understand the floral mechanism of different crop plants
- Emasculate and cross any crop species.
- Know the process of variety development, maintenance and certified seed production.

Course Contents:

- Introduction to animal breeding
- Breeding methods of animals
- Breeding of poultry
- Introduction to Plant breeding
- Modes of pollination, mechanisms that favors self and cross pollination.
- Apomixes and its types.
- Heterosis
- Incompatibility mechanism.
- Male sterility and its utilization.
- Inbreeding depression.
- Combining ability
 - Breeding methods of self-pollinated crop plants.
 - Introduction, Mass selection, Pure line selection.
 - Pedigree method, Bulk method
 - Single seed descent method, Back cross method • Breeding methods of cross pollinated crop plants.
 - Introduction, Mass selection, Progeny selection
 - Recurrent selection
 - Synthetics and composites varieties • Mutation Breeding
- Production of commercial hybrids
- Wide or distant hybridization
- Molecular breeding and Marker assisted selection.

Teaching Methodology:

- Student-centered teaching through communicative approach
- Situational learning through lectures, classroom activities, and practice sessions
- Multimedia-based lectures
- Classroom dynamics through maximization of interactive learning
- Field visits to incorporate hands-on experience

General Information:

- Late, missing, or plagiarized work will carry no credit.

Marks Distribution: (existing mark distribution can be used).

- Quizzes - 10%
- Assignments/ Presentation or case study - 10 %
- Midterm Examination - 30%
- Final Examination - 50%

Week-Wise Distribution:

Week#	Topics to be covered
Week 1	Course Orientation/Introduction Session
Week 2	Introduction to animal breeding
Week 3	Breeding methods of animals Breeding of poultry
Week 4	Introduction to Plant breeding Modes of pollination, mechanisms that favors self and cross pollination.
Week 5	Apomixes and its types. Heterosis Incompatibility mechanism. Male sterility and its utilization.
Week 6	Inbreeding depression. Combining ability
Week 7	Breeding methods of self-pollinated crop plants.
Week 8	Introduction, Mass selection
Week 9	Mid Term Examination
Week 10	Pure line selection. Pedigree method,
Week 11	Bulk method Single seed descent method, Back cross method
Week 12	Breeding methods of cross pollinated crop plants. Introduction, Mass selection,
Week 13	Progeny selection Recurrent selection Synthetics and composites varieties
Week 14	Mutation Breeding Production of commercial hybrids

Week 15	Wide or distant hybridization Molecular breeding and Marker assisted selection.
Week 16	Final Examination

Textbook/Reference:

1. Chahal G.S., S.S. Gosal, Principles and Procedures of Plant Breeding: Biotechnological and Conventional Approaches, CRC Press; 2002.
2. Richards A. J., Plant Breeding Systems, Stanley Thornes Pub Ltd; 1997
3. Bourdon, R.M. Understanding Animal Breeding. Prentice Hall Inc. Upper Saddle River New Jersey, USA, 2000
4. Ning L., and C. Yongfu, Animal Biotechnology, Intl Academic Pub House, 1997.
5. Allard R.W. Principles of Plant Breeding, 2nd Edition, John Wiley and Sons; 2 edition 1999

BGE225 Cell and Tissue Culture

Course Title : Cell and Tissue Culture

Course Code : BGE225

Offered to : Undergraduate Students at Hazara University

CrHr : 3 (2+1)

Pre-requisite : None

Course Objectives:

To acquaint students with the basic concepts and methodologies of cell and tissue culture.

Course Learning Outcome (CLOs):

At the end of the semester students would be aware of the evolution of tissue culture technology, its basic concepts and techniques and would be ready to study and apply the different experimental techniques of tissue cultures.

Course Contents:

- Introduction to the course; overview of structure of plant and animal cell
- Brief history, basic concepts; terminologies, types of cultures.
- Growth medium; components and their function. Cell culture media and reagents.
- Growth regulators: types and functions. Factors affecting callus/cell culture

- Techniques of cultures; sub cultures batch cultures, continuous cultures, open and closed cultures. Methods of plant tissue culture (micropropagation, clonal propagation, regeneration, organogenesis, embryogenesis, cell cultures and environment).
- Improvement of plant via plant cell culture. Production of variant plants from selected cells. Selection for stress resistance, production of disease resistant plants.
- Culture of mammalian cells, tissues and organs, primary culture, secondary culture, continuous cell lines, suspension cultures.
- Somatic cell cloning and hybridization, transfection and transformation of cells. Cryopreservation and storage of animal cells.

Practical:

- Cleaning and sterilization of glassware & equipment. Stock solution preparations, Medium Preparation Sterilization of explants by different sterilizers. Germination of seeds for tissue culture
- Inoculation of explants for callus induction.
- Callus proliferation sub culturing and organogenesis.

Teaching Methodology:

- Student-centered teaching through communicative approach
- Situational learning through lectures, classroom activities, and practice sessions
- Multimedia-based lectures
- Classroom dynamics through maximization of interactive learning
- Field visits to incorporate hands-on experience

General Information:

- Late, missing, or plagiarized work will carry no credit.

Marks Distribution: (existing mark distribution can be used).

- Quizzes - 10%
- Assignments/ Presentation or case study - 10 %
- Midterm Examination - 30%
- Final Examination - 50%

Week-Wise Distribution:

Week#	Topics to be covered
Week 1	Course Orientation/Introduction Session overview of structure of plant and animal cell
Week 2	Brief history, basic concepts; terminologies, types of cultures

Week 3	Growth medium; components and their function. Cell culture media and reagents.
Week 4	Growth regulators: types and functions. Factors affecting callus/cell culture. Phases of growth
Week 5	Techniques of cultures; sub cultures batch cultures, continuous cultures, open and closed cultures.
Week 6	Methods of plant tissue culture (micropropagation, clonal propagation, regeneration,
Week 7	Organogenesis, embryogenesis, cell cultures and environment).
Week 8	Improvement of plant via plant cell culture. Production of variant plants from selected cells
Week 9	Mid Term Examination
Week 10	Selection for stress resistance, production of disease resistant plants.
Week 11	Culture of mammalian cells, tissues and organs,
Week 12	Primary culture, secondary culture
Week 13	continuous cell lines, suspension cultures
Week 14	Somatic cell cloning and hybridization, transfection and transformation of cells.
Week 15	Cryopreservation and storage of animal cells.
Week 16	Final Examination

Recommended Books

1. John, H.D .and L.W. Roberts. Plant Tissue culture second edition. Cambridge University Press Cambridge.1985.
2. Smith R.H. Plant tissue culture techniques and Experiments second Edition Academic Press 2000.
3. Freshney IR, 2010. Culture of animal cells: A manual of basic techniques and specialized application. 6th Edition; Wiley-Blackwell
4. Masters JR, 2000. Animal cell culture. 3rd Edition; Oxford University Press.
5. Lanza et al., 2001. Methods of tissue engineering Academic Press Inc.
6. Doyle et al., 1998. Cells and tissue culture: Laboratory procedures in biotechnology. Wiley, John and Sons.
7. Barnum S, 2004. Biotechnology: An Introduction (with Infotrac) Brooks /Cole.

8. Tourte Y and Catherine TC, 2005. Genetic Engineering and Biotechnology: Concepts, Methods, and Agronomic Applications. Science Publishers.
9. Houdebine LM, 2003. Animal Transgenesis and Cloning. 1st Edition; John Wiley and Sons.

BGE333 Environmental Biotechnology

Course Title : Environmental Biotechnology
Course Code : BGE333
Offered to : Undergraduate Students at Hazara University
CrHr : 3 (2+1)

Course Objective:

To acquaint students with conservation and reclamation of environment through Biotechnology.

Course Learning Outcome (CLOs):

- To enable students to understand the applications of microbes
- To enable students to understand Ecology and Conservation of the Environment
- To enable students to understand wastewater treatment process

Course Contents:

- Introduction to environmental biotechnology
- Fundamentals of biological interventions
- Genetic manipulation strategies in environmental biotechnology
- Pollution indicators and pollution control strategies; bioreactors; domestic wastewater 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 of environmental biotechnology.

Lab Practicals:

- Biodegradation of environmental pollutants by microorganisms
- Bacteriology of drinking water
- Microscopic studies of water specimens collected from various locations
- Field survey of polluted areas
- Field study for pollution indicators (e.g., plants, microorganisms and air).

Teaching Methodology:

- Student-centered teaching through communicative approach
- Situational learning through lectures, classroom activities, and practice sessions
- Multimedia-based lectures
- Computer-facilitated lessons and strategies
- Classroom dynamics through maximization of interactive learning
- Field visits to incorporate hands-on experience
- **General Information:**
 - Late, missing, or plagiarized work will carry no credit.

Marks Distribution: (existing mark distribution can be used).

- Quizzes - 10%
- Assignments/ Presentation or case study - 10 %
- Midterm Examination - 30%
- Final Examination - 50%

Week-Wise Distribution:

Week#	Topics to be covered
Week 1	Course Orientation/Introduction Session
Week 2	Introduction to Environmental Biotechnology
Week 3	Fundamentals of Biological interventions
Week 4	Pollution & Pollution control strategies
Week 5	Pollution indicators
Week 6	Domestic waste water treatment
Week 7	Sludge treatment
Week 8	Phytoremediation
Week 9	Mid Term Examination
Week 10	Industrial effluent treatment
Week 11	Landfill types of landfills
Week 12	Compost types of composts

Week 13	Concept of integrated environmental Biotechnology
Week 14	Biodegradation and bio transformation of hazardous chemicals
Week 15	Products of Environmental Biotechnology
Week 16	Final Examination

Recommended Books (latest Editions):

1. Fluker MH, 2010. Environmental Biotechnology. CRC Press.
2. Faster CF and Wase J, 2004. Environmental Biotechnolog . John Willey & Sons.
3. Evans GM and Furlong JC, 2010. Environmental Biotechnology Theory and Application. 2nd Edition; Wiley-Blackwell Publishers.
4. Srinivas T, 2008. Environmental Biotechnology. 1st Edition; New Age International Publishers.
5. Spencer JFT and Spencer ALR, 2004. Environmental Microbiology: 8. Methods and Protocols (Methods in Biotechnology). 1st Edition; Humana Press.
6. Hurst et al., 2007. Manual of Environmental Microbiology. 3rd Edition; ASM Publishers.

BGE323 Genetic Engineering

Course Title : Genetic Engineering
 Course Code : BGE323
 Offered to : Undergraduate Students at Hazara University
 CrHr : 3(2+1)
 Pre-requisite : Molecular Biology

Course Objective:

The course is designed to provide basic concepts of the subject of Genetic Engineering with special emphasis on development of tools with reference to genetics and other new areas of biology.

Course Learning Outcome (CLOs)

- The course will provide the students with a concept of understanding different tools used in Genetic Engineering.
- The advancement in Genetic Engineering with the passage of time through history.

- Understanding major techniques used in it which make this subject as New Genetics.
- The students will be able to accomplish the fundamentals of Genetic Engineering with its applications in modern day applied sciences like Agriculture, medicines, and biotechnology.

Course Contents:

- Introduction to Genetic Engineering
- Advent of Gene Cloning/DNA Manipulation
- Manipulative enzymes (Polymerases, Ligases, Nucleases etc)
- Restriction digest, Restriction mapping
- Polymerase Chain Reaction in-detail with concepts
- Gel electrophoresis
- DNA Sequencing concepts
- Sanger-Coulson Method & Maxam-Gilbert method
- Vehicles for Gene Cloning
- Plasmids
- Bacteriophages
- Transformation of Bacteria & Identification of Recombinants
- Cloning PCR products
- Cloning vectors for higher plants
- Agrobacterium tumefaciens, Ti plasmid, Ri plasmid,
- Purification of DNA from Living Cells
- DNA finger printing and RFLPs
- DNA libraries
- RT-PCR
- Microarrays

Lab Practicals:

- Buffers preparation
- DNA extraction
- Gel Electrophoresis
- RFLP
- PCR

Teaching Methodology:

- Student-centered teaching through communicative approach.
- Situational learning through lectures, classroom activities, and practice sessions.
- Multimedia-based lectures.
- Computer-facilitated lessons and strategies.
- Classroom dynamics through maximization of interactive learning.

General Information:

- Late, missing, or plagiarized work will carry no credit.

Marks Distribution: (existing mark distribution can be used).

- Quizzes - 10%
- Assignments/ Presentation or case study - 10 %
- Midterm Examination - 30%
- Final Examination - 50%

Week-Wise Distribution:

Week#	Topics to be covered
Week 1	Orientation
	Introduction to Genetic Engineering
	Basic concepts
	Lab
Week 2	History of Genetic Engineering
	Major events with
	Concept behind its occurrence
	Lab
Week 3	Tools of trade i.e., Enzymes
	Enzymes
	Restriction enzymes
	Lab/work
Week 4	RFLP and ligases
	Restriction mapping
	Concept map of enzymes
	DNA modifying enzymes
Week 5	Introduction to PCR
	History and major steps
	Methodology of PCR
	Applications of PCR
Week 6	Lab
	Concept map
	PCR Continues....
	Lab experiment for group
Week 7	Plasmid introduction
	Types of plasmids
	Functional properties of plasmid
	Plasmid as cloning vector
Week 8	Plasmid as vector continued
	Expression vectors
	Tumor inducing plasmid
	Lab

Week 09	Mid Term Examination
Week 10	Uses of plasmids
	cDNA Library
	Lab experiment/bacteria
	Lab/assignments
Week 11	Literature review assignment
	Literature review assignment
	Literature review assignment
	<i>In-silico</i> analysis lab
Week 12	DNA extraction theory
	Protocols used in DNA extraction
	Concept behind buffer used
	Lab
Week 13	Measurement of DNA concentration
	Gel electrophoresis
	Spectrophotometry
	Lab work/experiment
Week 14	Presentation and assignment
	Mode of expression of gene
	Over and down regulation
Week 15	Expression measurement
	Microarray
Week 16	Final Examination

Recommended Text/Reference books (Latest edition)

1. Nicholl, D. An Introduction to Genetic Engineering (3rd Edition). Cambridge: Cambridge University Press. 2008 (2012 online)
2. Id R.W. and S.B. Primrose. Principles of Gene Manipulation, an Introduction to Genetic Engineering (4th edition). Blackwell Scientific Publications. 1994
3. Setlow J.K. , Genetic Engineering: Principles and Methods. Kluwer Academic Publishers. 2000
4. Nicholl D. S. T. , An Introduction to Genetic Engineering, Cambridge University Press, 2002
5. Yount L. , Genetic Engineering, Gale Group, 2002
6. Sambrook J. , D. W. Russell, J. Sambrook, Molecular Cloning: A Laboratory Manual (3Volume Set), Cold Spring Harbor Laboratory Press, 2001
7. Brown T. A., Gene Cloning and DNA Analysis: An Introduction 4th edition, Blackwell Science Inc 2001

BGE326 Techniques in Biotechnology

Course Title :	Techniques in Biotechnology
Course Code :	BGE326
Offered to :	Undergraduate Students at Hazara University
CrHr :	3 (2+1)
Pre-requisite :	None

Course Objective:

The course aims to introduce students with most of the practical aspects of the tools commonly used in Biotechnology and to enhance their capacity to plan for research in areas of their respective interest in future.

Course Learning Outcome (CLOs):

- The course will provide the students with a concept of different techniques used in Biotechnology.
- Understanding major techniques used in it which make this subject as one of important areas of biological sciences.
- The students will be able to understand the fundamentals of tools used in Biotechnology and their applications in modern day applied sciences including but not limited to agriculture, environment, food and medicines etc through genetic engineering.

Course Contents:

- Introduction to various lab techniques.
- Sterilization, sterilization principles, dry heat sterilization, steam sterilization

- Centrifugation (centripetal and centrifugal forces, rpm,)
- DNA, RNA and plasmid isolation
- Polymerase chain reaction and thermal cycler
- Gel electrophoresis, concepts and understanding (Agarose, SDS PAGE and 2D-PAGE)
- DNA sequencing: need for DNA sequencing, methods of DNA sequencing
- Blotting techniques: southern, northern and western blotting
- Enzyme-linked immunosorbent assay (ELISA)
- Principles and applications of various types of chromatography including paper, thin layer, gel filtration, ion-exchange, affinity
- Principles and applications of high performance liquid chromatography (HPLC),
- Principles and applications of gas chromatography, GC-MS and LC-MS
- Principles and applications of electron microscope
- Gene expression analysis techniques, qRT-PCR and microarray
- Spectrophotometry concepts and measurement of DNA and Proteins

Teaching Methodology:

- Student-centered teaching through communicative approach
 - Situational learning through lectures, classroom activities, and practice sessions
 - Multimedia-based lectures
 - Computer-facilitated lessons and strategies
 - Classroom dynamics through maximization of interactive learning
 - Lab visits to incorporate hands-on experience
- General Information:**
- Late, missing, or plagiarized work will carry no credit.

Marks Distribution: (existing mark distribution can be used).

- Quizzes - 10%
- Assignments/ Presentation or case study - 10 %
- Midterm Examination - 30%
- Final Examination - 50%

Week-Wise Distribution:

Week#	Topics to be covered
Week 1	Course Orientation/Introduction Session Introduction to various lab techniques
Week 2	Sterilization: sterilization principles, dry heat sterilization, steam sterilization
Week 3	Centrifugation (centripetal and centrifugal forces, rpm,)

Week 4	DNA and plasmid isolation, protocols with concept and use of each component Polymerase chain reaction and thermal cycler
Week 5	Gel electrophoresis, concepts and understanding (Agarose, SDS PAGE and 2DPAGE)
Week 6	DNA Sequencing: need for DNA sequencing, methods of DNA sequencing
Week 7	Blotting techniques: southern, northern and western blotting
Week 8	Enzyme-linked immunosorbent assay (ELISA)
Week 9	Mid Term Examination
Week 10	Principles and applications of various types of chromatography including paper, thin layer, gel filtration, ion-exchange, affinity
Week 11	Principles and applications of high performance liquid chromatography (HPLC),
Week 12	Principles and applications of gas chromatography, GC-MS and LC-MS
Week 13	Principles and applications of electron microscope
Week 14	Gene expression analysis techniques, qRT-PCR and microarray
Week 15	Spectrophotometry concepts and measurement of DNA and Proteins
Week 16	Final Examination

Reference Books (latest Editions):

1. Rapley, R. (2018). Recombinant DNA Techniques and Molecular Cloning. A. Hofmann & S. Clokie (Eds.), Cambridge: Cambridge University Press.
doi:10.1017/9781316677056.006
2. Sambrook J., D. W. Russell, J. Sambrook, Molecular Cloning: A Laboratory Manual (3Volume Set), Cold Spring Harbor Laboratory Press, 2001
3. Brown T. A., Gene Cloning and DNA Analysis: An Introduction. Blackwell Science Inc 2008
4. Dennis Howitt, Duncan Cramer, Introduction to Research Methods, 3rd Edition; Dec 2010

**SCHEME OF STUDIES FOR
MPHIL and PhD
BOTANY**

THE CURRICULUM MODEL FOR THE MPhil BOTANY PROGRAM:

Admission to programs:

1. Students having MSc (2 years) or BS (4 years) will be eligible to get admission in MPhil Botany.
2. Admission committee will decide the suitability of a candidate for admission.
3. Rules/Regulations for admission will be followed as designed by Academic Council of the University.

Study Scheme instructions

MPhil Students will be required to complete **24** Credit hours in courses divided into two semesters in order to complete MPhil course work. MPhil Research/Thesis will have **6 Credit hours**. Research work will be conducted after the completion of course work.

Teachers can offer a course from the list provided. Apart from the list provided, any other general Graduate course offered for biological sciences by the University will also be considered, if the contents of course are found suitable for students. Course codes for General Graduate courses offered by university will be followed as provided.

A student can take a Maximum of 4 courses (12 credit hours) per semester, which will be taken from the courses offered. University rules and regulations regarding research etc. will be followed.

Item #3 Approval of scheme of studies, course titles and codes (MPhil Botany)

The whole program is divided into four semesters as follows:

Semester	Subject	Credits
First	Course I (University Course-1)	3
	Course II (University Course-II)	3
	Course III	3
	Course IV	3
	Total	12
Second	Course V	3
	Course VI	3
	Course VII	3
	Course VIII	3
	Total	12
Third-Fourth	Thesis	6
Total		30

University Requirement for MPhil Scholars

HBS-600	Research Methodology for health and biological sciences	3	Compulsory
HBS-500	Advance data Analysis for health and biological sciences	3	Compulsory

**Specialization course titles and assigned course codes as per new format
for MPhil Botany**

Course Code	Course Title	Credit hrs.
BOT601	Advances in Plant Breeding	3
BOT602	Advanced Ethnobotany	3
BOT603	Advanced Molecular Biology	3
BOT603	Advances in Biosafety	3
BOT605	Advances in Cell Biology	3
BOT606	Advances in Microbiology	3
BOT607	Advances in Plant Ecology	3
BOT608	Advances in Plant Physiology	3
BOT609	Aerobiology	3
BOT610	Agricultural Botany and Evolution of Crop Plants	3
BOT611	Agrostology of Northern Pakistan	3

Course Code	Course Title	Credit hrs.
BOT612	Allelopathic Interactions	3
BOT613	Application of Ethnobotany in Plant Conservation	3
BOT614	Applied Ecology	3
BOT615	Biodiversity and Genetic Conservation	3
BOT616	Bioethics	3
BOT617	Bioinformatics	3
BOT618	Biology of halophytes	3
BOT619	Biology of Weeds	3
BOT620	Biotechnology	3
BOT621	Bryology and Evolutionary Trends of Higher Plants	3
BOT622	Chromosome Technology	3
BOT623	Developmental Genetics	3
BOT624	Ecological Communities	3
BOT625	Ecology and biodiversity of Temperate forest	3
BOT626	Ecology of the Denuded Soils	3
BOT627	Edaphology	3
BOT628	Elements of Biotechnology	3
BOT629	Environmental Biotechnology	3
BOT630	Environmental Botany	3
BOT631	Ethnopharmacology and Pharmacognosy	3
BOT632	Evolution of Lower Vascular Plants	3
BOT633	Experimental Design and Data Analysis	3
BOT604	Experimental Plant Taxonomy	3
BOT635	Food Biotechnology	3
BOT636	Fresh water Algae	3
BOT637	Genetic Engineering	3
BOT638	Genomics	3
BOT639	Hands on Computer and Access to Botanical Data Bases	3
BOT640	Intensive Study in the Specialization Courses	3
BOT641	Limnology	3
BOT642	Medical Biotechnology	3
BOT643	Medicinal Plants	3
BOT644	Meiotic Configuration and Genetic Analysis	3
BOT645	Microbes in Biotechnology	3
BOT646	Molecular Cytogenetics	3
BOT647	Molecular Genetics	3
BOT648	Molecular Phylogenetics	3
BOT649	Molecular Study of Dicots	3

Course Code	Course Title	Credit hrs.
BOT650	Molecular Study of Monocots	3
BOT651	Mushroom Biology	3
BOT652	Mycorrhizal Association	3
BOT653	Paleontology and Aerobotany	3
BOT654	Pharmaceutical Biotechnology	3
BOT655	Pharmacognosy	3
BOT656	Phytochemistry	3
BOT657	Phytogeography and Phylogenetics	3
BOT658	Phytogeography of Pakistan	3
BOT659	Plant Biochemistry	3
BOT660	Plant Pathology	3
BOT661	Plant Systematics	3
BOT662	Plant taxonomy and Biosystematics	3
BOT663	Plant Cell and Tissue Culture	3
BOT664	Pollution Ecology	3
BOT665	Population Genetics	3
BOT666	Principles and Practice of Plant Conservation	3
BOT667	Proteomics	3
BOT668	Pteridology	3
BOT669	Recent Development in Plant Physiology	3
BOT670	Recent Trends in Mycology	3
BOT671	Recent Trends of Research in Cyanobacteria	3
BOT672	Recombinant DNA Technology	3
BOT673	Research Methodology and Presentation of results	3
BOT674	Safety Consideration of the Advanced Lab Technology	3
BOT675	Salinity and water logging	3
BOT676	Stress Biology	3
BOT677	Stress Physiology	3
BOT678	Survey of the Recent ICBN Issues	3
BOT679	Vegetation Analysis	3
BOT680	Weed Ecology	3
BOT681	Transposable elements (TEs) Genomics	3
BOT682	Genome Biology	3
BOT683	Botanical Assays	3
BOT684	Plant Microbe Interaction	3
BOT685	Vegetation Ecology	3
BOT686	Agroforestry	3
BOT687	Advances in Ethnoecology	3

Course Code	Course Title	Credit hrs.
BOT688	Ecological Informatics	3
BOT689	Medicinal and Aromatic Plants	3

Item # 4 Approval of scheme of studies, course titles and codes (PhD Botany)**SCHEME OF STUDIES (PhD BOTANY)**

The whole program is divided into eight semesters as follows:

Semester	Subject	Credits
First	Course I (University Course-1)	3
	Course II (University Course-II)	3
	Course III	3
	Total	9
Second	Course V	3
	Course VI	3
	Course VII	3
	Total	9
Third- Sixth (Minimum duration)	Thesis	

UNIVERSITY REQUIREMENT FOR PhD SCHOLARS

HBS-600	Research Methodology for health and biological sciences	3	Compulsory
HBS-500	Advance data Analysis for health and biological sciences	3	Compulsory

Field of specialization codes and assigned course codes for PhD Botany

Course Code	Course Title	Credit hrs.
BOT731	Advanced Plant Microbe Interactions	3
BOT732	Lichenology	3
BOT733	Advanced Pteridology	3
BOT734	Bryophyte systematics	3
BOT735	Plant Conservation Strategies	3
BOT736	Applied Ethnobotany	3
BOT737	GIS for Botanical Sciences	3
BOT738	Principles of Forest Genetics	3
BOT739	Bryophytes of Pakistan	3
BOT740	Advances in Herbarium Management	3
BOT741	Chemotaxonomy	3
BOT742	Climate Change and Ecosystem	3

Course Code	Course Title	Credit hrs.
BOT743	Flora of Pakistan	3

Course Title : BOT 736 Applied Ethnobotany

Course Code : BOT736

Offered to : Graduate Students at Hazara University

CrHr : 3 (3+0)

Pre-requisite : None

Course Objective:

To understand the role that local peoples' knowledge, institutions and cultural perspectives can play in plant resource use, community development, sustainable land management and conservation.

Course Learning Outcome (CLOs)

- People-plant relations and importance of wild and domesticated plants to local livelihoods.
- The role that local peoples' knowledge, institutions and cultural perspectives can play in plant resource use, community development, sustainable land management and conservation.
- Ethnobotany in relation to local and national cross cutting issues such as gender, culture, equity, environmental concern, and intellectual property rights.

Course Contents:

- Concept of ethnobotany, botanical, and anthropological methods,
- Botanical surveys, surveys of community and household economies and local markets,
- Preparing a reference collection, analytical tools, qualitative and quantitative approaches
- Environment and the plant resources, economics and ethnobotany.
- Forest products, traditional food plants and their role as income source and as emergency foods.
- Ethnomedicine, collecting plants for phytochemical analysis, ethics in searching for new plant products, how to return knowledge to communities.
- Climate change, potential impact of climate change on peoples' access to plant resources.
- Application of local knowledge and the role of local institutions in conservation, sustainable use, and community development.

Week-Wise Distribution:

Week#	Topic to be covered
Week 1	Concept of ethnobotany
Week 2	Botanical and anthropological methods
Week 3	Botanical surveys
Week 4	Surveys of community and household economies and local markets
Week 5	Preparing a reference collection
Week 6	Analytical tools, qualitative and quantitative approaches
Week 7	Environment and the plant resources
Week 8	Economics and ethnobotany
Week 9	Midterm Examination
Week 10	Forest products
Week 11	Traditional food plants and their role as income source and as emergency foods.
Week 12	Traditional food plants and their role as income source and as emergency foods.
Week 13	Ethnomedicine, collecting plants for phytochemical analysis
Week 14	Ethics in searching for new plant products, How to return knowledge to communities.
Week 15	Climate change, potential impact of climate change on peoples' access to plant resources
Week 16	Climate change, potential impact of climate change on peoples' access to plant resources
Week 17	Application of local knowledge and the role of local institutions in conservation, sustainable use, and community development
Week 18	Final Examination

Reference Books (latest Editions)

1. Ansari A., Z.K. Abbas and Naeem M. 2016. Plant Biodiversity: Monitoring, Assessment and Conservation. ISBN: 9781780646947
2. Abbasi AM., Khan M.A. Shah M.H. 2015. Wild Edible Vegetables of Lesser Himalayas: Ethnobotanical and Nutraceutical Aspects. Springer New York, USA. ISBN: 978-3-319-09542-4
3. Singh, M., R.B. Singh and M.I. Hassan. 2014. Climate Change and Biodiversity. Springer, Japan. ISBN: 978-4-431-54837-9
4. Boutenko S. 2013. Wild edibles. North Atlantic Books. ISBN: 9781583946022.
5. Kallas J. 2010. Edible Wild Plants Wild Foods from Dirt to Plate. Gibbs Smith Publishers. ISBN: 9781423601500.
6. Michael J. and Cox P.A. 1997. Plants, people, and culture: The Science of Ethnobotany. Freeman and Company, 41 Madison Avenue, New York NY 10010. ISBN 0716760274.W.H.
7. Cotton C.M. 1996. Ethnobotany: Principles and Applications. John Wiley & Sons, UK. ISBN-13: 978-0471955375
8. Martin G.J. 1995. Ethnobotany. A methods manual. Springer US. ISBN 978-1-4615-2496

Course Title : BOT 741 Chemotaxonomy

Course Code : BOT 741

Offered to : Graduate Students at Botany Department

CrHr : 3

Pre-requisite : None

Course Objectives:

- To understand the principles and significance of chemotaxonomy in plant classification.
- To explore various chemical compounds used in plant taxonomy.
- To learn analytical techniques for chemotaxonomic studies.
- To examine the role of secondary metabolites in evolutionary relationships among plants.

Course Learning Outcome (CLOs):

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

- Explain the principles and significance of chemotaxonomy in plants including its historical development and relationship to classical taxonomy.
- Critically analyse the role of primary and secondary metabolites (e.g., alkaloids, terpenoids, flavonoids, phenolics) as chemotaxonomic markers.
- Compare and evaluate chemical data and biosynthetic pathways to infer taxonomic relationships among different taxa.
- Apply analytical techniques (such as chromatography, mass spectrometry, and NMR spectroscopy) to identify and quantify chemotaxonomic markers.
- Design and conduct independent research projects that use chemotaxonomic methods to address questions in systematics, evolution, or biodiversity.

Course Contents:

- 1: Introduction to Chemotaxonomy

- Definition, scope, and significance
- Historical development of chemotaxonomy
- Relationship between classical taxonomy and chemotaxonomy

2: Chemical Basis of Taxonomy

- Primary and secondary metabolites
- Importance of chemical markers in classification
- Chemotaxonomic characters at different taxonomic levels

3: Types of Chemical Constituents Used in Chemotaxonomy

- Alkaloids – Occurrence, biosynthesis, taxonomic significance
- Flavonoids – Structure, distribution, and role in plant taxonomy
- Terpenoids and Essential Oils – Classification and taxonomic applications
- Serotaxonomy – Use in phylogenetic studies
- Carbohydrates and Polysaccharides – Chemotaxonomic relevance
- Lipids and Fatty Acids – Role in chemotaxonomic differentiation
- Phenolic Compounds and Tannins – Distribution and taxonomic importance

4: Biochemical Techniques in Chemotaxonomy

- Chromatographic techniques (TLC, HPLC, GC-MS)
- Spectroscopic techniques (UV, IR, NMR, Mass Spectrometry)

5: Applications of Chemotaxonomy

- Role of chemotaxonomy in plant classification and phylogeny
- Chemotaxonomic studies in medicinal and aromatic plants
- Chemotaxonomy in evolutionary and ecological studies
- Use in conservation biology and biodiversity studies

6: Case Studies and Recent Advances

- Chemotaxonomic studies of selected plant families (e.g., Fabaceae, Asteraceae, Lamiaceae)
- Recent trends and future prospects in chemotaxonomy

Practical/Lab Work:

- Extraction and identification of phytochemicals
- Chromatographic analysis of plant metabolites
- Spectrophotometric analysis of plant extracts
- Chemotaxonomic profiling of selected plant species

Textbooks & Reference Books:

1. Harborne, J. B. (1998). *Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis* (3rd Ed.). Springer.
2. Young, D. A. & Seigler, D. S. (1981). *Phytochemistry and Angiosperm Phylogeny*. Praeger Publishers.
3. Hillis, D. M., & Moritz, C. (1996). *Molecular Systematics*. Sinauer Associates.
4. Krishnamurthy, K. V. (2003). *Textbook of Biodiversity*. Science Publishers.
5. Swain, T. (1975). *Chemical Plant Taxonomy*. Academic Press.
6. Markham, K. R. (1982). *Techniques of Flavonoid Identification*. Academic Press.
7. Torssell, K. B. G. (1997). *Natural Product Chemistry: A Mechanistic, Biosynthetic, and Ecological Approach*.

BOT 742 Climate Change and Ecosystem

Course Title : Climate Change and Ecosystem

Course Code : BOT

Offered To : Graduate (PhD) Students

Cr Hr : 3 (3+0)

Pre-requisite : None

Course Objectives:

1. Explain how climate change affects vegetation structure, composition, and distribution.
2. Analyze the cascading effects of climate change on ecosystem functions such as carbon sequestration, soil stability, and water cycles.
3. Evaluate the resilience and adaptability of plant species and ecosystems under climate stress.
4. Utilize ecological models and climate data tools to study vegetation-climate interactions.

Course Learning Outcome (CLOs):

This course explores the intricate relationships between climate change, vegetation, and ecosystems. It examines how rising temperatures, changing precipitation patterns, and extreme weather events alter plant communities, ecosystem services, and biodiversity. Through case studies, climate data analysis, and policy discussions, students will assess the vulnerability of ecosystems and explore adaptation and mitigation strategies for sustainable environmental management.

Course Contents:

Introduction to Climate Change and Ecosystems

- Overview of global climate systems and climate change drivers
- Introduction to ecosystems and their functions
- Interactions between climate variables and vegetation

The fundamentals of climate change

- Introduction to climate science and global climate patterns
- Climate change and consequences

- Causes and consequences of climate change
- Current climate trends and projections

Impact on Ecosystem Processes and Services

- Climate change effects on biodiversity and species composition
- Indicators of ecosystem service decline in biodiversity hotspot regions
- Carbon cycling and sequestration in forests and grasslands
- Effects on soil health, nutrient cycling, and decomposition
- Water availability, evapotranspiration, and ecosystem hydrology
- Drivers of ecosystem change

Vegetation Responses to Climate Change

- Temperature effects on plant growth, photosynthesis, and respiration
- Shifts in species distribution and plant migration patterns
- Phenological changes (flowering, fruiting, leafing cycles)

Biodiversity and Habitat Disruptions

- Species extinction risks and changes in species interactions
- Habitat fragmentation and ecosystem degradation

Extreme Weather Events and Ecosystem Disturbances

- Droughts, floods, hurricanes, and their effects on vegetation
- Wildfires: Causes, frequency, and ecological consequences
- Desertification and land degradation

Agricultural and Forestry Implications

- Climate change effects on crop productivity and food security
- Agroforestry and climate-smart agriculture
- Forest degradation, afforestation, and carbon offset programs

Ecosystem-Based Adaptation and Mitigation Strategies

- Reforestation, wetland restoration, and nature-based solutions
- Conservation planning and protected area management
- Climate-resilient ecosystem management and policy frameworks

Teaching Methodology:

- Board Lectures, PowerPoint Lectures, Class Discussion
- Computer-facilitated lessons and strategies
- Field visits to incorporate hands-on experience

General Information:

- Late, missing, or plagiarized work will carry no credit.

Marks Distribution: (existing mark distribution can be used).

- Quizzes - 10%
- Assignments/ Presentation or case study - 10 %
- Midterm Examination - 30%
- Final Examination - 50%

Week-Wise Distribution:

Week #	Topics to be covered
Week 1	Overview of global climate systems and climate change drivers, Introduction to ecosystems and their functions
Week 2	Interactions between climate variables and vegetation
Week 3	Introduction to climate science and global climate patterns, Climate change and consequences
Week 4	Causes and consequences of climate change, Current climate trends and projections
Week 5	Climate change effects on biodiversity and species composition, Indicators of ecosystem service decline in biodiversity hotspot regions, Carbon cycling and sequestration in forests and grasslands
Week 6	Effects on soil health, nutrient cycling, and decomposition, Water availability, evapotranspiration, and ecosystem hydrology, Drivers of ecosystem change
Week 7	Temperature effects on plant growth, photosynthesis, and respiration
Week 8	Shifts in species distribution and plant migration patterns, Phenological changes (flowering, fruiting, leafing cycles)
Week 9	Midterm Examination

Week 10	Species extinction risks and changes in species interactions, Habitat fragmentation and ecosystem degradation
Week 11	Droughts, floods, hurricanes, and their effects on vegetation, Wildfires: Causes, frequency, and ecological consequences
Week 12	Desertification and land degradation, Climate change effects on crop productivity and food security
Week 13	Agroforestry and climate-smart agriculture, Forest degradation, afforestation, and carbon offset programs
Week 14	Reforestation, wetland restoration, and nature-based solutions, Conservation planning and protected area management
Week 15	Climate-resilient ecosystem management and policy frameworks
Week 16	Final Term Examination

Recommended Books and Literature:

1. Anwar, M., Rais, M., Baig, M. B., & Behnassi, M. (2022). *Impacts of Climate Change on Biodiversity in Pakistan: Current Challenges and Policy Recommendations*. In *The Food Security, Biodiversity, and Climate Nexus* (pp. 101–123).
2. Archer, D., & Rahmstorf, S. (2010). *The Climate Crisis: An Introductory Guide to Climate Change*. Columbia University Press.
3. Bonan, G. B. (2015). *Ecological Climatology: Concepts and Applications* (3rd ed.). Cambridge University Press.
4. Chapin, F. S., Matson, P. A., & Vitousek, P. M. (2011). *Principles of Terrestrial Ecosystem Ecology* (2nd ed.). Springer.
5. Government of Pakistan. (2021). *National Climate Change Policy 2021*. Ministry of Climate Change.
6. Lovejoy, T. E., & Hannah, L. (Eds.). (2019). *Biodiversity and Climate Change: Transforming the Biosphere*. Yale University Press.
7. Sodhi, N. S., & Ehrlich, P. R. (Eds.). (2010). *Conservation Biology for All*. Oxford University Press.
8. U.S. Global Change Research Program. (2023). *Climate Change Impacts in the United States: The Third National Climate Assessment*. U.S. Government Printing Office.

BOT731 Advanced Plant Microbe Interaction

Course Title	:	Advanced Plant Microbe Interaction
Course Code	:	BOT 731
Offered to	:	Graduate Students at Hazara University
CrHr	:	3 (3+0)
Pre-requisite	:	None

Course Objectives:

The course is designed to teach students about the use of microbes, especially bacteria for plants (under stress conditions). It will help scholars to know about what's going on with plants in root zone under stress conditions. It will acquaint the scholars with a variety of bacteria present in root zone which can help plants in better growth under normal and stressed environment with special focus on abiotic stresses.

Course Learning Outcome (CLOs)

- To enable the students to use advanced microbiological tools.
- To enable the students to isolate bacteria from the root zone of plants under stress conditions.
- To enable the students to characterize the bacteria for abiotic stress amelioration.

Course Contents:

- Plant–microbe Interactions under stress conditions: Overview, changes in nature of interactions in rhizosphere under abiotic stresses, changes in rhizospheric microbial flora under stress conditions.
- Biological Nitrogen fixation under drought and other stresses, effect on nodule formation, impact on symbiotic and associative N fixation, impact on N-fixation in non-legumes.
- Phosphate solubilization under climate change scenario; mechanism, important species, use as biofertilizer and associated limitations.
- Potassium Solubilizing Bacteria: solubilization under climate change scenario; mechanism, important species, use as biofertilizer and associated limitations.
- Mycorrhizal Associations under abiotic stresses, especially drought, important species, mechanism and applications.

- Heavy metals stress and Bioremediation/phytoremediation, types of bioremediation, important bacterial species used for bioremediating polluted soils.
- Role of Plant growth promoting characters under stressful environment i.e., Phytohormones, siderophore and ACC deaminase production by rhizobacteria, their potential and mechanism of plant growth promotion under abiotic stresses.
- Drought and temperature; impact on plant growth, Importance and Mechanism of action of microbes and plants under these conditions.
- Salinity and Water logging; effects on plant growth, response of plants to such conditions, mechanisms of action of Salt tolerant plants and microbes.
- Climate change and its impact on plant growth and development, how plants and rhizobacteria could cope with such challenges.
- **Week-Wise Distribution:**

Week#	Topic to be covered
Week 1	Plant–microbe Interactions under stress conditions: Overview
Week 2	changes in nature of interactions in the rhizosphere under abiotic stresses, changes in rhizospheric microbial flora under stress conditions.
Week 3	Biological Nitrogen fixation under drought and other stresses, effect on nodule formation,
Week 4	Impact on symbiotic and associative N fixation, impact on N-fixation in non-legumes.
Week 5	Phosphate solubilization under climate change scenario; mechanism, important species, use as biofertilizer and associated limitations.
Week 6	Potassium Solubilizing Bacteria: solubilization under climate change scenario; mechanism, important species, use as biofertilizer and associated limitations.
Week 7	Mycorrhizal Associations under abiotic stresses, especially drought, important species, mechanism and applications.
Week 8	Heavy metals stress and Bioremediation/phytoremediation, types of bioremediation, important bacterial species used for bioremediating polluted soils. Mechanisms and applications.
Week 9	Midterm Examination
Week 10	Role of Plant growth promoting characters under stressful environment i.e., Phytohormones,

Week 11	siderophore and ACC deaminase production by rhizobacteria, their potential and mechanism of plant growth promotion under abiotic stresses.
Week 12	Drought and temperature; impact on plant growth, Importance and Mechanism of action of microbes and plants under these conditions.
Week 13	Salinity and Water logging; effects on plant growth, response of plants to such conditions, mechanisms of action of Salt tolerant plants and microbes.
Week 14	Climate change and its impact on plant growth and development, how plants and rhizobacteria could cope with such challenges.
Week 15	Assignments/Presentations on Latest Reviews regarding Plant Microbe Interactions under abiotic stresses.
Week 16	Final Examination

Reference Books

1. Plant-Microbe Interaction and Stress Management. 2024. Editors: Puneet Singh Chauhan, Shri Krishna Tewari, Sankalp Misra, Springer, 2024.
2. Microbial Management of Plant Stresses. 2021. Edited by: Ajay Kumar and Samir Droby , 2021 Elsevier Inc.
3. Plant-Microbe Interactions for Sustainable Agriculture. 2024. Arvind Kumar Rai, Priyanka Chandra, Nirmalendu Basak, Parul Sundha and Rajender Kumar Yadav. Cambridge Scholars Publishing.
4. Plant-Bacteria Interactions: Strategies and Techniques to Promote Plant Growth Editor(s): Iqbal Ahmad, John Pichtel, Shamsul Hayat
5. Research and review articles related to plant microbe interactions.

BOT 738 Principles of Forest Genetics

Course Title : Principles of Forest Genetics

Course Code : BOT 733

Offered to : Graduate Students at Hazara University

CrHr : 3 (3+0)

Pre-requisite : None

Course Objectives:

This course aims to introduce graduate students to the principles of forest genetics, focusing on genetic variation, adaptation, breeding, and conservation in forest tree species. Students will understand the genetic basis of important traits and how this knowledge is applied in

forest management, tree improvement, and conservation strategies in the face of environmental challenges.

- Course Learning Outcomes (CLOs):
- Understand the genetic structure and diversity of forest tree populations.
- Explain mechanisms of inheritance and variation in forest trees.
- Apply principles of quantitative genetics in forest tree breeding.
- Understand genetic conservation strategies for forest biodiversity.
- Evaluate the role of forest genetics in adaptation to climate change and sustainable forestry.

Course Contents:

- Introduction to Forest Genetics: Definition, scope, and relevance in forest biology and management.
- Genetic Variation in Forest Trees: Sources, types, and importance of genetic variation.
- Mendelian Inheritance and Molecular Markers: Classical genetics and modern molecular approaches.
- Quantitative Genetics: Polygenic traits, heritability, genetic correlations, and genotype-environment interactions.
- Tree Breeding Strategies: Mass selection, progeny testing, and clonal selection.
- Seed Orchard Design and Management: Concepts, types, and genetic gains.
- Genetic Conservation: In-situ and ex-situ conservation, gene pools, and forest genetic resources.
- Provenance Testing and Genecology: Understanding local adaptation and selection of planting material.
- Genomic Tools in Forest Genetics: SSRs, SNPs, genome sequencing, and association mapping.
- Forest Genetics and Climate Change: Adaptation strategies and assisted migration.
- Ethical and Policy Aspects: Intellectual property rights, access to genetic resources, and biodiversity laws.

Week-Wise Distribution:

Week #	Topic to be Covered
Week 1	Introduction to Forest Genetics: Scope and importance
Week 2	Sources and types of genetic variation in forest trees
Week 3	Principles of Mendelian genetics in forest tree studies
Week 4	Molecular markers and genetic diversity assessment
Week 5	Quantitative genetics and polygenic traits in forest trees
Week 6	Genotype-environment interactions and heritability
Week 7	Tree breeding methods and strategies
Week 8	Midterm Examination
Week 9	Design and management of seed orchards
Week 10	Provenance testing and adaptation studies
Week 11	Conservation of forest genetic resources
Week 12	Application of genomic tools in forest genetics
Week 13	Genetic response to climate change in forests
Week 14	Case studies in forest tree improvement

Week 15	Assignments/Presentations on forest genetics projects
Week 16	Final Examination

Reference Books and Resources:

- Forest Genetics – Timothy L. White, W. Thomas Adams, David B. Neale.
- Introduction to Forest Genetics – Jonathan Wendel, 2022.
- Forest Genetics and Tree Breeding – Shukla & Misra.
- Genetics and Genomics of Forest Trees – Edited by S. Kumar and M. Fladung.
- Research articles and case studies in forest genetics and breeding.

BOT 737 GIS for Botanical Sciences

Course Title : GIS for Botanical Sciences

Course Code : BOT 737

Offered to : Graduate Students at Hazara University

CrHr : 3 (2+1)

Pre-requisite : None

Course Objectives:

This course is designed to equip graduate students with essential concepts and applications of Geographic Information Systems (GIS) in botanical sciences. It emphasizes spatial thinking and the use of geospatial tools in vegetation mapping, habitat modeling, biodiversity monitoring, ecological niche analysis, and conservation planning. The course also includes hands-on experience with GIS software to strengthen skills in botanical data visualization, analysis, and decision-making.

Course Learning Outcomes (CLOs):

- Understand fundamental GIS concepts, tools, and spatial data types relevant to plant sciences.
- Apply GIS techniques in vegetation mapping, ecological modeling, and conservation research.
- Develop skills in spatial data collection using GPS and remote sensing integration.
- Conduct habitat suitability analysis and species distribution modeling for plant species.
- Prepare GIS-based botanical reports and thematic maps for research and planning.

Course Contents:

- Introduction to GIS and Its Relevance to Botanical Sciences: Overview of GIS, scope in ecological and botanical studies.
- Spatial Data Types and Sources: Raster and vector data, botanical data formats, satellite imagery, aerial photos.
- Coordinate Systems and Map Projections: Basic concepts and selection of appropriate projections.
- Data Collection Techniques: Use of GPS, mobile apps, and drones for plant data collection.
- Vegetation Mapping and Classification: Land use/land cover analysis, supervised/unsupervised classification techniques.

- Habitat Suitability and Species Distribution Modeling (SDM): MaxEnt, Bioclim, and other tools used in plant habitat modeling.
- Ecological Niche Modeling: Parameters affecting plant distribution; climate layers and spatial filtering.
- GIS for Biodiversity and Conservation: Mapping hotspots, endemic zones, and threat assessment.
- Temporal Analysis and Change Detection: Monitoring vegetation change under climate or anthropogenic pressures.
- Remote Sensing Integration: Use of NDVI, EVI, and vegetation indices in botanical analysis.
- Field Applications and Case Studies: Review of GIS-based botanical research.
- Practical Component: Lab work using QGIS/ArcGIS for data import, map layout design, and spatial analysis.

Week-Wise Distribution:

Week #	Topic to be Covered
Week 1	Introduction to GIS and its importance in Botanical Sciences
Week 2	Types of spatial data and data sources used in plant studies
Week 3	Coordinate systems and map projections relevant to botanical data
Week 4	Introduction to GPS and field data collection techniques
Week 5	Fundamentals of vegetation mapping and classification
Week 6	Introduction to remote sensing for vegetation monitoring
Week 7	NDVI, EVI and interpretation of vegetation indices
Week 8	Midterm Examination
Week 9	Habitat suitability analysis using GIS tools
Week 10	Species distribution modeling (SDM) using MaxEnt and others
Week 11	Ecological niche modeling with climate and topographic data
Week 12	GIS for biodiversity mapping and conservation prioritization
Week 13	Case studies on plant habitat modeling under climate change
Week 14	Temporal analysis: vegetation changes detection techniques
Week 15	Lab-based practical project: GIS mapping and analysis report
Week 16	Final Examination

Reference Books and Resources:

- GIS Fundamentals: A First Text on Geographic Information Systems – Paul Bolstad
- Remote Sensing and GIS for Ecologists – Steven Franklin
- GIS Applications in Agriculture and Plant Sciences – Gary Taylor & Tom Gittings
- Spatial Analysis in Plant Ecology – Mark R. T. Dale
- Relevant research articles, case studies, and software tutorials (e.g., QGIS, ArcGIS, MaxEnt)

BOT 743 Flora of Pakistan

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- Course Title : Flora of Pakistan
- Course Code : BOT 743
- Offered to : M.Phil scholars at Botany Department
- CrHr : 3
- Pre-requisite : None
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- **Course Objectives:** To acquire the knowledge regarding Flora of Pakistan
- **Course Learning Outcome (CLOs):**
- Upon successful completion of the course, the student will be able to:
 - Acquire the historic journey of the flora and various attempts made by the workers.
 - Solve the problems related to the identification and recognition of various groups
 - Understand the concepts of vascular and nonvascular plants
 - Demonstrate individually different morphological characteristics of plants
 - Evaluate the importance of plants in the environment
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- **Course Contents:**
- The following attributes/parameters will be included in this course:
 - **Introduction to flora:** definition; significance; historical background; importance and affinity in different plant disciplines.
 - **History of flora of pakistan:** initial collectors/exploration history; old relevant taxonomic literature; evolutionary stages; prominent workers; compilation phases of the flora; editors and their contributions
 - **Numerical analysis of the flora:** various taxonomic groups; number of families and genera; endemism; endemism in relation to phytogeography; significant areas/regions in the country; significant families in relation to endemism.
 - **Conservation efforts:** background; current approaches in conservation; iucn red list categories and criteria; targeted taxa for conservation; numerical analysis of assess species; gaps/future needs.
 - **Some primitive and advanced families:** magnoliaceae; rosaceae; orchidaceae; asteraceae.
 - **Future targets:** compilation of pteridophytes; revision of the flora; conservation assessment of the flora; awareness about the flora
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Week#	• Topic to be taught
Week 1	• Introduction to Flora with special reference to Pakistan including significance
Week 2	• Historical background; Importance and affinity in different plant disciplines.

Week 3	Historical Background of the Flora: Initial collectors/exploration history; Old relevant taxonomic literature; Prominent Workers
Week 4	Historical Background: Compilation phases of the Flora; Editors and their contributions
Week 5	NUMERICAL ANALYSIS OF THE FLORA: Magnitude of Various taxonomic groups; Number of families and Genera
Week 6	NUMERICAL ANALYSIS OF THE FLORA: Geographic elements; Distribution of species in various phytogeographical regions
Week 7	Endemism; Endemism in relation to phytogeography; Significant areas/regions in the country
Week 8	Significant families in relation to endemism
Week 9	Mid-Term Exam
Week 10	Conservation efforts: Background; Current approaches in conservation; IUCN Red list; Categories and Criteria
Week 11	Conservation efforts: Targeted Taxa for conservation; Numerical analysis of assessed species; Gaps/future needs
Week 12	Some Primitive families: Magnoliaceae; Ranunculaceae
Week 13	Some Advanced families: Orchidaceae; Asteraceae
Week 14	Future Targets: Compilation of Pteridophytes; Revision of the Flora;
Week 15	Future targets: Conservation assessment of the flora; Awareness about the flora
Week 16	Final term

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• **Reference Books:**

1. Nasir, E. and S.I. Ali. 1971-1989. Flora West of Pakistan. Department of Botany, University of Karachi, Karachi and National Herbarium, Islamabad.
2. Ali, S.I. and M. Qaiser. 1995-2021. Flora of Pakistan. Department of Botany, University of Karachi, Karachi.
3. Ali, S.I. and Y.J. Nasir. 1989-1991. Flora of Pakistan. Department of Botany, University of Karachi, Karachi and National Herbarium, Islamabad.
4. Stewart, R. R. 1972. Flora of Pakistan: An Annotated Catalogue of the Vascular Plants of West Pakistan and Kashmir. Fakhri Printing Press, Karachi.

5. Stewart, R. R. 1982. History and Exploration of Plants in Pakistan and Adjoining Areas. Flora of Pakistan, Islamabad,
6. Clinn-Lacy, J and Kaufman, P.B. 2006. Botany Illustrated: introduction to plants major groups, flowering plant families, Springer, USA.