

DEPARTMENT OF ZOOLOGY
HAZARA UNIVERSITY, MANSEHRA



Minutes of 21st meeting of BOS Zoology
(Held on 27-08-2021)

Submitted to

BOARD OF FACULTY
FACULTY OF BIOLOGICAL & HEALTH SCIENCES

The 21st meeting of Board of Studies of Department of Zoology was held in the department of Zoology on August 27th, 2021 in the conference/Meeting Room of the Department of Bioinformatics, at 10:00 AM. Associate Professor Dr. Shumaila Noreen, Chairperson Department of Zoology chaired the meeting. The following members attended the meeting:

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| 1. | Dr. Shumaila Noreen
Chairperson,
Department of Zoology,
Hazara University, Mansehra | Convener |
| 2. | Prof. Dr. Arshad Pervez
Director COMSATS institute of information
Technology (CIIT), Abbottabad | Member |
| 3. | Dr. Basharat Ahmad,
Chairman, Department of Zoology
University of Azad Jammu and Kashmir, Muzafarabad | Member |
| 4 | Dr. Tariq Mehmood
Chairman, Department of Wildlife Management,
Pir Mehar Ali Shah Arid Agriculture University, Rawalpindi | Member |
| 5. | Dr. Muhammad Zahid
Head and Associate Professor Department of Zoology,
Islamia College University, Peshawar | Member |
| 6. | Dr. Muhammad Ayaz
EX-Director, Veterinary institute Abbottabad | Member |
| 7. | Dr. Muhammad Fiaz Khan
Assistant Professor
Department of Zoology, Hazara University Mansehra | Member |
| 8. | Dr. Sardar Azhar Mehmood
Assistant Professor
Department of Zoology, Hazara University Mansehra | Member |
| 9. | Dr. Shabir Ahmed
Assistant Professor
Department of Zoology, Hazara University Mansehra | Member |

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| 10. | Dr. Sajid Mehmood
Assistant Professor
Department of Zoology, Hazara University Mansehra | Member |
| 11. | Mr. Hamid ur Rahman
Lecturer
Department of Zoology, Hazara University Mansehra | Member |
| 12. | Dr. Huma Tariq
Lecturer
Department of Zoology, Hazara University Mansehra | Member |

After recitation of verses from Holy Quran, Assoc. Prof. Dr. Shumaila Noreen, Chairperson Department of Zoology, Hazara University formally started the meeting with her introductory welcome remarks. She extended her heart felt gratitude to the participants who had travelled from Peshawar and Islamabad to assist them with their valuable experience in the subject. The chair then presented the agent items in sequential manner:

AGENDA ITEM NO 1: CONFIRMATION OF MINUTES OF SECOND MEETING OF THE BOARD OF STUDIES OF ZOOLOGY

The 20th meeting of Board of Studies of Department of Zoology was held on 10th March, 2021 in the Meeting Room of the Department, at 10:00 AM. Assoc. Prof. Dr. Shumaila Noreen, Chairperson Department of Zoology chaired the meeting. Minutes of the meeting were presented for confirmation

Decision: The Board approved the minutes of 20th meeting of board of Studies of Department of Zoology.

AGENDA ITEM NO 2: NOMINATION OF ONE MEMBER OF BOARD OF STUDIES AS MEMBER OF BOARD OF FACULTY

As per Hazara University statute one member of Board of studies should be nominated for board of faculty. Board was requested to nominate one member for the board of faculty from the members of BOS of the department of Zoology.

Decision: The board approved the name of Dr Shabir Ahmed as a nominee of BOS for the Board of Faculty meeting.

AGENDA ITEM NO 3: APPROVAL OF CURRICULUM FOR BS (4 YEARS), MPHIL AND PHD ZOOLOGY THE CURRICULUM MODEL FOR THE BS, MPHIL, AND PHD ZOOLOGY:

The curriculum model for BS, MPhil and PhD Zoology was also presented for approval The description of each category is given below.

Sr #	Category	Description	CrHr
1	General Education (or University Requirement courses)	We believe that a graduate of four-year degree programme from the Hazara University should not have only knowledge about the discipline concerned but should have sufficient knowledge about the common aspects of the society. Therefore, courses consist of about 30 CrHr are compulsory for each student to cover from general education areas such as English, Computing skills, Pakistan studies, humanities, social sciences and Islamic studies etc. As per HEC undergraduate education policy 2020, a maximum of 39CrHr courses from general education can be taken.	36
2	Faculty Requirements/Faculty Common (Supporting Courses)	Each student is also required to cover certain important courses related to their discipline but specific to the degree programme in which the student is registered. Each Faculty has designed some courses which are common to academic programmes offered by the faculty concerned. Around 21 CrHr are dedicated to this category. In this case courses related to basic sciences are included.	21
3	Discipline Specific Foundation Courses/ Core Course	Core courses related to the degree programme as per the HEC and HU guidelines.	60
4	Technical Elective (Major Courses/ Electives within the major)	In the senior years students are provided opportunity to choose area of specializations of their own interest. The Department offers various important and latest specializations under this programme.	12
5	Internship/Research Project/special papers/review paper	In order to train students to work on some real-world problem, students are required to complete Internship/project/thesis/two special papers or review paper during the last semester.	06
		Total	135

Semester Plan (BS Zoology): The whole program is divided into eight semesters as follows:

Code	Title	CrHr	Pre - req	Code	Title	CrHr	Pre-req
Year 1, Semester I				Year 1, Semester II			
XXX	University Req. I	3(2+1)		XXX	University Req. VI	3(3+0)	
XXX	University Req. II	3(3+0)		XXX	University Req. VII	3(3+0)	
XXX	University Req. III	3(3+0)		XXX	University Req. VIII	3(3+0)	
XXX	University Req. IV	3(3+0)		XXX	University Req. IX	3(2+1)	
XXX	University Req. V	3(2+1)		XXX	University Req. X	3(2+1)	
XXX	Faculty Req. I	3(2+1)		XXX	Supporting Course-I	3(2+1)	
Year 2, Semester III				Year 2, Semester IV			
XXX	University Req. XI	3(3+0)		XXX	University Req. XII	3(3+0)	
XXX	Foundation Course-I	3(3+0)		XXX	Faculty Req-III	3(3+0)	
XXX	Supporting Course-II	3(2+1)		XXX	Faculty Req-IV	3(2+1)	
XXX	Foundation Course-II	3(2+1)		XXX	Foundation Course-III	3(2+1)	
XXX	Supporting Course-III	3(2+1)		XXX	Foundation Course-IV	3(2+1)	
XXX	Faculty Req. II	3(2+1)		XXX	Foundation Course-V	3(2+1)	
Year 3, Semester V				Year 3, Semester VI			
XXX	Supporting Course-II	3(2+1)		XXX	Supporting Course-III	3(2+1)	
XXX	Foundation Course-VI	3(2+1)		XXX	Foundation Course-VIII	3(2+1)	
XXX	Foundation Course-VII	3(2+1)		XXX	Foundation Course-IX	3(2+1)	
XXX	Core Course-I	3(2+1)		XXX	Core Course-V	3(2+1)	
XXX	Core Course-II	3(2+1)		XXX	Core Course-VI	3(2+1)	
XXX	Core Course-III	3(2+1)		XXX	Core Course-VII	3(2+1)	
XXX	Core Course-IV	3(2+1)		XXX	Core Course-VIII	3(2+1)	
Year 4, Semester VII				Year 4, Semester VIII			
XXX	Core Course-IX	3(2+1)		XXX	Core Course-XII	3(2+1)	
XXX	Core Course-X	3(2+1)		XXX	Core Course-XIII	3(2+1)	
XXX	Core Course-XI	3(2+1)		XXX	Core Course-XIV	3(2+1)	
XXX	Elective-I	3(2+1)		XXX	Elective-III	3(2+1)	
XXX	Elective-II	3(2+1)		XXX	Elective-IV	3(2+1)	

Area/Field Specialization and Course Codes Assigned to Zoology Courses

Area of Specialization	Specialization Code	Subjects Falling in the area	Course Code
Basic Zoology	0	Principles of Animal Life	ZOOL200
		Animal Diversity-I (Invertebrates)	ZOOL201
		Animal Diversity- II (Chordates)	ZOOL202
		Evolution	ZOOL301
		Wildlife	ZOOL302
		Zoogeography and Paleontology	ZOOL303
Anatomy, Physiology and Taxonomy	1	Animal Form & Function-I	ZOOL213
		Animal Form & Function-II	ZOOL214
		Physiology	ZOOL311
		Animal Behavior	ZOOL312
		Principles of Systematics	ZOOL313
		Developmental Biology	ZOOL314
Environmental/Applied	2	Biological Techniques	ZOOL321
		Environmental Biology	ZOOL322
		Economic Zoology	ZOOL421
		Biology and Control of Vertebrate Pests	ZOOL423
		Conservation Biology	ZOOL424
		Integrated Pest Management	ZOOL425
		Epidemiology of Parasitic disease	ZOOL426
		Wildlife Parasitology	ZOOL427
		Zoological Techniques	ZOOL428
		Pathology	ZOOL429
Molecular/Advanced	3	Genetics	ZOOL331
		Endocrinology	ZOOL431
		Immunology	ZOOL432
		Cancer Biology	ZOOL434
		Molecular Genetics	ZOOL435
Specialized Fields in Zoology	4	Entomology	ZOOL431
		Parasitology	ZOOL415
		Ichthyology	ZOOL422
		Fish and Aquatic Toxicology	ZOOL442
		Introductory Freshwater Biology	ZOOL423
		Wildlife Parasitology	ZOOL427
		Insect Ecology	ZOOL433

		Advanced Medical Helminthology	ZOOL429
		Advanced Medical Protozoology	ZOOL411
		Aqua Culture	ZOOL437
		Vector Biology	ZOOL438
		Conservation Biology of Wildlife	ZOOL445
		Principles of Wildlife Management	ZOOL446
		Wildlife of Pakistan	ZOOL447
Internship/Research/ Review/Seminar	5	Internship/Research Project/Review Report	ZOOL500

List of General Education (University Requirement) Courses: Students will be required to complete 12 Courses, i.e., 36 CrHr from the below list. Compulsory courses are marked with the ‘*’.

Code	Title	CrHr	Pre-Requisite
ENG100	English - I (Functional English) *	3(3+0)	None
ENG200	English – II (Communication Skills) *	3(3+0)	ENG100
ENG300	English – III (Academics Reading and Writing) offered in 6 th Semester	3(3+0)	ENG200
ISL100	Islamic Studies *	3(3+0)	None
PKS100	Introduction to Pakistan Studies *	3(3+0)	None
CS100	Introduction to Computing *	3(3+0)	None
MGT100	Principles of Management	3(3+0)	None
MGT200	Human Resources Management	3(3+0)	None
ACT230	Principle of Accounting	3(3+0)	None
MGT225	Organizational Theory and Behavior	3(3+0)	None
MGT400	Entrepreneurship (offered in last year – 4 th year)	3(3+0)	None
SWS100	Introduction to Sociology	3(3+0)	None
SWS200	Social Psychology	3(3+0)	None
SWS215	Human Rights	3(3+0)	None
SWS230	Social Work and Human Behavior	3(3+0)	None
PHI101	Introduction to Logic	3(3+0)	None
PHI102	Introduction to Philosophy	3(3+0)	None
MTH100	Fundamental of Mathematics	3(3+0)	None
MTH200	Introduction to Statistics	3(3+0)	None
JMC100	Social Media	3(3+0)	None
SWS230	Social Issues	3(3+0)	None
SWS250	Iqabliyat	3(3+0)	None
XXX***	Any Foreign Language (may be Chinese)	3(3+0)	None
RSM300	Research Methodology	3(3+0)	ENG200

LIST OF DISCIPLINE SPECIFIC FOUNDATION COURSES

Course Code	Subjects Falling in the area	Credit hours	Pre-requisite
ZOOL200	Principles of Animal Life	3 (2+1)	None
ZOOL201	Animal Diversity-I (Invertebrates)	3 (2+1)	None
ZOOL202	Animal Diversity-II (Chordates)	3 (2+1)	None
ZOOL213	Animal Form & Function-I	3 (2+1)	None
ZOOL214	Animal Form & Function-II	3 (2+1)	None
ZOOL421	Economic Zoology	3 (2+1)	None
ZOOL321	Biological Techniques	3 (1+2)	None
ZOOL301	Evolution	3 (3+0)	Animal Diversity-I and II
ZOOL313	Principles of Systematics	3 (2+1)	Animal Diversity-I and II

LIST OF DISCIPLINE SPECIFIC CORE COURSES

ZOOL312	Animal Behavior	3 (3+0)	None
ZOOL322	Environmental Biology	3 (2+1)	None
ZOOL311	Physiology	3 (2+1)	Animal form and function I and II
ZOOL314	Developmental Biology	3 (2+1)	Animal Diversity-I and II
ZOOL302	Wildlife	3 (2+1)	Animal Diversity II
ZOOL331	Genetics	3 (2+1)	Cell biology
ZOOL303	Zoogeography and Paleontology	3 (2+1)	Animal Diversity-I and II
ZOOL432	Immunology	3 (2+1)	Animal form and function I and II
ZOOL441	Mammalogy	3 (3+0)	Animal Diversity II
ZOOL431	Endocrinology	3 (2+1)	Animal form and function I and II
ZOOL439	Bioinformatics	3 (3+0)	None

LIST OF DISCIPLINE SPECIFIC SPECIAL ELECTIVE COURSES

ZOOL443	Ornithology	3 (2+1)	
ZOOL428	Zoological Techniques	3 (2+1)	
ZOOL434	Cancer Biology	3 (3+0)	
ZOOL435	Molecular Genetics	3 (3+0)	
ZOOL424	Conservation Biology	3 (3+0)	

LIST OF DISCIPLINE SPECIFIC ELECTIVE COURSES FOR SPECIALIZATION

Fisheries	1	ZOOL442	Fish and Aquatic Toxicology	3 (3+0)	
	2	ZOOL422	Ichthyology	3 (2+1)	
	3	ZOOL423	Introductory Freshwater Biology	3 (3+0)	
	4	ZOOL437	Aqua Culture	3 (3+0)	
Entomology	1	ZOOL425	Integrated Pest Management	3 (2+1)	
	2	ZOOL426	Epidemiology of Parasitic disease	3 (3+0)	
	3	ZOOL431	Entomology	3 (2+1)	
	4	ZOOL433	Insect Ecology	3 (3+0)	
	5	ZOOL438	Vector Biology	3 (3+0)	
Parasitology	1	ZOOL415	Parasitology	3 (2+1)	
	2	ZOOL429	Advanced Medical Helminthology	3 (3+0)	
	3	ZOOL411	Advanced Medical Protozoology	3 (2+1)	
	4	ZOOL427	Wildlife Parasitology	3 (3+0)	
Wildlife	1	ZOOL445	Conservation Biology of Wildlife	3 (3+0)	
	2	ZOOL446	Principles of Wildlife Management	3 (3+0)	
	3	ZOOL447	Wildlife of Pakistan	3 (3+0)	

LIST OF FACULTY REQUIREMENT/SPECIFIC COURSES

Course Code	Title of Course	Credit hour
BGE203	Molecular Biology	3(3+0)
BOT121	Cell biology	3(2+1)
BCH101	Introductory Biochemistry	3(2+1)
MIC100	Fundamentals of Microbiology	3(2+1)

LIST OF ACADEMIC MERGING COURSES

Course Code	Title of Course	Credit hour
MIC230	General Immunology	3(3+0)
BGE323	Genetic Engineering	3(2+1)
BGE224	Cell and Tissue Culture	3(2+1)
BGE205	Introduction to Biotechnology	3(2+1)
BGE101	Principles of Genetics	3(3+0)
BI141	Introduction to Bioinformatics	3(2+1)
MIC311	Biosafety and Biosecurity	3(2+1)

LIST OF SUPPORTING COURSES/COURSES TO BE TAKEN FROM OTHER DEPARTMENTS

Course Code	Title of Course	Credit hour
BOT101	Fundamentals of Botany	3(2+1)
CHEM151	Inorganic Chemistry	3(2+1)
CHEM161	Organic Chemistry	3(2+1)

Decision: After thorough evaluation and discussion the board unanimously approved above courses for BS (4 year) Zoology.

AGENDA ITEM NO 4: APPROVAL OF INTERNSHIP/RESEARCH PROJECT/REVIEW REPORT/ SPECIAL PAPERS FOR BS 7TH AND 8TH SEMESTER STUDENTS

Department of zoology offers Internship/Research Project/Review Report/special papers for BS 7th semester students. The board was requested to approve Internship/Research Project/Review Report/special papers for the students of BS 7th semester.

Decision: The board approved Internship/Research Project/Review Report/special papers for the students of BS 7th semester. Moreover, it was also decided that the students having CGPA 3.50 or above will be eligible for Internship/Research Project/Review Report.

ENG100 English I - (Functional English)

Course Title	:	English - I (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#	Topic 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	Midterm 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. Devoto, J., *The Essential Elements of Public Speaking*. Boston: Allyn and Bacon, 2003

MTH100 Fundamental of Mathematics

Course Title: : **Fundamental of Mathematics**
Course Code : MT100
Offered to : Undergraduate Students at Hazara University
CrHr : 3 (3+0)
Pre-requisite : None

Course Objective:

The course aims at

- Augmenting students' command and proficiency in mathematics.
- The course will provide students with sufficient knowledge to apply basic mathematics concepts during their bachelor's studies and in the future.

The outcome of the Course:

At the end of the course student will be able:

- To create a good foundation in mathematics which is essential for a graduate.
- To create a good understanding of the importance of mathematics for university graduates and research activities.
- To understand various mathematical tools

General Course Contents:

- Real Numbers,
- Properties,
- Real Line,
- Sets,
- and Radicals, Laws of Exponents, Algebraic Operations, Fractional Expressions, Parallel and Perpendicular lines, Distance Formula, Quadratic Inequalities, Graphs, Circles, Functions, Value of the function, Mathematical Modeling, Trigonometric, Functions, Periodicity, Trigonometric Formulas and Application

General information:

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

Marks Distribution:

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

Week wise distribution:

Week	Topics
Week 1	Real Numbers, Properties, Real Line, Sets, Intervals, Mode/Absolute, Distance between, numbers
Week 2	Exponents and Radicals, Laws of Exponents
Week 4	Algebraic Operations, Factoring Formulas, Fractional Expressions
Week 5	Equations, Quadratic Equations, Linear Inequalities
Week 6	Cartesian Plane, Slopes, Equations of Straight line
Week 7	Parallel and Perpendicular lines, Distance Formula, Circles
Week 8	Quadratic Inequalities
Week 9	Graphing, Parabolas, Functions, Value of the function, Types of Functions, Piece-Wise Defined Functions
Week 10	Sketching
Week 11	Mathematical Modeling
Week 12	Combining Functions
Week 13	Shifting and Scaling
Week 14	Trigonometric Functions, Periodicity
Week 15	Trigonometric Formulas and Application

Text and Reference Books (latest edition):

1. Calculus by Thomas, 11th Edition
2. Calculus and Analytic Geometry 7th edition by Howard Anton
3. Any other book recommended by the instructor with approval.

CS100 Introduction to Computing

Course Title	:	Introduction to Computing
Course Code	:	CS100
Offered to	:	Undergraduate Students at Hazara University
CrHr	:	3 (3+0)
Pre-requisite	:	None

Course Objective:

This course is intended

- to familiarize students with the history and evolution of the computers, hardware and software, basics of computer Networks, HTML, basic skills in word processing, presentation software, basic usage of internet, and social media.
- The course emphasizes on knowledge of application of computers to various areas.
- The course also describes the social impact of computers to facilitate in office, industry and education.
- This course focuses on a breadth-first coverage of computer science discipline, introducing computing environments, general application software, basic computing hardware, operating systems, desktop publishing, Internet, software applications and tools and computer usage concepts;
- Introducing Software engineering and Information technology within the broader domain of computing, social issues of computing.

Course Learning Outcome (CLOs)

At the completion of this course, the student will be able to:

- Identify the basic parts of a computer system.
- Identify the functions of memory and secondary storage and the differences between them.
- Implementing the basic & advanced Microsoft Office Tools: Word, Excel, Access files, Power point presentations, NIC and Networking and HTML basics.
- To handle basic scale software & hardware issues to understand the functions & architecture of the different types of hardware and software, operating systems, some simple code executing examples, and finally the implementation of simple functions.
- To make effective presentation.
- To make website and social media sites
- To know the impact of computer technology from social point of view.

Course Contents:

- History,
- classification,
- basic components,
- CPU, memory, peripheral devices,

- storage media and devices, physical and logical storage,
- data organization, file storage, programs, and software,
- system software, application software,
- operating systems, programming languages,
- compilation and interpretation, problem specification,
- algorithms, flow chart, pseudo code, basic programming techniques,
- data types and declaration, header file and linkage,
- variables and constants, input/output,
- termination, remark, control structures,
- branching, conditional structures,
- repetition and loops, basic library functions.
- Programming concept, XML coding, social media, and creating of webs pages.

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

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

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

General information:

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

Week-Wise Distribution:

Week#	Topic to be covered
Week 1	Course Orientation/Introduction Session
Week 2	Identify the basic parts of a computer system.
Week 3	History, classification, basic components, CPU, memory, peripheral devices, storage media and devices, physical and logical storage

Week 4	Data organization, file storage, programs and software, system software, application software
Week 5	Operating systems
Week 6	Programming languages
Week 7	Compilation and interpretation problem specification
Week 8	Algorithms,
Week 9	Midterm Examination
Week 10	Flow chart, pseudo code
Week 11	Basic programming techniques
Week 12	Data types and declaration
Week 13	Header file and linkage, variables and constants, input/output, termination, remark, control structures, branching,
Week 14	Conditional structures, repetition and loops, basic library functions.
Week 15	Programming concept, XML coding, social media, and creating of webs pages.
Week 16	Final Examination

Recommended Text/Reference books ((Latest edition)

1. “Computers” by Larry Long & Nancy Long, latest edition or 12th edition (check the web monthly for the updates: www.prenhall.com/long).
2. Brian Williams and Stacey Sawyer, “Using Information Technology,” Seventh Edition, 2007, McGraw-Hill, ISBN: 0072260718.
3. William Stallings, “Computer Organization and Architecture: Designing for Performance,” Seventh Edition, 2006, Prentice Hall, ISBN: 0131856448.

SWS200 Social Psychology

Course Title	:	Social Psychology
Course Code	:	SWS200
Offered to	:	BS Students at Hazara University
CrHr	:	3 (3+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#	Topic 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	Midterm 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):

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

ENG300 English III – Academics reading and writing Technical Writing

Course Title	:	English - III Academics reading and writing
Course Code	:	ENG300
Offered to	:	Undergraduate Students at Hazara University
CrHr	:	3 (3+0)
Pre-requisite	:	ENG200 English -II

Course Objective:

- The course aims at augmenting students' proficiency in technical writing in order to sensitize them to the dynamics, challenges, and needs of the modern world characterized by technologically advanced social, cultural, and corporate settings.
- It will focus on students' ability to effectively convey and exchange information in cross-cultural, international, and multinational milieu necessitated by the emergence of global society.

Course Contents:

- Technical Writing Overview/Strategies/Do's and Don'ts
- Technical Vocabulary
- Language Technicalities
- Steps to Effective Writing
- Common Writing Errors
- Proofreading and Editing
- Memo Writing
- Letter Writing
- Email Writing
- Report Writing
- Minute Taking
- User Manuals
- References
- Presentation Skills
- CV and Cover Letter
- Interview Skills

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:

- Quizzes - 10%
- Assignments/Presentation/Case Studies - 10 %
- Midterm Examination - 30%
- Final Examination - 40%

Week-Wise Distribution:

Week#	Topic to be covered
1	Difference between GW and TW Types/Source/Specifications Classification, Description, Definition, Cause and Effect, Problem and Solution , Instructions, Comparison, Contrast, Narration Do's and Don'ts
2	Understanding Sentence Structure Subject and predicate Subject-verb agreement Clauses & Sentences
3	Effective Sentences and Paragraphs Run-ons Fragments Comma Splice Pronoun Reference Parallel Structure Topic Sentence Controlling Idea Supporting Sentence Concluding Sentence Paragraph Writing
4	Summarizing/Reporting Information The gist/key ideas Appropriate linking devices Brevity Difference between paraphrasing and summarizing
5	Seven C's of Communication Application of seven C's of communication in interpersonal and professional correspondence

6	Email Writing Tone and style Context Formatting Etiquette
7	Memo-Writing Types/Format/Documentation
8	Midterm Examination
9	Letter-Writing Applying YOU attitude Using positive tone and style Avoiding “you” if it suggests blame Focusing on the reader “you” and not “I” Focusing on the benefits for the reader Understanding human nature Avoiding objectionable expressions Employing ethical principles Avoiding redundancy Organizing your writing Appropriate punctuation Types /Format
10	Minute Taking/Proofreading and Editing Minutes Agenda
11	Report Writing Purpose /Types/Format/Segments/Referencing
12	Presentation Skills Types of presentation Types of Delivery Delivery Techniques Preparation
13	CV and Covering Letter General Personal Statement/Career Objective Specific Personal Statement/Career Objective Matching Skills with Job Requirement Formatting
14	Interview Skills Interview Do’s and Don’ts Questions to Ask/Avoid
15	Technical Vocabulary Building
16	Final Examination

PKS100 Introduction to Pakistan Studies

Course Title : Introduction to Pakistan Studies
Course Code : PKS100
Offered to : Undergraduate Students at Hazara University
CrHr : 3 (3+0)
Pre-requisite : None

Course Objective:

Pakistan studies is an important course at this university in which students study about their motherland. The following are the specific objective of the course

- to develop vision of Historical Perspective, Government, Politics, Contemporary Pakistan, ideological background of Pakistan.
- To study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

Learning Outcome:

- To educate students about the history of Pakistan
- To educate student about the various pillar of the state
- To educate student Government and politics

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
1 &2	Historical Perspective 1. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah. 2. Factors leading to Muslim separatism

	3. People and Land i. Indus Civilization ii. Muslim advent iii. Location and Geo-Physical features. iv. Historical Locations and its international standing
3, 4 &5	Government and Politics in Pakistan Political and constitutional phases: 1. 1947-58 2. 1958-71 3. 1971-77 4. 1977-88 5. 1988-99 6. 1999 onward 7. Political system of Pakistan 8. Reasons for the Intervention of Army
6 & 7	Contemporary Pakistan 1. Economic institutions and issues 2. Society and social structure 3. Ethnicity 4. Foreign policy of Pakistan and challenges 5. Futuristic outlook of Pakistan
8&9	Geographical and natural resources 1. Neighboring countries 2. Water Resources 3. Natural Resources 4. Climates 5. Famous corps
10&11	Challenges faced by Pakistan in the 21th century 1. Global Challenges 2. Foreign policy of Pakistan and challenges 3. Economic Challenges 4. Political Challenges 5. Religion Challenges
12&13	Achievements made by Pakistan 1. Education and Research 2. Industrial 3. Sports

14&15	Case Study to Model Pakistan. Student will be divided into group and assign a task to create an ideal model for Pakistan. The model should highlight that what should be political, administrative, and educational system & setup of the Pakistan. Note: In case, case study cannot be arranged then the Instructor should invite guest speakers to talk about an ideal Pakistan.
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Reference Books:

1. Burki, Shahid Javed. *State & Society in Pakistan*, The Macmillan Press Ltd 1980.
2. Akbar, S. Zaidi. *Issue in Pakistan's Economy*. Karachi: Oxford University Press, 2000.
3. Wilcox, Wayne. *The Emergence of Banglades.*, Washington: American Enterprise, Institute of Public Policy Research, 1972.
4. Afzal, M. Rafique. *Political Parties in Pakistan*, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.

BOT121 Cell Biology

Course Title : Cell Biology
Course Code : BOT121
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:

1. INTRODUCTION TO CELL STRUCTURE AND FUNCTION

- a. Introduction and brief history of cell biology
- b. Cell theory
- c. Comparison of plant and animal cells
- d. Comparison of prokaryotic and eukaryotic cells
- e. Cell wall structure and composition in prokaryotic and eukaryotic cells

2. CELL MEMBRANE

- a. Structural model
- b. Chemical composition and function

3. CELL ORGANELLES (structure and function)

- a. Endoplasmic reticulum
- b. Golgi Bodies
- c. Mitochondria
- d. Lysosome
- e. Microbodies (Peroxisomes and Glyoxisomes)
- f. Ribosome

- g. Plastids
- h. Dictyosomes

4 . NUCLEUS

- a. Structure and function
- b. Nuclear membrane
- c. Ultrastructure and morphology of chromosomes.

5. CYTOSKELETON

- a. Structure and types
- b. Function of cytoskeleton

6. CELLULAR REPRODUCTION

- a. Cell Cycle and apoptosis
- b. Mitosis
- c. Meiosis

Practicals

1. Study of prokaryotic and eukaryotic cell.
2. Study of different cell organelles by staining.
3. Study of Mitosis in onion roots
4. 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%

Week-Wise Distribution:

Week#	Topic 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	Midterm 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.

- De. Robertis, E.D.P and De. Robertis jr, E.M.F. Cell and Molecular Biology, CCH, a Wolters Kluwer Business, New York.
- Alberts. B. Molecular Biology of the Cell Taylor and Francis, Inc.
- Karp, G. Cell and Molecular Biology, Study Guide: Concepts and Experiments. Wiley, John and Sons Inc.
- 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.

James, D. W. Molecular Biology of Gene Benjamin Cumming

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 molecular nature of genes.
 - Chemical and physical properties of nucleic acids.
 - Genic and Extragenic DNA
 - Basic molecular genetic mechanisms
 - Transcription of Protein-Coding Genes and Formation of Functional mRNA
 - Post-transcriptional processing
 - Translation in Prokaryotes and Eukaryotes
 - Post translational processing

- Control of Gene expression
- DNA replication
- DNA recombination
- Types of DNA damage and DNA Repair
- Genome organization in prokaryotes and Eukaryotes
- Concept of operon and split genes
- Gene Families
- Transposable DNA Elements
- Methods in molecular biology
- DNA extraction
- Gel electrophoresis
- PCR
- RFLP
- Sequencing

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#	Topic to be covered
Week 1	Introduction to molecular biology
Week 2	The molecular nature of genes. Chemical and physical properties of nucleic acids.
Week 3	Genome organization: Genic and Extragenic DNA

	Introduction to gene expression
Week 4	Transcription in Eukaryotes and Prokaryotes
Week 5	Transcription in Eukaryotes and Prokaryotes
Week 6	Post transcriptional modifications
Week 7	Translation and Genetic Code
Week 8	Post translational modifications
Week 9	Midterm Examination
Week 10	Control of Gene expression
Week 11	DNA Replication
Week 12	DNA Replication
Week 13	Types of DNA damage and DNA Repair
Week 14	Transposable DNA Elements
Week 15	Chromatin organization
Week 16	DNA Recombination
Week 17	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.

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

MIC 100 Fundamentals of Microbiology

Course Code	MIC 100
Course Title	Fundamentals of Microbiology
Credit Hours	3 (2+1)
Prerequisites	by Students should have a basic knowledge of microorganisms and their
Course(s)	and types.
Topics	
Course Description	The purpose of this course is • to demonstrate an understanding of the structural similarities and differences among microbes and the unique structure/function relationships of prokaryotic cells. • This is an introductory microbiology course that covers morphology, Structure, nutrition growth and control of microorganisms, with emphasis on bacteria. Laboratory techniques on culture and identification of bacteria are used to augment lecture content.
Objectives	• To become familiar with the foundation concepts of history of Microbiology • To understand the structure and functions of a typical prokaryotic cell. • To gain the knowledge of microscopy and staining concepts. • To understand the concept of microbial control.
Learning Outcomes	At the end of the course, students will • Have a basic knowledge of the main microbiological techniques to be applied in the laboratory. • Be able to work with microorganisms. • Understand the basic techniques of sterilization, culturing and isolation. • Be able to follow the safety measures while handling microbes.
Textbook	1. Tortora, G. J., Funke, B. R. and Case, C. L. 2018. Microbiology: An Introduction, Benjamin-Cummings Publishing Company, U.S.A. 13 th Edition
Reference Material	2. Talaro, K. P. 2021. Foundations in Microbiology: Basic Principles, McGraw-Hill Companies, N.Y. 11 th Edition 2. Black, J. G. 2017. Microbiology: Principles & Explorations, 10 th edition, John Wiley and Sons, N.Y. 3. Parker, N., Scheegurt, M., Tu, A. T., Forster. B. M. and Lister, P. 2016. Microbiology. Openstax. 1 st Edition

Major topics to be covered:

- Fundamentals of Microbiology

- Microorganisms & Their Respective place in the World
- Differentiate between Prokaryotes & Eukaryotes
- Historical Development of Microbiology & its Scope.
- Differentiation Between Pro and Eukaryotic Cells.
- Microscopy & Staining Techniques
- Bacterial Morphology & Arrangement
- Detailed Anatomy of Bacterial Cell
- Growth, Nutrition (Physical and Nutritional Requirement) and Reproduction.
- General Methods of Studying Microorganisms: Culture Media & its Types.
- Control of Microorganisms by Physical and Chemical Methods.
- Basic Properties of Fungi and Protozoa.
- A Brief Introduction to Structure and Propagation of Viruses.

WEEK WISE BREAK DOWN OF CURRICULUM

Week No	Activity	Course Topic	Details of Topics
1	Class Work	Introduction to Microbiology, its Scope & History	• Introduction to Microbiology & Scope • Microorganisms & Their Respective place in the World • Historical development of Microbiology • Definition between Prokaryotes and Eukaryotes.
	Class Work	Bacterial Morphology & Bacterial Structure	• Bacterial Morphology: Size, Shape & Arrangement of Bacteria. • Overview of Structure External to Bacterial Cell Wall. • Structure & Function of Glycocalyx: Capsule & Slime Layer. • Structure & Function of Flagella & Axial Filaments.
3	Class Work	Structure of Bacterial Cell	• Structure & Function of Fimbriae & Pili • Overview of Bacterial Cell Wall • Structure & Function of Peptidoglycan • Structure & Function of Teichoic Acid
4	Class Work	Structure of Bacterial Cell	• Structure & Function of Outer Membrane. • Characteristics & Examples of Atypical Cell Wall. • Overview of Structures Internal to the Cell Wall.
5	Class Work	Structure of Bacterial Cell	• Structure & Function of Plasma Membrane • Fluid Mosaic Model. • Mechanism of Movement of Materials across Plasma Membrane. • Passive Transport: (Simple Diffusion, Facilitated Diffusion, Osmosis).

			• Active Transport
6	Class Work	Structure of Bacterial Cell	• Functions of Cytoplasm, Nucleoid, Plasmid & Ribosomes. • Functions of Inclusion Bodies (Metachromatic Granules, Polysacchride Granules, Lipid Inclusions).
7	Class Work	Structure of Bacterial Cell	• Functions of Inclusion Bodies (Sulfur Granules, Gas Vacuoles, Magnetosomes) • Structure & Function of Endospore.
8	Class Work	Physical Requirements for Growth of Bacteria.	• Temperature (Psychrophiles, Psychrotrophs, Mesophiles, Thermophiles) • pH (Acidophiles, Neutrophiles, Alkaliphiles) • Osmotic Pressure (Hypertonic, Hypotonic, Isotonic)
9	Class Work	Chemical Requirements for Growth of Bacteria.	• Carbon • Nitrogen, Sulfur & Phosphorus • Trace Elements • Oxygen (Aerobes, Anaerobes, Facultative Anaerobes, Microaerophiles, Aerotolerant Anaerobes) • Detoxification of Reactive Oxygen Species.
10	Class Work	Culture Media & its Types	• Define Culture & Inoculum • Properties of Agar • Chemically Defined & Complex Media • Anaerobic Growth Media • Special Culture Techniques • Selective & Differential Media • Enrichment Culture.
11	Class Work	Bacterial Growth	• Bacterial Division (Binary Fission, Budding, Conidiation) • Generation Time • Logarithmic Representation of Bacteria (Lag Phase, Log Phase, Stationary Phase, Death Phase).
12	Class Work	Bacterial Control by Physical Methods	• Terminologies of Microbial Control • Action of Microbial Control Agents • Effect of High Temperature • Moist Heat Sterilization (boiling, Steam Under Pressure)
13	Class Work	Bacterial Control by Physical Methods	• Effect of Pasteurization • High Temperature Short Time Pasteurization Treatment • Ultra-High Temperature Treatment • Dry Heat Sterilization (Flaming, Incineration, Hot Air Sterilization)

14	Class Work	Bacterial Control by Physical & Chemical Methods	• Effect of Filtration (HEPA Filters, Membrane Filters) • Effect of Low Temperature • Dessication: Lyophilization • Effect of Pressure • Effect of Radiation (Ionizing & Non-Ionizing) • Types of Disinfectants and their Functions
15	Class Work	Basic Properties of: Fungi, Protozoa & Viruses	• Characters of Fungi • Growth & Nutrition of Fungi • Characters of Protozoa • Medically Important Phyla of Protozoa • General Characteristics of Viruses • Viral Structure • Viral Multiplication

MGT100 Principles of Management

Subject Name : Principles of Management

Semester : 1st semester

Course Code : MGT-100

Credit Hours : 03

Course Objectives

- The focus of attention will be given to learning fundamental principles of management and of managing people and organization in a historical as well as contemporary world.
- To provide an essential understanding of the basic theories relevant to management organizations.
- guidelines on principles of management that are applicable to all types of enterprises; basic management philosophy and decision making; principles involved in planning, organizing, leading, and controlling; and recent concepts in management.

Learning Outcomes

- After studying this course, students will be able to specify how the managerial tasks of planning, organizing, and controlling can be executed in a variety of circumstances.
- They will be able assess global situation, including opportunities and threats that will impact management of an organization.
- The course will help them to integrate management principles into management practices.
- They will be able to determine the most effective action to take in specific situations.
- The students will be able to evaluate approaches to addressing issues of diversity.

A. Course Contents

- **Introduction**
- Basic concept
- Organization, department, vision, mission, goals and objectives.
- Organizational type
- Component of organization.
- Definition and process of Mgt.
- Other concept of management.
- Define manager different level of management hierarchy.
- Managerial role and skills.
- Organization performance.
- Achieving organizational goal managerial role in achieving goals.

- Concept/ nature of management.

Need of management.

- **The history and evaluation of management**

- Management thoughts
- Classical, new classical and modern.

- **Organizational environment**

- Organizational culture and the manager.
- External environment and manager.
- Internal environment and manager.

- **SWOT analysis of organization**

- **Foundation of basic element in planning.**

MBO, the process of MBO, assumption of MBO, merits and demerits of MBO.

Planning

- Definition of planning
- Nature of planning.
- Importance of planning.
- Merit and demerit of planning.
- Planning process.
- Type of planning
- Level of planning

B (1) Type of plan

- Strategic planning
- Definition of strategic planning,
- Forces of strategic planning.
- Planning type
- Strategic, operational, business planning.

- **Decision making**

Definition decision / nature of decision.

- Decision making process.
- Decision making condition.
- Type of decision
- Problem
- Definition of problem
- Type of problem
- **Strategic management**
- Definition
- Strategic management process.

- **Organizational structure**
 - Definition
 - Different form of organization structure
 - Merits and demerits of different form of organization.
- **Human resources management**
 - Definition of HRM
 - Nature of HRM
 - Objectives of HRM
 - HRM functions
- **Motivation**
 - Basic concept
 - Definition of Motivation
 - Feature of motivation
 - Type of motivation
 - Factor affecting motivation
 - Monetary and non-monetary
 - Motivation theory
- **Leadership**
 - Definition
 - Leader power
 - Definition power
 - Different leader and their powers
 - Leadership qualities
 - Style of leadership
- **Team work and group behavior**
 - Case of team and team work
- **Staffing**
 - Definition
 - Importance and need of staffing
 - Staffing process.
- **Controlling**
 - Definition of controlling
 - Nature of controlling
 - Importance of controlling
 - Controlling process.

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.

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

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

General information:

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

Week-Wise Distribution:

Week#	Topic to be covered
Week 1	Introduction Basic concept
Week 2	Organization, department, vision, mission, goals and objectives. Organizational type
Week 3	Component of organization. Definition and process of Mgt. Other concept of management.
Week 4	Define manager different level of management hierarchy. Managerial role and skills
Week 5	Organization performance. Achieving organizational goal managerial role in achieving goals.
Week 6	Strategic management Definition Strategic management process.
Week 7	Organizational structure Definition Different form of organization structure
Week 8	Merits and demerits of different form of organization
Week 9	Midterm Examination

Week 10	Human resources management Definition of HRM Nature of HRM Objectives of HRM HRM functions
Week 11	• Motivation Basic concept Definition of Motivation Feature of motivation Type of motivation
Week 12	Factor affecting motivation Monetary and non-monetary Motivation theory
Week 13	• Leadership Definition Leader power Definition power Different leader and their powers Leadership qualities Style of leadership
Week 14	• Team work and group behavior Case of team and team work • Staffing Definition Importance and need of staffing Staffing process
Week 15	• Controlling Definition of controlling Nature of controlling Importance of controlling Controlling process.
Week 16	Final Examination

Books Recommended (Latest Editions)/ References

- Harold Knootz& Heins Weihrich: Management
- Robbins, S., & Coulter, Mary (2012) Management, 11th Edition. Upper Saddle River, NJ: Pearson Press.
- Drucker, P.F, The Practice of Management.
- Mc Farland: Management: Foundation and Practice
- Robert M. Fulmer: The New Management

ENG200 English II - Communications Skills

Course Title	:	English - II Communication Skills
Course Code	:	ENG200
Offered to	:	Undergraduate Students at Hazara University
CrHr	:	3 (3+0)
Pre-requisite	:	ENG100 English -I

Course Objective:

- To enhance students' linguistic command, so they could communicate effectively in diversified socio-cultural situations;
- To create larger stretches of interactive text in speech and writing; and
- To identify and repair any instances of potential communication break-up.

Course Contents:

- Communication Overview
- Nonverbal Communication
- Paralanguage
- Listening
- Seven C's of Communication
- Comma Splice/Run-ons/Fragments/ Parallelism
- Telephone Skills
- Business Meetings
- Note-taking
- Proofreading and Editing
- Presentation Skills
- Email/ Letter Writing

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):

- Quizzes - 10%
- Assignments/ Presentation - 10 %
- Midterm Examination - 30%
- Final Examination - 40%

Week-Wise Distribution:

Week#	Topic to be covered
Week 1	Course Orientation/Introduction Session
Week 2	Communication Overview Process/Modes/Models/Types/Purpose/Needs/ Competence
Week 3	Communication Barriers/Behaviours
Week 4	Verbal/Nonverbal Communication/ Paralanguage
Week 5	Listening - Strategies/Barriers
Week 6	Seven C's of Communication
Week 7	Comma Splice/Run-ons/Fragments/Parallelism/Pronoun Reference
Week 8	Midterm Examination
Week 9	Telephone Skills/Business Meetings
Week 10	Note-Taking/Minute-Taking/Proofreading and Editing
Week 11	Email Writing
Week 12	Letter Writing
Week 13	Presentation Skills

Week 14	Individual/Group Presentations
Week 15	Reinforcement/Meeting Individual Needs Session
Week 16	Final Examination

Reference Books (latest editions):

1. Mary Ellen Guffey, *Business Communication Process and Product*, Third Edition
2. Bovee, Courtland *Business Communication Today*, Seventh Edition
3. Lahiff, James M. and Penrose, John M. *Business Communication : Strategies and Skills*, Fifth Edition
4. Murphy, Herta A. *Effective Business Communications*, International Edition

Konar, Nira *Communication Skills for Professionals*

SWS100 Introduction to Sociology

Course Title	:	Introduction to Sociology
Course Code	:	SWS100
Offered to	:	Undergraduate Students at Hazara University
CrHr	:	3 (3+0)
Pre-requisite	:	None

Course Objective:

The course is designed

- to introduce the students with sociological concepts and the discipline.
- The focus of the course shall be on significant concepts like social systems and structures, socio-economic changes and social processes.
- The course will provide due foundation for further studies in the field of sociology.

Course Learning Outcome (CLOs)

The students will be able to:

- Understand the social process and networking in community.
- Understand human behavior in different environments.
- Concept of social grouping and cultural norms.

Course Contents:

- Introduction
- Definition, Scope, and Subject Matter
- Sociology as a Science
- Historical background of Sociology
- Basic Concepts
- Group, Community, Society
- Associations
- Non-Voluntary
- Voluntary
- Organization
- Informal
- Formal
- Social Interaction
- Levels of Social Interaction
- Process of Social Interaction
- Cooperation
- Competition
- Conflict
- Accommodation
- Acculturation and diffusion

- Assimilation
- Amalgamation
 - Social Groups
 - Definition & Functions
 - Types of social groups
 - In and out groups
 - Primary and Secondary group
 - Reference groups
 - Informal and Formal groups
 - Pressure groups
 - Culture
 - Definition, aspects and characteristics of Culture
 - Material and non-material culture
 - Ideal and real culture
 - Elements of culture
 - Beliefs
 - Values
 - Norms and social sanctions
 - Organizations of culture
 - Traits
 - Complexes
 - Patterns
 - Ethos
 - Theme
 - Other related concepts
 - Cultural Relativism
 - Subcultures
 - Ethnocentrism and Xenocentrism
 - Cultural lag
- Socialization & Personality
- Personality, Factors in Personality Formation
- Socialization, Agencies of Socialization
- Role & Status
- Deviance and Social Control
- Deviance and its types
- Social control and its need
- Forms of Social control
- Methods & Agencies of Social control
- Collective Behavior
- Collective behavior, its types
- Crowd behavior
- Public opinion

- Propaganda
- Social movements
- Leadership

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#	Topic to be covered
Week 1	Introduction • Definition, Scope, and Subject Matter • Sociology as a Science • Historical back ground of Sociology
Week 2	Basic Concepts • Group, Community, Society • Associations - Non-Voluntary - Voluntary • Organization - Informal - Formal
Week 3	Social Interaction • Levels of Social Interaction
Week 4	Process of Social Interaction • Cooperation • Competition • Conflict • Accommodation

	• Acculturation and diffusion • Assimilation ▪ Amalgamation
Week 5	Social Groups • Definition & Functions • Types of social groups ▪ In and out groups ▪ Primary and Secondary group ▪ Reference groups ▪ Informal and Formal groups ▪ Pressure groups
Week 6	Culture • Definition, aspects and characteristics of Culture • Material and non-material culture • Ideal and real culture
Week 7	Elements of culture • Beliefs • Values • Norms and social sanctions
Week 8	Organizations of culture • Traits • Complexes • Patterns • Ethos • Theme
Week 9	Midterm Examination
Week 10	Other related concepts • Cultural Relativism • Sub Cultures
Week 11	• Ethnocentrism and Xenocentrism • Cultural lag
Week 12	Socialization & Personality • Personality, Factors in Personality Formation
Week 13	Socialization, Agencies of Socialization • Role & Status
Week 14	Deviance and Social Control • Deviance and its types • Social control and its need • Forms of Social control • Methods & Agencies of Social control

Week 15	Collective Behavior • Collective behavior, its types • Crowd behavior • Public opinion • Propaganda • Social movements • Leadership
Week 16	Final Examination

Recommended Books:

1. Anderson, Margaret and Howard F. Taylor. 2001. *Sociology the Essentials*. Australia: Wadsworth.
2. Brown, Ken 2004. *Sociology*. UK: Polity Press
3. Gidden, Anthony 2002. *Introduction to Sociology*. UK: Polity Press.
4. Macionis, John J. 2006. 10th Edition *Sociology* New Jersey: Prentice-Hall
5. Tischler, Henry L. 2002. *Introduction to Sociology* 7th ed. New York: The Harcourt Press.
6. Frank N Magill. 2003. *International Encyclopedia of Sociology*. U.S.A: Fitzroy Dearborn Publishers
7. Macionis, John J. 2005. *Sociology* 10th ed. South Asia: Pearson Education
8. Kerbo, Harold R. 1989. *Sociology: Social Structure and Social Conflict*. New York: Macmillan Publishing Company.
9. Koenig Samuel. 1957. *Sociology: An Introduction to the Science of Society*. New York: Barnes and Nobel..
10. Lee, Alfred Mclung and Lee, Elizabeth Briant 1961. *Marriage and The family*. New York: Barnes and Noble, Inc.
11. Leslie, Gerald et al. 1973. *Order and Change: Introductory Sociology* Toronto: Oxford University Press.
12. Lenski, Gevbard and Lenski, Jeam. 1982. *Human Societies*. 4th edition New York: McGraw-Hill Book Company.
13. James M. Henslin. 2004. *Sociology: A Down to Earth Approach*. Toronto: Allen and Bacon.

ISL100 Islamic Studies

Course Code : ISL 100
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#	Topic 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	Midterm 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" Allama Iqbal Open University, Islamabad (2001).

BCH101 Introductory Biochemistry

Course title: Introductory Biochemistry

Course code: BCH101

Level: BS students of Hazara University

Credit hours: 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.

Learning Outcomes

- 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.

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

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

General information:

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

Week wise Distribution

Week#	Topic to be covered
Week 01	Introduction to biochemistry
Week 02	Carbohydrates - structure and classification
Week 03	Proteins- overview with emphasis on their composition and structure classification and function
Week 04	Lipids- structure, classification and biological significance
Week 05	Enzymes - properties, nomenclature, classification, and factors affecting enzyme activity; coenzymes
Week 06	Vitamins
Week 08	Nucleic acids- structure and function
Week 09	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. [SEP]
4. Murray et al., 2012. Harper's Illustrated Biochemistry. 29th Edition; McGraw-Hill Medical Publishing.
5. FerrierDR, 2013. Lippincott's Biochemistry. 6th Edition; Lippincott Williams & Wilkin Publishing Company.
6. Schantz JT, 2007. A Manual for Biochemistry Protocols. World Scientific Publishing. (available online)

ZOOL201 Animal Diversity-I (Invertebrates)

Course Title	:	Animal Diversity-I (Invertebrates)
Course Code	:	ZOOL201
Offered to	:	Undergraduate Students at Hazara University
CrHr	:	3 (2+1)
Pre-requisite	:	Students should have a basic knowledge of life forms

Course Objective:

- To provide the knowledge of evolutionary/phylogenetic relationship (from simple to the complex organisms).
- To impart the basic taxonomic characteristics and classification of all the invertebrate phyla.
- To provide understanding of body organization, Feeding and Digestive system; Other Organ System.
- To provide the description of mode of Reproduction and Development.
- To provide the information of their economic and ecological importance.

Course Learning Outcome (CLOs)

Upon successful completion, students will have the knowledge and skills to:

- Describe the variety of invertebrate organisms and explain their evolutionary origin and diversification.
- Investigate invertebrates in laboratory and field conditions, and identify major taxonomic groups.
- Understand the requirements for collection and short-term maintenance of invertebrate species for photographic and scientific observation.
- Understand and communicate the major evolutionary innovations in invertebrate groups, and describe the functional significance of associated morphologies and behaviours.

Course Contents:

1. Introduction: Architectural pattern of an animal, taxonomy and phylogeny, major subdivisions of animal kingdom with evolutionary perspective.

2. Animal-Like Protists: The Protozoa; life within a single plasma membrane; symbiotic life-styles. Protozoan taxonomy: (up to phyla, subphyla and super classes, wherever applicable). Pseudopodia and amoeboid locomotion; cilia and other pellicular structures; nutrition; genetic control and reproduction; symbiotic ciliates; further phylogenetic considerations.

3. Multicellular and Tissue Levels of Organization: origins of multicellularity; animal origins. Phylum porifera: cell types, body wall, and skeletons; water currents and body forms; maintenance functions; reproduction. Phylum Cnidaria (coelenterata) the body wall and nematocysts; alternation of generations; maintenance functions; reproduction and classification up to class.

4. Triploblastics and Acoelomate Body Plan: Phylum Platyhelminthes: classification up to class; the free-living flatworms and the tapeworms; Phylum Nemertea; Phylum Gastrotricha; further phylogenetic considerations.

5. Pseudocoelomate Body Plan: Aschelminths: general characteristics; classification up to phyla with external features; feeding and the digestive system; other organ systems; reproduction and development of Phylum.

6. Rotifera and Phylum Nematoda; Phylum Kinorhyncha. Some important nematode parasites of humans; further phylogenetic considerations.

7. Molluscan Success: relationships to other animals; origin of the coelom; molluscan characteristics; classification up to class. The characteristics of shell and associated structures, feeding, digestion, gas exchange, locomotion, reproduction and development, other maintenance functions and diversity in gastropods, bivalves and cephalopods; further phylogenetic considerations.

8. Annelida: The Metameric Body Form: relationship to other animals, metamerism and tagmatization; External structure and locomotion, feeding and the digestive system, gas exchange and circulation, nervous and sensory functions, excretion, regeneration, reproduction and development in different classes; further phylogenetic considerations.

Blueprint for Success: classification and relationships to other animals; metamerism and tagmatization; the exoskeleton; metamorphosis; classification up to class; further phylogenetic considerations; phylogeny and adaptive diversification.

9. Echinoderms: relationships to other animals; echinoderm characteristics; classification up to class. Maintenance functions, regeneration, reproduction, and development; further phylogenetic considerations.

Teaching Methodology:

- Student-centered teaching through communicative approach
- 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	1.Introduction: Architectural pattern of an animal, taxonomy and phylogeny,major subdivisions of animal kingdom with evolutionary perspective.
Week 2	Animal-Like Protists: The Protozoa; life within a single plasma membrane;symbiotic life-styles. Protozoan taxonomy: (up to phyla, subphyla and super classes, wherever applicable.
Week 3	Pseudopodia and amoeboid locomotion; cilia and other pellicular structures; nutrition; genetic control and reproduction; symbiotic ciliates; further phylogenetic considerations
Week 4	Multicellular and Tissue Levels of Organization: origins of multicellularity; animal origins. Phylum porifera: cell types, body wall, and skeletons; water currents and body forms; maintenance functions; reproduction.
Week 5	Phylum Cnidaria (coelenterata) the body wall and nematocysts; alternation of generations; maintenance functions; reproduction and classification up to class.
Week 6	.Triploblastics and Acoelomate Body Plan: Phylum Platyhelminthes: classification up to class;
Week 7	The free-living flatworms and the tapeworms; Phylum Nemertea; Phylum Gastrotricha; further phylogenetic considerations.
Week 8	Pseudocoelomate Body Plan: Aschelminths: general characteristics; classification up to phyla with external features; Feeding and the digestive system
Week 9	MID TERM EXAM
Week 10	6.Rotifera and Phylum Nematoda; Phylum Kinorhyncha. Some important nematode parasites of humans; further phylogenetic considerations
Week 11	Molluscan Success: relationships to other animals; origin of the coelom; molluscan characteristics; classification up to class.
Week 12	The characteristics of shell and associated structures, feeding, digestion, gas exchange, locomotion, reproduction and development, other maintenance functions and diversity in gastropods, bivalves and cephalopods;.
Week 13	Annelida: The Metameric Body Form: relationship to other animals, metamerism and tagmatization;
Week 14	Echinoderms: relationships to other animals; echinoderm characteristics; classification up to class.

Week 15	Maintenance functions, regeneration, reproduction, and development; further phylogenetic considerations.
Week 16	FINAL TERM EXAM
	Practical (Lab)
Week #	Museum study of representative Phyla, Permanent slide preparation
Week 1	Study of Euglena, Amoeba, Entamoeba, Plasmodium, Trypanosoma,
Week 2	Paramecium as representative of animal like protists. (Prepared slides).
Week 3	Study of sponges and their various body forms.
Week 4	Study of principal representative classes of Phylum Cnidaria.
Week 5	Study of principal representative classes of Phylum Platyhelminthes.
Week 6	Study of representative of Phylum Rotifera, Phylum Nematoda.
Week 7	Study of principal representative classes of Phylum Mollusca.
Week 8	Study of principal representative classes of Phylum Annelida.
Week 9	MID TERM EXAM
Week 10	Brief notes on medical/economic importance of the following:
Week 11	Plasmodium, Entamoeba histolitica, Leishmania,
Week 12	Liverfluke, Tapeworm.
Week 13	Earthworm, Silkworm, Citrus butterfly.
Week 14	Study of principal representative classes of Phylum Arthropoda
Week 15	Study of principal representative classes of Phylum Arthropoda
Week 16	FINAL TERM EXAM

Books Recommended:

1. Miller, A.S and Harley, J.B 1999 & 2002 Zoology 4th and 5th Edition (international) Singapore. McGraw Hill.
2. Pechinik J.A 2000 "Biology of Vertebrates" 4th Edition (international) McGraw Hill.
3. Hickman, C.P, Roberts, L.S and Larson A, 2001 "Integrated Principles of Zoology". 11th Edition (International) Singapore. McGraw Hill.
4. Miller, S.A 2002 General Zoology Laboratory Manual 5th Edition (International) Singapore McGraw Hill.

5. Hickman, C.P and Kats .H.L 2000 Laboratory Studies in integrated Principles of Zoology. Singapore McGraw Hill.

ZOOL202 Animal Diversity-II (Chordates)

Course Title: Animal Diversity-II (Chordates)

Course Code: ZOOL202

Offered to: Undergraduate Students at Hazara University

Cr Hr: 3 (2+1)

Pre-requisite: None

Course Objectives:

- To provide the knowledge of evolutionary/phylogenetic relationship (from simple to the complex organisms).
- To impart the basic taxonomic characteristics and classification of all the invertebrate phyla.
- To provide understanding of body organization, Feeding and Digestive system; Other Organ System.
- To provide the description of mode of Reproduction and Development.
- To provide the information of their economic and ecological importance.

Learning Outcomes

Upon successful completion, students will have the knowledge and skills to:

- 1. Describe the variety of vertebrates organisms and explain their evolutionary origin and diversification.
- 2. Investigate vertebrates in laboratory and field conditions, and identify major taxonomic groups.
- 3. Understand the requirements for collection and short-term maintenance of vertebrate species for photographic and scientific observation.
- 4. Understand and communicate the major evolutionary innovations in vertebrate groups, and describe the functional significance of associated morphologies and behaviours.

Teaching Methodology:

- Situational learning through lectures, classroom activities, and practice sessions
- Computer-facilitated lessons and strategies
- Field visits to incorporate hands-on experience
- Learning through practical work at lab.
- Guide students to read, write, and pronounce correctly scientific names and key terms in the concerned course.
- Students' discussion during the group activity or experiment using either English or another familiar language. The presentation of findings from the group work or the experiment was done in English.

Course Contents:

Phylum Chordata

Sub system vertebrata

General characters vertebrata

Classification

- | | | |
|------|----------|---------------------------------------|
| i. | Pisces | General characters and classification |
| ii. | Amphibia | General characters and classification |
| iii. | Aves | General characters and classification |
| iv. | Mammalia | General characters and classification |

(One example from each of the above-mentioned groups)

2. Adaptations:

- i. Cursorial Adaptations
- ii. Fossorial Adaptations
- iv. Arboreal Adaptations
- v. Aquatic Adaptations
- vi. Desert Adaptations
- vii. Aerial or Volent Adaptations

3. Migration

- i. Birds migration
- ii. Fishes migration

4. Parentanl care

5. Breeding habits

6. Biting Mechanism of Snake

7. Dinosaurs

8. Archaeopteryx

9. Zoo geographical regions (distribution of various groups of vertebrates.

- | | | |
|-----|-----------------------|-----------------------|
| 10. | i. Australian Region | ii. Oriental Region |
| | iii. Ethiopian Region | iv. Palearctic Region |

v. Neurotic Region vi. Neotropical region.

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

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

Course Contents

S. No.	Lecture detail/topic
Week 1	Phylum Chordata: Sub phylum vertebrata General characters vertebrata, Pisces: General characters and classification
Week 2	Amphibia: Aves: General characters and classification
Week 3	Mammalia: General characters and classification and Adaptations
Week 4	Cursorial Adaptations and Fossorial Adaptations
Week 5	Arboreal Adaptations and Aquatic Adaptations
Week 6	Desert Adaptations and Aerial or Volant Adaptations
Week 7	Migration: Birds migration and Fish migration
Week 8	Parental care and Breeding habits
Week 9	Mid Term Exam
Week 10	Biting Mechanism of Snake
Week 11	Dinosaurs: Archaeopteryx
Week 12	Dinosaurs: Archaeopteryx
Week 13	Zoo geographical regions (distribution of various groups of vertebrates. Australian Region
Week 14	Oriental Region and Ethiopian Region
Week 15	Paleartic Region, Nearctic Region and Neotropical region
Week 16	Final Term Exam
	LAB;
Lab1	Study and writing notes on skeletal system of Labeo.
Lab2	Study and writing notes on skeletal system of Rana tigrina,

Lab3	Study and writing notes on skeletal system of Snake .
Lab4	Study and writing notes on skeletal system of Rabbit
Lab7	Dissection of Pigeon or Uromastic and study of its various systems.
Lab8	Dissection of Pigeon or Uromastic and study of its various systems.
Lab9	Study of Scales of Fishes.
Lab10	Study of Amphibian Skin.
Lab11	Study of Reptiles Scales, Bird Feathers and Mammalian Skin.
Lab12	Study of Bird Feathers and Mammalian Skin.
Lab13	Study of Bird Feathers and Mammalian Skin.
Lab14	Field Trips to study Animals Diversity, with Emphasis to their Adaptation.
Lab15	Field Trips to study Animals Diversity, with emphasis to their Adaptation.
Lab16	Field Trips to study Animals Diversity, with emphasis to their Adaptation.

Books Recommended:

1. Miller.A.S and Harley, J.B 1999 & 2002 Zoology 4th and 5th Edition (international) Singapore. McGraw Hill.
2. Pechinik J.A 2000 “Biology of Vertebrates” 4th Edition (international) McGraw Hill.
3. Hickman, C.P, Roberts, L.S and Larson A, 2001 “Integrated Principles of Zoology”. 11th Edition (International) Singapore. McGraw Hill.
4. Miller,S.A 2002 General Zoology Laboratory Manual 5th Edition(International) Singapore McGraw Hill.
5. Hickman, C.P and Kats .H.L 2000 Laboratory Studies in integrated Principles of Zoology. Singapore McGraw Hill.

ZOOL213 Animal Form & Function-I

Course Title : Animal Form & Function-I
Course Code : ZOOL213
Offered to : Undergraduate Students at Hazara University
Cr Hr : 3(2+1)
Pre-requisite : Students should have a basic knowledge of invertebrates and vertebrates

Course Objective:

The objectives of the course are: -

- To teach about animals' diversity adapted in different strategies for performance of their similar functions through modifications in body parts in past and present times.
- To impart understanding of diverse strategic structural adaptations in each of the functions of integumentary, skeletal, muscular, nervous and sensory, endocrine, circulatory and respiratory systems for effective survival in their specific conditions.
- To understand the organ systems, their specialization and coordination with each other and constantly changing internal and external environment, inside and outside the animal's body.
- To embrace the phenomena in basic structure of each system that determines its particular function.

Course Learning Outcome (CLOs)

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

- Acquire the concept that for the performance of a function for example exchange of respiratory gases the different forms are adapted in the environments e.g. gills in aquatic and lungs in terrestrial environment.
- Understand that diverse forms adapted to perform the same functions are because of the different past and present conditions.
- Solve of emergence of diversity of forms for the performance of similar function.
- Analyze the requirements of diverse forms for the performance of similar function in their past and present needs.
- Evaluate the adaptations in forms for its efficiency in managing the function in differing situations in the past and present times.
- Demonstrate that a form is successfully adapted to perform a function adequately and successfully.

Course Contents:

- Protection: the integumentary system of invertebrates and vertebrates. Movement and support: the skeletal system of invertebrates and vertebrate.
- Movement: non-muscular movement; an introduction to animal muscles; the muscular system of invertebrates and vertebrates.
- Communication I: Nerves: Neurons: structure and function.

- Communication II: Senses: Sensory reception: baroreceptors, chemoreceptors, georeceptors, hygroreceptors, phonoreceptors, photoreceptors, proprioceptors, tactile receptors, and thermoreceptors of invertebrates. Lateral line system and electrical sensing, lateral-line system and mechanoreception, hearing and equilibrium in air and water, skin sensors of mechanical stimuli, sonar, smell, taste and vision in vertebrates.
- Communication III: The Endocrine System and Chemical Messengers: Chemical messengers: hormones chemistry; and their feedback systems; mechanisms of hormone action b. Hormones with principal function each of porifera, cnidarians, platyhelminthes, nemerteans, nematodes, molluscs, annelids, arthropods, and echinoderms invertebrates; an overview of the vertebrate endocrine system; endocrine systems of vertebrates, endocrine systems of birds and mammals. Circulation and Immunity. Internal transport and circulatory systems in invertebrates.
- Characteristics of invertebrate coelomic fluid, hemolymph, and blood cells c. transport systems in vertebrates; characteristics of vertebrate blood, blood cells and vessels; the hearts and circulatory systems of bony fishes, amphibians, reptiles, birds and mammals; the human heart: blood pressure and the lymphatic system; immunity: nonspecific defenses, the immune response.

Teaching Methodology:

- Student-centered teaching through communicative approach
- 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, Introduction to Animal form and function I.
Week 2	The integumentary system of invertebrates and vertebrates. Movement and support: the skeletal system of invertebrates and vertebrate.
Week 3	Movement: non-muscular movement; an introduction to animal muscles; the muscular system of invertebrates and vertebrates.
Week 4	Communication I: Nerves: Neurons: structure and function.
Week 5	Communication II: Senses: Sensory reception: baroreceptors, chemoreceptors, georeceptors, hygroreceptors, phonoreceptors, photoreceptors, proprioceptors, tactile receptors, and thermoreceptors of invertebrates.
Week 6	Lateral line system and electrical sensing, lateral-line system and mechanoreception, hearing and equilibrium in air and water, skin sensors of mechanical stimuli, sonar, smell, taste and vision in vertebrates.
Week 7	Communication III: The Endocrine System and Chemical Messengers.
Week 8	Hormones chemistry; and their feedback systems; mechanisms of hormone action, Hormones with principal function each of porifera, cnidarians, platyhelminthes, nemerteans, nematodes, molluscs, annelids, arthropods, and echinoderms invertebrates.
Week 9	Midterm Examination
Week 10	An overview of the vertebrate endocrine system.
Week 11	Circulation and Immunity.
Week 12	Internal transport and circulatory systems in invertebrates. Characteristics of invertebrate coelomic fluid, hemolymph, and blood cells.
Week 13	Transport systems in vertebrates; characteristics of vertebrate blood, blood cells and vessels.

Week 14	Hearts and circulatory systems of bony fishes, amphibians, reptiles, birds and mammals; the human heart.
Week 15	Blood pressure and the lymphatic system; immunity: nonspecific defenses, the immune response.
Week 16	Final Examination

Reference Books (latest Editions):

1. Pechenik, J.A. 2013. Biology of Invertebrates, 4th Ed. (International), Singapore: McGraw-Hill.
2. Hickman, C.P., Roberts, L.S., Larson, A. 2004. Integrated Principles of Zoology, 11th Ed. (International), Singapore: McGraw-Hill.
3. Miller, S.A. and Harley, J.B. 2002. Zoology, 5th Ed. (International), Singapore: McGraw-Hill.
4. Campbell, N.A. 2002. Biology, 6th Ed. Menlo Park, California: Benjamin/Cummings Publishing
5. Kent, G.C., Miller, S. 2001. Comparative Anatomy of Vertebrates. New York: McGraw-Hill.
6. Hickman, C.P., Kats, H.L. 2000. Laboratory Studies in Integrated Principles of Zoology. Singapore: McGraw-Hill.

ZOOL421 Economic Zoology

Course Title : Economic Zoology
Course Code : ZOOL421
Offered to : Undergraduate Students at Hazara University
CrHr : 3 (2+1)
Pre-requisite : Students should have a basic knowledge of animals and their products of economic importance

Course Objective:

The objectives of the course are:

- to educate scholars about the relationship of commerce with domestic animals, their products, by-products and associated farming practices,
- to teach the importance of human and domestic animal diseases and their vital relation to the economy,
- to provide knowledge about internal and external parasites and their effects on domestic animals and their farming practices,
- to familiarize with the value of studying various general practices, principles and techniques in farming and rearing of animals in sericulture (silk worms), apiculture (honey bees), aquaculture (fisheries, pearl culture, prawns and oysters), poultry (domestic fowl and ostriches) and cattle husbandry,
- to study the economics and principles of stored grained pests, pesticides and integrated pest management.

Course Learning Outcome (CLOs)

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

- ACQUIRE basic knowledge of Commerce and Economics in relation to Zoology.
- UNDERSTAND the Economic relationship of Animals with Humans.
- SOLVE problems related to animal husbandry and pest management by applying theoretical knowledge with practical efficacy.
- ANALYZE and enhance Animal husbandry techniques by using different Entrepreneurship skills.
- EVALUATE problems using practical knowledge in Zoology.
- DEMONSTRATE the Economy based interactions of Man and Animals

Course Contents:

- Basic concepts in Economic Zoology.
- Parasitic protozoans and human disease. Economic importance of protozoa.
- Vectors of human and domestic animals.

- Ecto- and Endo-parasites of fish, poultry, cattle and Man (Crustacea, Helminthes and Arachnida).
- Pests of pulse crops. Pests of oil seed crops. Stored grain pests. Pests of cotton. Pests of vegetables. Pests of fruits. Pests of tea.
- Apiculture, and Sericulture, Lac insect culture and Pearl culture.
- Aquaculture and Fisheries (Edible Fresh water, Pond and Marine fish, Prawns, Pearl oysters). Economic importance of fishes.
- Bird farming (Poultry, Quail, Turkey, Ostrich and Pigeon).

Practical:

- To study the prepared slides of various types of ecto- and endo-parasites.
- To observe and study Museum specimens of vertebrate and invertebrate pests of important crops and stored grains in Pakistan.
- To visit Honeybee farm. Write a report on their observations.
- Visit to Sericulture farm in a nearby locality and write report on their observations.
- Study visits to fish Hatchery, Nursery ponds, Stocking ponds, Commercial fish breeding farms and report writing.
- Identification of important species of Fish and their natural animal.
- Visit to any bird farm and write a report on their observations.

Teaching Methodology:

- Student-centered teaching through communicative approach
- Multimedia-based lectures
- Written Assignments
- Guest Speakers
- Field visits to poultry farms, hatcheries and beekeepers to incorporate hands-on experience.
- Report writing

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	Course Orientation/Introduction Session
Week 2	Basic concepts in Economic Zoology
Week 3	Parasitic protozoans and human disease
Week 4	Economic importance of protozoa
Week 5	Vectors of human and domestic animals
Week 6	Ecto- and Endo-parasites of fish, poultry, cattle and Man (Crustacea, Helminthes and Arachnida)
Week 7	Pests of pulse crops, Pests of oil seed crops
Week 8	Stored grain pests, Pests of cotton, Pests of vegetables
Week 9	Midterm Examination
Week 10	Pests of fruits. Pests of tea.
Week 11	Apiculture, and Sericulture, Lac insect culture and Pearl culture
Week 12	Aquaculture and Fisheries (Edible Fresh water, Pond and Marine fish, Prawns, Pearl oysters)
Week 13	Economic importance of fishes
Week 14	Bird farming (Poultry, Quail)
Week 15	Bird farming (Turkey, Ostrich and Pigeon).
Week 16	Final Examination

Reference Books (latest Editions) :

1. Economic Zoology. Ravindra Nathan, K. R. 2003. 1st ed. Dominant Publishers and Distributors. New Delhi. India

2. Principles of Wildlife Management. Bailey, J. A. 1986. John Wiley and Sons Inc. USA.
3. Wildlife ecology and management. Robinson, W. L. and Bolen, E. G. 1984. McMillan Publishing Company. Cambridge, UK.
4. A Primer of Conservation of Biology. Primack R. B. 2000. 2nd ed. Sinauer Associates Inc. USA.
5. Animal biodiversity of Pakistan. Mirza, Z. B. 1998. 1st ed: Printopack, Rawalpindi. Pakistan.
6. Ahmad, R. and Muzaffar, N., 1987. Rearing of Silkworm. Misc. Pub. Pak. Agric. Res. Council, pp. 53.
7. Akhtar, M. and Muzaffar, N., 2008. Introduction to Apiculture, Department of Zoology, Punjab University Press, 36 pp.
8. Anon, 1986. The Hive and the Honeybee. Dadant & Sons. Illinois, USA, pp. 740.50
9. Anon, 1999. FAO Bulletins on Sericulture Nos. 1 & 2. FAO Office, Rome, Italy.
10. Blackiston, H., 2001. Beekeeping for Dummies. Wiley Publishing, Inc. Indiana, USA, pp. 303.
11. Shukla, G.S. and Upadhyay, V.B., 1997. Economic Zoology, 3rd Ed. Rastogi Publications, Meerut, India, pp. 369.

ZOOL312 Animal Behavior

Course Title	:	Animal Behavior
Course Code	:	ZOOL312
Offered to	:	Undergraduate Students at Hazara University
CrHr	:	3 (3+0)
Pre-requisite	:	Students should have knowledge about the morphology and physiology of organisms and their physical environment.

Course Objective:

- The course aims at to impart knowledge about animal responses to external stimuli,
- to emphasize on different behavioural mechanisms (classical and recent concepts),
- to explain development of behavior with suitable examples of animals,
- to understand role of genetic and neurophysiology in behavioural development.

Course Learning Outcome (CLOs)

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

- OUTLINE the baseline information and knowledge for animal behavior.
- ASSOCIATE the likely role of external and internal stimuli on various animals during the day, season and year.
- RELATE daily behavioural rhythms in diurnal and nocturnal periodicities.
- PREDICT and anticipate variety of animal actions (costs and benefits) as assessed by innate and learned behavioural displays.
- INTEGRATE the animal behavior as balanced mechanism to develop animal personality.

Course Contents:

- Foundations of animal behavior: ethology, classical ethology
- Development of behavior: innate mechanisms, imprinting
- Kinds of behavior: innate, conditioned, complex behaviour patterns, habituation.
- Mechanisms of behavior: Nervous system and behavior, hormones and behavior,
- Social behavior: agonistic, altruistic, kinship, mating, ritualization, dominance, territoriality
- Biological rhythms: circadian clocks, clock genes etc.
- Social organization: conflict, sexual behavior, reproduction and fitness, parental care, social system.
- Animal Communication: chemical attraction, in moths, honeybees, communication displays, pheromones etc.

Teaching Methodology:

- Student-centered teaching through communicative approach
- 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	Course Orientation/Introduction Session, Introduction to Animal Behavior, Behaviour and its types, Proximate and ultimate causes of behavior, How and Why Birds Sing?
Week 2	Evolution of Behavior, Sociobiology, Selfish Genes, and Adaptation, Development of behavior: A focus on Heredity
Week 3	Development of behavior: A focus on Environment, Role of external and internal stimuli and animal responses
Week 4	Physiology of behavior in changed environments, Hormones and behavior in animals
Week 5	Innate behavior and innate releasing mechanisms, built in programmed performance by offspring to that of parents, Innate behavior of three spined stickle back fish
Week 6	Learned behavior and its mechanisms, quick learners' vs slow learners.

	Concept of animal cognition; key to understand and develop multiple behavioural choices.
Week 7	Ecological and genetics to maintain animal behavior, Concept of territoriality and defense in animals, Circadian rhythms and concept of bio-rhythmicity in animals.
Week 8	Maintenance of internal biological clock to perform various diurnal and nocturnal periodicities, Costs and benefit ratios in behavior; successful foragers and winners of predator-prey relationships.
Week 9	Midterm Examination
Week 10	Altruism and parental sacrifice to nurture the young, Antipredator behavior: Avoiding predators, fleeing, approaching predators, signaling to predators
Week 11	Cultural transmission, Modes of Cultural transmission, Sexual Selection, Learning and mate choice, Kinship and Animal Behavior
Week 12	Competition for resources, social organization in animals, Concept of group living; benefits and losses, Aggression, appeasement, and selfish individuals.
Week 13	Social organization in insects and mammals Play, types and functions of play
Week 14	Animal Personalities, Boldness and Shyness, Hyena Personalities, Octopus and Squid Personalities
Week 15	Communication in animals: Visual, Bioacoustics, Chemical, Tactile
Week 16	Final Examination

Reference Books (latest Editions) :

12. Dugatkin, L. A. Principles of Animal Behavior. W.W. Norton and Co. New York (latest edition).
13. Alcock, J. Animal Behavior, An Evolutionary Approach. 9th Edition. Sinauer Publishers (latest edition).
14. Scott, G. Essential Animal Behavior. Wiley Publishers (latest edition)
15. Goodenough, J., McGuire, B., Wallace, R.A. Perspective on Animal Behavior. John Wiley & Sons, New York (latest edition)
16. Barnard, C. Animal Behaviour: Mechanism, Development, Function and Evolution. Pearson Education Limited, UK (latest edition).

RMS300 Research Methodology

Course Title	:	Research Methodology
Course Code	:	RMS300
Offered to	:	Undergraduate Students at Hazara University
CrHr	:	3 (3+0)
Pre-requisite:		Students should have a basic knowledge of animals and ecosystem, along with the use of statistical tools

Course Objective:

The course is aims

- to: develop research skills, provide understanding how to design scientific research,
- to collect data and its interpretation, emphasize the importance of ethics in scientific research,
- To enable students to write a research proposal.

Course Learning Outcome (CLOs)

On completion of this course, the students should be able to:

- UNDERSTAND a general definition of research design.
- IDENTIFY the overall process of designing a research study from its inception to its report.
- Become FAMILIAR with ethical issues in educational research, including those issues that arise in using quantitative and qualitative research.
- KNOW the primary characteristics of quantitative research and qualitative research.
- IDENTIFY a research problem stated in a study.
- Become FAMILIAR with how to write a good introduction to an educational research study.
- To DISTINGUISH a purpose statement, a research question or hypothesis, and a research objective.

Course Contents:

- Introduction:
 - a. Objectives of Research, Motivations
- Research Process:
 - a. Research methods vs. research methodology, scientific method
 - b. Types of research, general steps involved in research
 - c. Problems of research in Pakistan
- Topic Selection:
 - a. Problem identification for research, criteria and evaluation
- Literature review:

- a. Importance and sources
 - b. Referencing and citation and Bibliography
 - c. plagiarism
- Research Design:
 - a. Parts, important features, important concepts in research design
- Aims and objectives:
 - a. Research objectives, qualities of research objectives
- Material and methods:
 - a. Bioethics, sampling, data collection and data analysis, sampling requirements, scales of measurement, error of measurement and its sources
- Data Analysis:
 - a. Processing, statistics in research, hypothesis testing, t-tests and ANOVA
- Scientific Writing:
 - a. Difference between thesis/report/synopsis/research proposal
 - b. Parts of synopsis/project proposal, parts of thesis/report
- Budgeting: Cost estimates for a research project, funding sources e.g. USAID, HEC, DoST, HED, PMRC, WWF, PSF etc.

Teaching Methodology:

- Student-centered teaching through communicative approach
- Multimedia-based lectures
- Written Assignments
- Quizzes
- Report/Proposal writing

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	Course Orientation/Introduction Session
Week 2	Objectives of Research, Motivations
Week 3	Research Process: a. Research methods vs. research methodology, scientific method b. Types of research, general steps involved in research c. Problems of research in Pakistan
Week 4	Topic Selection: a. Problem identification for research, criteria and evaluation
Week 5	Literature review: a. Importance and sources b. Referencing and citation and Bibliography c. plagiarism
Week 6	Research Design: a. Parts, important features, important concepts in research design
Week 7	Aims and objectives: a. Research objectives, qualities of research objectives
Week 8	Material and methods: a. Bioethics, sampling, data collection and data analysis, sampling requirements, scales of measurement, error of measurement and its sources
Week 9	Midterm Examination
Week 10	Data Analysis: a. Processing, statistics in research, hypothesis testing
Week 11	Data Analysis: t-tests and ANOVA
Week 12	Scientific Writing: a. Difference between thesis/report/synopsis/research proposal

Week 13	Scientific Writing: b. Parts of synopsis/project proposal, parts of thesis/report
Week 14	Budgeting: Cost estimates for a research project.
Week 15	Budgeting: Cost estimates for funding sources e.g. USAID, HEC, DoST, HED, PMRC, WWF, PSF etc.
Week 16	Final Examination

Reference Books (latest Editions) :

17. Paul Leedy, 2004, Practical Research: Planning and Design (8th Edition), Jeanne Ellis Ormrod.
18. Creswell, J. W. (2013). Research Design Quantitative, Qualitative and Mixed Methods Approaches. Sage.
19. Hess-Biber, S. N. and P. Leavy. (2004). Approaches to Qualitative Research, A Reader on Theory and Practice. New York, Oxford University Press.
20. Khan, J.A. (2008). Research Methodology. New Delhi: APH Publishing.
21. Kothari, C.R., & Gaurav, G. (2014). Research Methodology: Methods and Techniques. New Delhi: New Age International.
22. Kumar, R. (2011). Research Methodology: A Step by Step Guide for Beginners. Cornwall: SAGE Publications, Inc.
23. Laurel, B. (2003). Design Research, Methods and Perspectives. London England, The MIT Press.
24. Walliman, N. (2005). Your Research Project, 2nd Edition, A step by step guide for the first-time researcher. New Delhi, Vistaar Publications.

ZOOL432 Immunology

Course Title	:	Immunology
Course Code	:	ZOOL432
Offered to	:	Undergraduate Students at Hazara University
Cr Hr	:	3 (2+1)
Pre-requisite	:	Students should have a basic knowledge of Cell Biology and microbiology

Course Objective:

The objectives of the course are:-

- To be able to clearly state the role of the immune system and a foundation in immunological processes
- To provide students with knowledge on how the immune system works building on their previous knowledge from biochemistry, genetics, cell biology and microbiology
- The students will be able to describe immunological response and how it is triggered and regulated.

Course Learning Outcome (CLOs)

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

- Explore the basic knowledge of immune system
- Describe the concepts of how the immune system works.
- Interpret the problems using immunological techniques for diagnosis of immune disorders.
- Identify the problems using immunological diagnostic tools.
- Detect the problems using the same techniques for other disorders.
- DEMONSTRATE individually the ELISA and other Assays/Tests

Course Contents:

- Immunology: Immunobiology, Immunophysiology and Immunopathology, Immunity: Natural and acquired immunity, Active and passive immunity, Antigens and elicitation of immune responses, Antigens and their types, Antigenicity and immunogenicity, Factors important for immunogenicity of an antigen,
- Cell mediated and humoral immune responses, Immunoglobulins, Synthesis of antibodies, Detection and application of antigen-antibody reactions, Monoclonal antibodies: Importance, synthesis, isolation and applications, Major histocompatibility complex: types and importance, Cellular basis of immune response, Origin of lymphocytes, Primary and secondary lymphoid organs, Specific response of individual lymphocytes to antigenic stimulation, Histological features of immune response,
- Hypersensitivity: Immediate hypersensitivity (anaphylaxis, antibody dependent cytotoxicity, Immune-complex mediated disease and stimulatory hypersensitivity),

Delayed type or cell mediated hypersensitivity, Immunological tolerance and autoimmunity, Autoimmune diseases and types, T

- ransplantation immunology, Tumor immunology, Immunity against infectious diseases, Immuno deficiency diseases, Immunity and malnutrition. Immunization procedures. Vaccines and their types.

Teaching Methodology:

- Student-centered teaching through communicative approach
- 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, Introduction to Immunology.
Week 2	Immunology: Immunobiology, Immunophysiology and Immunopathology
Week 3	Immunity: Natural and acquired immunity, Active and passive immunity.
Week 4	Antigens and elicitation of immune responses, Antigens and their types, Antigenicity and immunogenicity, Factors important for immunogenicity of an antigen.

Week 5	Cell mediated and humoral immune responses.
Week 6	Immunoglobulins, Synthesis of antibodies, Detection and application of antigen-antibody reactions, Monoclonal antibodies.
Week 7	Major histocompatibility complex: types and importance, Cellular basis of immune response.
Week 8	Origin of lymphocytes, Primary and secondary lymphoid organs, Specific response of individual lymphocytes to antigenic stimulation.
Week 9	Midterm Examination
Week 10	Hypersensitivity: Immediate hypersensitivity (anaphylaxis, antibody dependent cytotoxicity, Immune-complex mediated disease and stimulatory hypersensitivity).
Week 11	Delayed type or cell mediated hypersensitivity, Immunological tolerance and autoimmunity.
Week 12	Autoimmune diseases and types.
Week 13	Transplantation immunology, Tumor immunology, Immunity against infectious diseases.
Week 14	Immuno deficiency diseases, Immunity and malnutrition.
Week 15	Immunization procedures. Vaccines and their types.
Week 16	Final Examination

Reference Books (latest Editions):

1. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Molecular Biology of the Cell (5th ed. 2008, Garland)
2. Thomas J Kindt, Richard A Goldsby, Barbara A Osborne, Janis Kuby: Immunology (2003, Freeman).
3. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt: Roitt's Essential Immunology (12th ed. 2012, Blackwell)

4. Abul Abbas, Andrew H. Lichtman, Shiv Pillai. Cellular and Molecular Immunology, 9th edition, 2017. Elsevier Pub Co.
5. Gerd R. Burmester, Antonio Pezzutto Color Atlas of Immunology, 2006. Thieme Stuttgart, New York.

ZOOL303 Zoogeography & Paleontology

Course Title	:	Zoogeography & Paleontology
Course Code	:	ZOOL303
Offered to	:	Undergraduate Students at Hazara University
CrHr	:	3 (2+1)
Pre-requisite	:	None

Course Objective:

- Provide information on the distribution of animals and their associations in the past and to rationalize their relationship in the present time.
- Impart knowledge and concepts of evolution mainly on the basis of fossil record.
- Give understanding that fossil record also provides information about the distribution of animals in the past eras.

Course Contents:

(i) Zoogeography

- Branches of zoogeography: descriptive, chorology, faunistics, systematic, biocoenotic, causal, ecological, historical, experimental and applied zoogeography.
- Animal distribution: cosmopolitan distribution, discontinuous distribution, isolation distribution, bipolar distribution and endemic distribution, barriers and dispersal.
- Zoogeographical regions: zoogeographic division and boundaries, geographic ranges, physical features, climates, faunas and affinities of Palaearctic, Nearctic regions, Oriental, Ethiopian, Australian, and Neotropical Regions, insular fauna
- Palaeogeography: Theories of continental drift and plate tectonics; Pangea.

(ii) Paleontology

- The Planet Earth: History, age, shells of earth; atmosphere, hydrosphere, biosphere and lithosphere.
- Rocks: types; Igneous rocks, sedimentary rocks and metamorphic rocks.
- Fossil types and uses of fossils, nature of fossils.
- Fossilization: Geological time scale. Pre-Cambrian life. Post Cambrian life,
- Palaeozoic life, Mesozoic life, Cenozoic life.
- Geochronometry: Uranium/Lead dating, radiocarbon dating, methods, index fossils; evolutionary history of man, elephant, horse and camel
- Paleoecology, Paleomagnetism.

Teaching Methodology:

- Student-centered teaching through communicative approach
- 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	Course Orientation/Introduction Session, Introduction to Zoogeography, Branches of zoogeography: descriptive, chorology, faunistics, systematic, biocoenotic, causal, ecological, historical, experimental and applied zoogeography
Week 2	Animal distribution: cosmopolitan distribution, discontinuous distribution, isolation distribution, bipolar distribution and endemic distribution,
Week 3	Barriers and dispersal.
Week 4	Zoogeographical regions: zoogeographic division and boundaries, geographic ranges, physical features, climates, faunas and affinities of Palaearctic and Nearctic regions
Week 5	Zoogeographical regions: zoogeographic division and boundaries, geographic ranges, physical features, climates, faunas and affinities of Oriental and Ethiopian regions

Week 6	Zoogeographical regions: zoogeographic division and boundaries, geographic ranges, physical features, climates, faunas and affinities of Australian and Neotropical Regions.
Week 7	Palaeogeography: Theories of continental drift and plate tectonics; Pangea.
Week 8	Introduction to Paleontology, The Planet Earth: History, age, shells of earth; atmosphere, hydrosphere, biosphere and lithosphere.
Week 9	Midterm Examination
Week 10	Rocks: types; Igneous rocks, sedimentary rocks and metamorphic rocks.
Week 11	Fossilization, Fossil types and uses of fossils, nature of fossils.
Week 12	Geological time scale. Pre-Cambrian life. Post Cambrian life, Palaeozoic life, Mesozoic life, Cenozoic life.
Week 13	Geochronometry: Uranium/Lead dating, radiocarbon dating, methods, index fossils.
Week 14	Evolutionary history of man, elephant, horse and camel.
Week 15	Paleoecology, Paleomagnetism.
Week 16	Final Examination

Reference Books

Zoogeography

1. Beddard, F. E. 2008. A text book of zoogeography. Bibliobazar, LLC.
 2. Tiwari, S.K. 2006. Fundamentals of world zoogeography. Wedams eBooks Ltd (India) Sarup & Sons. Delhi.
 3. Ali, S.S. 1999. Palaeontology, Zoogeography and Wildlife Management. Nasim Book Depot, Hyderabad, India.
 4. Darlington, P. J. Jr. 1963. Zoogeography, John Wiley and Sons.
- ### Paleontology
1. Michael, J. B. David, A and Haper, T. 2009. Paleobiology and the fossil record. 3rd Ed. Wiley Black, UK.
 2. Foote, M and Millar, A. I. 2007. Principles of paleontology. 3rd Ed. W. H. Freeman & Co.

USA.

3. Ali, S.S. 1999. Palaeontology, Zoogeography and Wildlife Management. Nasim Book Depot, Hyderabad, India.

4. Brouwer, A. 1977. General Palaeontology, Oliver and Boyd, London.

ZOOL331 Genetics

Course Title : Genetics
Course Code : ZOOL331
Offered to : Undergraduate Students at Hazara University
CrHr : 3(2+1)
Pre-requisite : Cell Biology

Course Objective:

- Provide understanding about the continuity of the life from one generation to other generation is based on the mechanisms involving nucleus, chromosomes and genes etc.
- Develop the concept that continuity not only transfers the traits of the parents but also imparts variations that render the generations sustainable in changing environment.

Course Contents:

- **Classical Genetics:** Scope and importance of genetics, gene concept; classical and modern), Multiple Alleles: blood groups and coat color in rabbits.
- Chromosomal Basis of Inheritance: interaction of genes, changes in chromosomal number, euploidy, aneuploidy, polyploidy; structural changes, insertion, deletion (Cri du chat syndrome), duplication and translocation
- Pedigree Analysis: Normal human chromosome complement; Karyotyping. Sex-determination and Sexlinkage: Sex determination in animals and humans, linkage, recombination and chromosome mapping in eukaryotes. Molecular Genetics: Elements of genetic engineering; genetic basis of diseases, like cancer, genetic control of animal development.
- Human Genetics; Single and Multifactorial Disorders: Autosomal anomalies, Pseudoautosomal genes, (eg. Down syndrome, Edwards syndrome and), Single gene disorders Gene mutation and disorders; autosomal single gene disorders (Sickle cell anemia, brachydactyly; inborn errors of metabolism such as Phenylketonuria, alkaptonuria). Definition - characteristics criss-cross inheritance. Polygenic traits - Cleft lip and cleft palate, Sex-linked Chromosomal anomalies: Klinefelters syndrome, and Turners syndrome.
- Sex-influenced inheritance: Hemophilia, muscular dystrophy, color blindness. Prenatal Diagnosis: Amniocentesis and choriovillous sampling – Ultrasound scanning and Fetoscopy. Genetic counselling, Eugenics and Euthenics.
- Population Genetics: Hardy-Wienberg equilibrium, systematic and dispersive pressures, inbreeding and heterosis.

Teaching Methodology:

- Student-centered teaching through communicative approach
- 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	Course Orientation/Introduction Session, Scope and importance of genetics, gene concept; classical and modern), Multiple Alleles: blood groups and coat color in rabbits.
Week 2	Chromosomal Basis of Inheritance: interaction of genes, changes in chromosomal number, euploidy, aneuploidy, polyploidy; structural changes, insertion, deletion (Cri du chat syndrome), duplication and translocation
Week 3	Pedigree Analysis: Normal human chromosome complement; Karyotyping. Sex-determination and Sexlinkage: Sex determination in animals and humans,
Week 4	linkage, recombination and chromosome mapping in eukaryotes.
Week 5	Molecular Genetics: Elements of genetic engineering;
Week 6	Genetic basis of diseases, like cancer, genetic control of animal development.
Week 7	Human Genetics; Single and Multifactorial Disorders
Week 8	Autosomal anomalies, Pseudoautosomal genes, (eg. Down syndrome, Edwards syndrome and)

Week 9	Midterm Examination
Week 10	Single gene disorders Gene mutation and disorders; autosomal single gene disorders (Sickle cell anemia, brachydactyly; inborn errors of metabolism such as Phenylketonuria, alkaptonuria).
Week 11	Definition - characteristics criss-cross inheritance.
Week 12	Polygenic traits - Cleft lip and cleft palate, Sex-linked Chromosomal anomalies: Klinefelters syndrome, and Turners syndrome.
Week 13	Sex-influenced inheritance: Hemophilia, muscular dystrophy, color blindness.
Week 14	Prenatal Diagnosis: Amniocentesis and choriovillous sampling - Ultrasound scanning and Fetoscopy.
Week 15	Genetic counselling, Eugenics and Euthenics. Population Genetics: Hardy-Wienberg equilibrium, systematic and dispersive pressures, inbreeding and heterosis.
Week 16	Final Examination

Reference Books

1. Snustad, D.P., Simmons, M.J. 2003. Principles of Genetics. 3rd Ed., John Wiley and Sons Ins. New York, USA.
2. Tamarin, R.H. 2001. Principles of Genetics. 7th Ed., WCB Publishers USA.
3. Lewin, B. 2000. GENE-VIII. Oxford University Press. UK.
4. Gardener, E.J., Simmons, M.J., Snustad, D.P. 1991. Principles of Genetics. John Wiley and Sons Ins. New York, USA.
5. Strickberger, M.W. 2014. Genetics. McMillan, New York. USA.

ZOOL214 Animal Form & Function II

Course Title	:	Animal Form & Function II
Course Code	:	ZOOL214
Offered to	:	Undergraduate Students at Hazara University
CrHr	:	3(2+1)
Pre-requisite	:	None

Course Objective:

- The course aims to provide information on morphology and physiology of different groups of animals.
- Impart detailed knowledge about Homeostasis and its importance, and to know about the role of thermoregulation and osmoregulation in physiology.
- Provide understanding of the mechanisms of reproduction and development with emphasis on descriptive embryology.

Course Learning Outcome (CLOs)

- To know the basic concepts of nutrition and its components.
- To enable students to know the mechanism of digestion in various animals.
- To enable the students to know about the concepts of homeostasis.
- To know about the thermoregulation and osmoregulation in different groups of animals.
- To enable students to know about the gametes and their role in sexual reproduction
- To know about the embryogenesis.
- To enable the students to understand the concept of germinal layers and their derivatives.

Course Contents

- **Nutrition and Digestion:** Evolution of nutrition; the metabolic fates of nutrients in heterotrophs; digestion; animal strategies for getting and using food, diversity in digestive structures of invertebrates and vertebrates; the mammalian digestive system: gastrointestinal motility and its control, oral cavity, pharynx and esophagus, stomach, small intestine: main site of digestion; large intestine; role of the pancreas in digestion; and role of the liver and gallbladder in digestion.
- **Temperature and Body Fluid Regulation:** Homeostasis and Temperature Regulation; The Impact of Temperature on Animal Life; Heat Gains and Losses; Some Solutions to Temperature Fluctuations; Temperature Regulation in Invertebrates, Fishes, Amphibians, Reptiles, Birds and Mammals; Heat Production in Birds and Mammals; Control of Water and Solutes (Osmoregulation and Excretion); Invertebrate and Vertebrate Excretory Systems; How Vertebrates Achieve Osmoregulation; Vertebrate Kidney Variations; Mechanism in Metanephric Kidney Functions.

- **Reproduction and Development:** Asexual reproduction in invertebrates; advantages and disadvantages of asexual reproduction; sexual reproduction in invertebrates; advantages and disadvantages of sexual reproduction; sexual reproduction in vertebrates; reproductive strategies; examples of reproduction among various vertebrate classes; the human male reproductive system: spermatogenesis, transport and hormonal control, reproductive function; the human female reproductive system: folliculogenesis, transport and hormonal control, reproductive function; hormonal regulation in gestation; prenatal development and birth: the placenta; milk production and lactation.
- **Descriptive Embryology:** Fertilization; embryonic development: cleavage, and egg types; the primary germ layers and their derivatives; echinoderm embryology; vertebrate embryology: the chordate body plan, amphibian embryology, development in terrestrial environments, avian embryology and fate of mesoderm

S. No	Lab/Practicals Detail
Lab 1	Study of excretory system in an invertebrate representative (Model).
Lab 2	Study of excretory system in a vertebrate representative (Model).
Lab 3	Study of nutritive canal in an invertebrate representative (Dissection).
Lab 4	Study of nutritive canal in a vertebrate representative (Dissection).
Lab 5	Study of male reproductive system in an invertebrate representative (Dissection).
Lab 6	Study of male reproductive system in a vertebrate representative (Dissection).
Lab 7	Study of female reproductive system in an invertebrate representative (Dissection).
Lab 8	Study of female reproductive system in a vertebrate representative (Dissection).
	Midterm Examination
Lab 9	Study of hormonal influence of a reproductive function (Model).
Lab 10	Study of preserved advanced stages of avian and mammalian development for amniotic membranes and placenta (Model).
Lab 11	Study of stages in the development of an Echinoderm.
Lab 12	Study of early stages in the development of a frog
Lab 13	Study of early stages in the development of a chick
Lab 14	Study of early stages in the development of a mammal.

	Final Examination
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Teaching Methodology:

- Student-centered teaching through Lectures and demonstration
- Study through Practical/ Lab work
- Multimedia-based lectures and Simulations of concepts
- Computer-facilitated lessons and presentations

General information:

- The focus will be on both lessons and practical work

Marks Distribution:

Theory: Total 100 Marks (75%)

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

Lab Task: Total 100 Marks (25%)

- Performance/ Practical note book/ Collection/ Viva

Week-Wise Distribution:

Week#	Topic to be covered
Week 1	Evolution of nutrition; the metabolic fates of nutrients in heterotrophs; Macronutrients and micronutrients
Week 2	digestion; animal strategies for getting and using food, diversity in digestive structures of invertebrates and vertebrates;
Week 3	the mammalian digestive system: gastrointestinal motility and its control, oral cavity, pharynx and esophagus, stomach, small intestine main site of digestion;
Week 4	large intestine; role of the pancreas in digestion; and role of the liver and gallbladder in digestion.
Week 5	Homeostasis and Temperature Regulation; The Impact of Temperature on Animal Life; Heat Gains and Losses; Some Solutions to Temperature Fluctuations; Temperature Regulation in Invertebrates,
Week 6	Temperature Regulation in vertebrates, Fishes, Amphibians, Reptiles, Birds and Mammals; Heat Production in Birds and Mammals; Control of Water and Solutes (Osmoregulation and Excretion);
Week 7	Invertebrate and Vertebrate Excretory Systems; How Vertebrates Achieve Osmoregulation;
Week 8	Vertebrate Kidney Variations; Mechanism in Metanephric Kidney Functions. counter current exchange

Week 9	Midterm Examination
Week 10	Asexual reproduction in invertebrates; advantages and disadvantages of asexual reproduction; sexual reproduction in invertebrates; advantages and disadvantages of sexual reproduction;
Week 11	sexual reproduction in vertebrates; reproductive strategies; examples of reproduction among various vertebrate classes; the human male reproductive system: spermatogenesis, transport and hormonal control,
Week 12	reproductive function; the human female reproductive system: folliculogenesis, transport and hormonal control, reproductive function; hormonal regulation in gestation;
Week 13	Prenatal development and birth: the placenta; milk production and lactation. the placenta; milk production and lactation
Week 14	Fertilization; embryonic development: cleavage, and egg types; the primary germ layers and their derivatives; echinoderm embryology;
Week 15	vertebrate embryology: the chordate body plan, amphibian embryology, development in terrestrial environments, avian embryology and fate of mesoderm
Week 16	Final Examination

S. No	Week wise Lab/Practicals Detail
Week 1	Study of excretory system in an invertebrate representative (Model).
Week 2	Study of excretory system in a vertebrate representative (Model).
Week 3	Study of nutritive canal in an invertebrate representative (Dissection).
Week 4	Study of nutritive canal in a vertebrate representative (Dissection).
Week 5	Study of male reproductive system in an invertebrate representative (Dissection).
Week 6	Study of male reproductive system in a vertebrate representative (Dissection).
Week 7	Study of female reproductive system in an invertebrate representative (Dissection).
Week 8	Study of female reproductive system in a vertebrate representative (Dissection).
Week 9	Midterm Examination
Week 10	Study of hormonal influence of a reproductive function (Model).
Week 11	Study of preserved advanced stages of avian and mammalian development for amniotic membranes and placenta (Model).
Week 12	Study of stages in the development of an Echinoderm.
Week 13	Study of early stages in the development of a frog
Week 14	Study of early stages in the development of a chick
Week 15	Study of early stages in the development of a mammal.
Week 16	Final Examination

Reference Books (latest Editions) :

1. Gilbert, S. F. 2013. Developmental Biology, Sinauer Associates, Sunderland, MA.
2. Klaus, K. 2001. Biological Development. 2nd Ed., McGraw-Hill. 67

3. Scott F. Gilbert and Michael J. F. Barres. 2016. *Developmental Biology*. Sinauer Associates, Sunderland, MA.
4. Jamie. A. Davies. 2014. *Life Unfolding: How the Human Body Creates Itself*. Oxford University Press, USA
5. Balinsky, B. I. 198
5. Pechenik, J.A. 2013. *Biology of Invertebrates*, 4th Ed. (International), Singapore: McGraw Hill.
6. Hickman, C.P., Roberts, L.S., Larson, A. 2004. *Integrated Principles of Zoology*, 11th Ed. (International), Singapore: McGraw Hill.
7. Miller, S.A., Harley, J.B. 2002. *Zoology*, 5th Ed. (International), Singapore: McGraw Hill.
8. Campbell, N.A. 2002. *Biology*, 6th Ed. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.
9. Miller, S.A. 2002. *General Zoology Laboratory Manual*. 5th Ed. (International), Singapore: McGraw Hill.
10. Kent, G.C., Miller, S. 2001. *Comparative Anatomy of Vertebrates*. New York: McGraw Hill.
11. Hickman, C.P., Kats, H.L. 2000. *Laboratory Studies in Integrated Principles of Zoology*. Singapore: McGraw Hill.

ZOOL200 Principles of Animal Life

Course Title	:	Principles of Animal Life
Course Code	:	ZOOL200
Offered to	:	Undergraduate Students at Hazara University
CrHr	:	3 (2+1)
Pre-requisite	:	None

Course Objective:

The course aims

- to impart very basic knowledge about advanced concepts such as: the concept and status of Zoology in life sciences and the common processes of life through its biochemical and molecular processes, the structure and function of cell organelles and how common animal cell diversified in various tissues, organs and organ systems, biochemical mechanisms eventually generating energy for animal work, animals, and their relationship with their environment.
- Cell division and its significance in cell cycle, concepts and mechanisms of inheritance pattern, chromosome and gene linkage and molecular basics of genetics, animal behavior and communication, theories of evolution, gene flow and mechanism of evolution with reference to animal diversity

Course Learning Outcome (CLOs)

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

- Describe the concept and status of Zoology in life sciences and the common processes of life through its biochemical and molecular processes.
- Study the structure and function of cell organelles and how common animal cell diversified in various tissues, organs and organ systems.
- Observe the biochemical mechanisms eventually generating energy for animal work.
- Know the animals and their relationship with their environment.

Course Contents:

- Scope of Zoology: Introduction; significance and applications of zoology; animal diversity; the scientific method; environment and world resources.
- The Chemical Basis of Animal Life: Brief introduction to biomolecules; carbohydrates, lipids, proteins, and nucleic acids.
- Animal tissues: Types: epithelial, connective, muscle and nervous tissue; organs and organ systems.
- Enzymes: Structure, types; function and factors affecting their activity; cofactors and coenzymes.
- Energy Harvesting: Aerobic and anaerobic respiration: glycolysis, citric acid cycle and electron transport chain; fermentation, the major source of ATP.
- Reproduction and Development: Types; asexual and sexual, gametogenesis, fertilization, metamorphosis, zygote and early development.

- Ecological Concepts: Ecosystem, types, homeostasis, biomes, food chain, food web, energy flow and thermodynamics; biogeochemical cycles, and limiting factors, populations and communities, human population growth, pollution, resource depletion and biodiversity.
- Cell Division: Cell cycles: Mitosis and meiosis; control of the cell cycle.
- Inheritance Patterns: Mendelian genetics; Chromosomes and Gene Linkage: Eukaryotic chromosomes; linkage and crossing over; Chromosomal aberrations. Basic concepts Animal Behavior (General lecture)
- Evolution: A Historical Perspective: Theories of evolution, Natural selection Lamarckism and neo-Lamarckism, Darwinism and Neo-Darwinism
- Gene mutation; Gene Frequencies: Hardy-Weinberg principle; evolutionary mechanisms (General lecture)
- Hardy-Weinberg principle; evolutionary mechanisms: population size, genetic drift, gene flow, de Vries mutation theory and rates of evolution, polymorphism; species and speciation; molecular evolution; mosaic evolution.

Practical:

- Tests for different carbohydrates, proteins and lipids.
- Study of the prepared slides of epithelial tissue (squamous, cuboidal, columnar), connective tissue (adipose, cartilage, bone, blood), nervous tissue and muscle tissue (skeletal, smooth and cardiac). Note: Prepared microscopic and/or projection slides and/or CD ROM computer projections must be use
- Plasmolysis and deplasmolysis in blood. Preparation of blood smears.
- Protein digestion by pepsin.
- Ecological notes on animals of a few model habitats.
- Field observation and report writing on animals in their ecosystem (a terrestrial and an aquatic ecosystem study).

Teaching Methodology:

- Student-centered teaching through communicative approach
- 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	Course Orientation/Introduction Session, Scope of Zoology: Introduction; significance and applications of zoology; animal diversity
Week 2	The Chemical Basis of Animal Life: Brief introduction to biomolecules; carbohydrates, lipids, proteins, and nucleic acids.
Week 3	Enzymes: Structure, types; function and factors affecting their activity; cofactors and coenzymes.
Week 4	Energy Harvesting: Aerobic and anaerobic respiration: glycolysis, citric acid cycle and electron transport chain; fermentation, the major source of ATP.
Week 5	Animal tissues: Types: epithelial, connective, muscle and nervous tissue; organs and organ systems.
Week 6	Reproduction and Development: Types; asexual and sexual, gametogenesis, fertilization, metamorphosis, zygote and early development.
Week 7	Ecological Concepts: Ecosystem, types, homeostasis, biomes, food chain, food web, energy flow and thermodynamics; biogeochemical cycles, and limiting factors
Week 8	Populations and communities, human population growth, pollution, resource depletion and biodiversity.
Week 9	Midterm Examination
Week 10	Cell Division: Cell cycles: Mitosis and meiosis; control of the cell cycle.
Week 11	Inheritance Patterns: Mendelian genetics; Chromosomes and Gene Linkage: Eukaryotic chromosomes; linkage and crossing over
Week 12	Chromosomal aberrations. Basic concepts Animal Behavior (General lecture)
Week 13	Evolution: A Historical Perspective: Theories of evolution, Natural selection Lamarckism and neo-Lamarckism, Darwinism and Neo-Darwinism
Week 14	Gene mutation; Gene Frequencies: Hardy-Weinberg principle; evolutionary mechanisms (General lecture)
Week 15	Hardy-Weinberg principle; evolutionary mechanisms: population size, genetic drift, gene flow, de Vries mutation theory and rates of evolution, polymorphism; species and speciation; molecular evolution; mosaic evolution.
Week 16	Final Examination

Books Recommended

1. Miller, S.A. and Harley, J.B. 2005. Zoology, 6th Ed. (International), Singapore: McGraw-Hill.

2. Molles, M.C. 2005. Ecology: Concepts and Applications. 6 th Ed. McGraw Hill, New York, USA.
3. Hickman, C.P., Roberts, L.S. and Larson, A. 2004. Integrated Principles of Zoology, 12th Ed. (International), Singapore: McGraw Hill.
3. Campbell, N.A. 2002. Biology. 6th Ed. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.
4. Miller, S.A. 2002. General Zoology Laboratory Manual. 5th Ed. (International), Singapore: McGraw Hill.
5. Hickman, C.P. and Kats, H.L. 2000. Laboratory Studies in Integrated Principles of Zoology. Singapore: McGraw Hill.
6. Odum, E. P. 1994. Fundamentals of Ecology. 3rd Ed. W.B. Saunders. Philadelphia.

ZOOL314 Developmental Biology

Course Title	:	Developmental Biology
Course Code	:	ZOOL314
Offered to	:	Undergraduate Students at Hazara University
CrHr	:	3 (2+1)
Pre-requisite	:	Animal diversity I and II

Course Objective:

The course aims to:

- Provide information on transmission of traits from the parents in their gametes, the formation of zygote and its development
- Impart detailed knowledge about cellular basis of morphogenesis, mechanisms of cellular differentiation and induction.
- Provide understanding of the mechanisms of organogenesis, factors controlling growth and oncogenesis.

Course Learning Outcome (CLOs)

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

- Gain familiarity with features that make an organism model for the learning of developmental biology e.g., fertilization in sea urchin with mammalian like mechanisms.
- Apprehend the contributions of the sperm and the egg to form zygote
- Elucidate the problems associated with cell differentiation through fate mapping.
- Arrange and investigate the classical and modern experiments into “find it”, “block it”, and “move it” categories
- Assess the set of experiments that will establish whether a planned aspect is both necessary and ample to cause a developmental episode
- Demonstrate the ability to label macromeres, mesomeres, and micromeres and know which cell types are derived from each of these cell layers in the early embryo (e.g., primary and secondary mesenchyme, ectoderm, endoderm, and mesoderm).

- **Course Contents:**

1. Introduction

- a. History and Basic Concepts of developmental biology
- b. Principal features of developmental biology and embryology with special emphasis on vertebrate models
- c. Origin of sexual reproduction
- d. Developmental patterns

2. Spermatogenesis

- a. Mammalian spermatogenesis as model for all vertebrates
- b. Spermiogenesis or (spermateliosis)

- c. The role of Sertoli and Leydig cells in spermatogenesis
 - d. Hormonal control of spermatogenesis
3. Primates Menstrual cycle
- 1. Oogenesis
 - a. Mechanism of oogenesis among various classes of vertebrates.
 - b. Vitellogenesis
 - c. Hormonal control of Vitellogenesis and oogenesis
 - 4. Fertilization
 - a. External & Internal Fertilization
 - b. Species-specific recognition of sperm and egg
 - c. Fusion of male and female gametes
 - d. Polyspermy: slow and fast blocks to polyspermy
 - e. Activation of egg metabolism
 - 5. IN VITRO Fertilization (IVF)
 - a. History, Steps and advantages of IVF
 - b. Disadvantages and risk factors
 - 6. Cleavage & Blastulation
 - a. Patterns of embryonic cleavage and blastulation among vertebrate classes
 - b. Mechanism of cleavage.
 - 7. Gastrulation
 - a. Fate maps
 - b. Gastrulation in amphibians, birds and mammals
 - 8. Early Vertebrate Development
 - a. Neurulation, ectoderm, mesoderm and endoderm formation
 - 9. Placenta and extraembryonic membranes
 - 10. Cellular Basis of Morphogenesis
 - a. Differential cell affinity, cell adhesion molecules
 - b. Organogenesis
 - c. Mechanism of teratogenesis
 - 11. Aging and Regeneration in vertebrates

S. No	Lab/Practicals Detail
Lab 1	Study of the structure of gametes in fish
Lab 2	Study of the structure of gametes in frog
Lab 3	Study of the structure of gametes in reptiles
Lab 4	Study of the structure of gametes in birds.
Lab 5	Study of the structure of gametes in mammal.
Lab 6	Hen's egg internal and external structural details
Lab 7	Microscopic analysis of hen's egg yolk, albumin and shell membranes
Lab 8	Study of cleavage and subsequent development from prepared slides and/or models in fish & frog
	Midterm Examination
Lab 9	Study of cleavage and subsequent development from prepared slides and/or models in reptiles & birds
Lab 10	Study of cleavage and subsequent development from prepared slides and/or models in mammals
Lab 11	Study of fertilization, early development of frog/fish through induced spawning under laboratory conditions
Lab 12	Study of developmental stages of nematodes through microscopic analysis of animal dung
Lab 13	Semen analysis
Lab 14	Dactylography and its uses in developmental biology
	Final Examination

Teaching Methodology:

- Student-centered teaching through Lectures and demonstration
- Study through Practical/ Lab work
- Multimedia-based lectures and Simulations of concepts
- Computer-facilitated lessons and presentations

General information:

- The focus will be on both lessons and practical work

Marks Distribution:

Theory: Total 100 Marks (75%)

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

Lab Task: Total 100 Marks (25%)

- Performance/ Practical note book/ Collection/ Viva

Week-Wise Distribution:

Week#	Topic to be covered
Week 1	1. Introduction a. History and Basic Concepts of developmental biology b. Principal features of developmental biology and embryology with special emphasis on vertebrate models
Week 2	c. Origin of sexual reproduction d. Developmental patterns
Week 3	2. Spermatogenesis a. Mammalian spermatogenesis as model for all vertebrates b. Spermiogenesis or (spermateliosis)
Week 4	c. The role of Sertoli and Leydig cells in spermatogenesis d. Hormonal control of spermatogenesis
Week 5	3. Primates Menstrual cycle 1. Oogenesis a. Mechanism of oogenesis among various classes of vertebrates. b. Vitellogenesis c. Hormonal control of Vitellogenesis and oogenesis
Week 6	4. Fertilization a. External & Internal Fertilization b. Species-specific recognition of sperm and egg c. Fusion of male and female gametes
Week 7	d. Polyspermy: slow and fast blocks to polyspermy e. Activation of egg metabolism
Week 8	5. IN VITRO Fertilization (IVF) a. History, Steps and advantages of IVF b. Disadvantages and risk factors
Week 9	Midterm Examination
Week 10	6. Cleavage & Blastulation a. Patterns of embryonic cleavage and blastulation among vertebrate classes b. Mechanism of cleavage.
Week 11	7. Gastrulation a. Fate maps b. Gastrulation in amphibians, birds and mammals
Week 12	8. Early Vertebrate Development a. Neurulation, ectoderm, mesoderm and endoderm formation
Week 13	9. Placenta and extraembryonic membranes 10. Cellular Basis of Morphogenesis a. Differential cell affinity, cell adhesion molecules
Week 14	b. Organogenesis c. Mechanism of teratogenesis
Week 15	11. Aging and Regeneration in vertebrates

Week 16	Final Examination
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S. No	Week wise Lab/Practical's Detail
Week 1	Study of the structure of gametes in fish
Week 2	Study of the structure of gametes in frog
Week 3	Study of the structure of gametes in reptiles
Week 4	Study of the structure of gametes in birds.
Week 5	Study of the structure of gametes in mammal.
Week 6	Hen's egg internal and external structural details
Week 7	Microscopic analysis of hen's egg yolk, albumin and shell membranes
Week 8	Study of cleavage and subsequent development from prepared slides and/or models in fish & frog
Week 9	Midterm Examination
Week 10	Study of cleavage and subsequent development from prepared slides and/or models in reptiles & birds
Week 11	Study of cleavage and subsequent development from prepared slides and/or models in mammals
Week 12	Study of fertilization, early development of frog/fish through induced spawning under laboratory conditions
Week 13	Study of developmental stages of nematodes through microscopic analysis of animal dung
Week 14	Semen analysis
Week 15	Dactylography and its uses in developmental biology
Week 16	Final Examination

Text and Reference Books

1. Gilbert, S. F. 2013. Developmental Biology, Sinauer Associates, Sunderland, MA.
2. Klaus, K. 2001. Biological Development. 2nd Ed., McGraw-Hill. 67
3. Scott F. Gilbert and Michael J. F. Barres. 2016. Developmental Biology. Sinauer Associates, Sunderland, MA.
4. Jamie. A. Davies. 2014. Life Unfolding: How the Human Body Creates Itself. Oxford University Press, USA
5. Balinsky, B. I. 198
6. Oppenheimer, S.S. 1984. Introduction to Embryonic Development, Allen and Bacon.
7. Saunders, J. W. 1982. Developmental Biology, McMillan and company.
8. Ham, R. G., Veomett, M. J. 1980. Mechanism of Development. C. V. Mosby Co.

ZOOL302Wildlife

Course Title : Wildlife
Course Code : ZOOL302
Offered to : Undergraduate Students at Hazara University
CrHr : 3 (2+1)
Pre-requisite : Animal diversity II

Course Objectives:

Course Objectives: The objective of this course is

- To enable the student to understand philosophy and significance of wildlife conservation
- To understand the wildlife management rules and regulations in pakistan
- To understand how National and International agencies are involved in conservation and management of wildlife

Course Learning Outcomes (CLOs)

At the end of course the students are able to:

- Acquire theoretical knowledge about the identification, distribution, status, conservation and management of amphibians, reptiles, birds and mammals of major importance in Pakistan
- Understand the protected area system (game reserves, wildlife sanctuaries and national parks)
- Solve the threats to wildlife by applying the scientific principles and modern technologies (sustainable development through local community participation).
- Analyze, interpret and synthesize data and other information about the population of wildlife
- Evaluate the conservation management by government department, national and international organizations
- Demonstrate the ecological assessment and importance of wildlife to certain area.

Course Outline

1. Wildlife of Pakistan
 - a. Introduction
 - b. Important Definitions
 - c. Identification
 - d. Distribution
 - e. Status
 - f. Conservation and Management of fishes, amphibians, reptiles, birds and mammals of major importance in Pakistan
2. Philosophy and significance of wildlife conservation
3. Biodiversity and sustainability of wildlife.
4. Wildlife rules and regulations in Pakistan
 - a. Provincial Rules
 - b. Federal Management of Wildlife (NCCW)
5. National and International agencies involved in conservation and management of wildlife

- a. National Organizations
 - b. International Organizations
- 6. Protected Areas in Pakistan
 - a. Sanctuaries
 - b. Game Reserves
 - c. National Parks
- 7. Ramsar convention
 - a. Wetlands
 - b. Ramsar Criteria
 - c. Ramsar Sites
- 8. Threatened species of Pakistan.
 - a. Vulnerable
 - b. Endangered
 - c. Critically Endangered

Teaching Methodology

- Lecturing
- Written assignments
- Guest speaker
- Field visits
- Report writing

Assessment

Marks Distribution:

Theory: Total 100 Marks (75%)

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

Practical: Total 100 Marks (25%)

- Performance/ Field visit note book/Animal distribution maps/ Collection/ Viva

Week-Wise Distribution:

Week#	Topic to be covered
Week 1	Wildlife of Pakistan a. Introduction b. Important Definitions c. Identification d. Distribution e. Status f. Conservation and Management of fishes, amphibians, reptiles, birds and mammals of major importance in Pakistan
Week 2	Classification and distribution of (Amphibians and reptiles)

Week 3	Classification and distribution of (Birds)
Week 4	Classification and distribution of (Birds)
Week 5	Classification and distribution of (Mammals)
Week 6	Classification and distribution of (Mammals)
Week 7	Philosophy and significance of wildlife conservation
Week 8	Biodiversity and sustainability of wildlife.
Week 9	Midterm Examination
Week 10	Wildlife rules and regulations in Pakistan a. Provincial Rules b. Federal Management of Wildlife (NCCW)
Week 11	National and International agencies involved in conservation and management of wildlife a. National Organizations b. International Organizations
Week 12	Protected Areas in Pakistan a. Sanctuaries b. Game Reserves
Week 13	Protected Areas in Pakistan c. National Parks
Week 14	Ramsar convention a. Wetlands b. Ramsar Criteria c. Ramsar Sites
Week 15	Threatened species of Pakistan. a. Vulnerable b. Endangered c. Critically Endangered
Week 16	Final Examination

Practical:

1. Visit to protected areas of Pakistan (Captive, Semi-captive and Wild Areas)
2. Ecological Indices
3. Animal Distribution Maps

Text and Reference Books:

1. Miller, A.S. and Harley, J.B., 1999 & 2002. Zoology, Latest Edition (International). Singapore: McGraw-Hill.
2. Ali, S.S. 2005 Wildlife of Pakistan.
3. Odum, E.P., 1994. Fundamentals of Ecology, W.B. Saunders.
4. Smith, R.L. 1980. Ecology and Field Biology, Harper and Row.
5. Roberts, T. J., 1991, 1992. The Birds of Pakistan, Vol. I1 and II. Oxford University Press
6. Roberts, T. J., 1997. The Mammals of Pakistan, Oxford University Press

7. Robinson, W.L. and Bolen, E.G., 1984. Wildlife Ecology and Management. McMillan, Cambridge.
8. Wildlife of the Punjab, Punjab Wildlife Department.
9. Khan M. S. 2011, Amphibian and Reptiles of Pakistan
10. Mirza Z.B. 2011 Biodiversity of Pakistan.

ZOOL303 Zoogeography & Paleontology

Course Title	:	Zoogeography & Paleontology
Course Code	:	ZOOL303
Offered to	:	Undergraduate Students at Hazara University
CrHr	:	3 (2+1)
Pre-requisite	:	None

Course Objective:

- Provide information on the distribution of animals and their associations in the past and to rationalize their relationship in the present time.
- Impart knowledge and concepts of evolution mainly on the basis of fossil record.
- Give understanding that fossil record also provides information about the distribution of animals in the past eras.

Course Learning Outcomes:

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

- **DESCRIBE** the zoogeographical distribution of animals and processes involved in the fossilization of animals.
- **ILLUSTRATE** the association of animals present to their past through fossils record.
- **DEVELOP** the understanding of speciation, dispersal isolation and extinction process through biogeography and fossils record.
- **ILLUSTRATE** the ability to locate, characterize and differentiate various biomes and fossils of animals over time.
- **EXPLAIN** the distribution of animals on the basis of fossils record.
- **DEVELOP** understanding regarding process of fossilization and its importance in evolutionary history of an animal and its distribution.

Course Contents:

(i) Zoogeography

- Branches of zoogeography: descriptive, chorology, faunistics, systematic, biocoenotic, causal, ecological, historical, experimental and applied zoogeography.
- Animal distribution: cosmopolitan distribution, discontinuous distribution, isolation distribution, bipolar distribution and endemic distribution, barriers and dispersal.
- Zoogeographical regions: zoogeographic division and boundaries, geographic ranges, physical features, climates, faunas and affinities of Palaearctic, Nearctic regions, Oriental, Ethiopian, Australian, and Neotropical Regions, insular fauna
- Palaeogeography: Theories of continental drift and plate tectonics; Pangea.

(ii) Paleontology

- The Planet Earth: History, age, shells of earth; atmosphere, hydrosphere, biosphere and lithosphere.
- Rocks: types; Igneous rocks, sedimentary rocks and metamorphic rocks.
- Fossil types and uses of fossils, nature of fossils.
- Fossilization: Geological time scale. Pre-Cambrian life. Post Cambrian life,
- Palaeozoic life, Mesozoic life, Cenozoic life.
- Geochronometry: Uranium/Lead dating, radiocarbon dating, methods, index fossils; evolutionary history of man, elephant, horse and camel
- Paleoecology, Paleomagnetism.

Teaching Methodology:

- Student-centered teaching through communicative approach
- 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	Course Orientation/Introduction Session, Introduction to Zoogeography, Branches of zoogeography: descriptive, chorology, faunistics, systematic, biocoenotic, causal, ecological, historical, experimental and applied zoogeography

Week 2	Animal distribution: cosmopolitan distribution, discontinuous distribution, isolation distribution, bipolar distribution and endemic distribution,
Week 3	Barriers and dispersal.
Week 4	Zoogeographical regions: zoogeographic division and boundaries, geographic ranges, physical features, climates, faunas and affinities of Palaearctic and Nearctic regions
Week 5	Zoogeographical regions: zoogeographic division and boundaries, geographic ranges, physical features, climates, faunas and affinities of Oriental and Ethiopian regions
Week 6	Zoogeographical regions: zoogeographic division and boundaries, geographic ranges, physical features, climates, faunas and affinities of Australian and Neotropical Regions.
Week 7	Palaeogeography: Theories of continental drift and plate tectonics; Pangea.
Week 8	Introduction to Paleontology, The Planet Earth: History, age, shells of earth; atmosphere, hydrosphere, biosphere and lithosphere.
Week 9	Midterm Examination
Week 10	Rocks: types; Igneous rocks, sedimentary rocks and metamorphic rocks.
Week 11	Fossilization, Fossil types and uses of fossils, nature of fossils.
Week 12	Geological time scale. Pre-Cambrian life. Post Cambrian life, Palaeozoic life, Mesozoic life, Cenozoic life.
Week 13	Geochronometry: Uranium/Lead dating, radiocarbon dating, methods, index fossils.
Week 14	Evolutionary history of man, elephant, horse and camel.
Week 15	Paleoecology, Paleomagnetism.
Week 16	Final Examination

Reference Books

Zoogeography

1. Beddard, F. E. 2008. A text book of zoogeography. Bibliobazar, LLC.
2. Tiwari, S.K. 2006. Fundamentals of world zoogeography. Wedams eBooks Ltd (India) Sarup & Sons. Delhi.
3. Ali, S.S. 1999. Palaeontology, Zoogeography and Wildlife Management. Nasim Book Depot, Hyderabad, India.
4. Darlington, P. J. Jr. 1963. Zoogeography, John Wiley and Sons.

Paleontology

1. Michael, J. B. David, A and Haper, T. 2009. Paleobiology and the fossil record. 3rd Ed. Wiley Black, UK.
2. Foote, M and Millar, A. I. 2007. Principles of paleontology. 3rd Ed. W. H. Freeman & Co. USA.
3. Ali, S.S. 1999. Palaeontology, Zoogeography and Wildlife Management. Nasim Book Depot, Hyderabad, India.
4. Brouwer, A. 1977. General Palaeontology, Oliver and Boyed, London.

ZOOL441 Mammalogy

Course Title	:	Mammalogy
Course Code	:	ZOOL441
Offered to	:	Undergraduate Students at Hazara University
CrHr	:	3 (3+0)
Pre-requisite	:	Animal diversity II

Course Objective:

The objectives of this course is

- To assess ecological and evolutionary processes which led to the diversification and diversity of mammals, identify factors for mammalian adaptations for survival in a variety of conditions,
- study mammalian classification up to orders and determine the distribution and abundance of the mammalian species with structure communities for various ecosystems.

Course Learning Outcome (CLOs)

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

- ACQUIRE the basic knowledge of the mammals in diversified ecosystems.
- UNDERSTAND the behavior of the mammals and their relationships to the natural habitats.
- SOLVE the problems in the mammalian study using scientific approaches and methods.
- ANALYZE the impacts of mammals on the ecosystem and likely impacts on economy.
- UNDERSTANDING the role played by mammalogists in the conservation and management of mammals.

Course Contents:

- Introduction, history of mammalogy; basic characteristics of mammals; diversified habitats for mammals in Pakistan and various continents.
- Mammalian phylogeny; dentition and dental formulae, cranial characteristics, evolution of mammals. Concepts of viviparity and ovoviviparity.
- Concept of biogeography; mammalian radiations, biogeography of mammals of Pakistan, occurrence, habits and varied habitats, importance to ecosystems and negative values.
- Food and feeding strategies; preferred food sources of mammals, foraging habits, diurnal and nocturnal feeding regimes of mammals; ecological constraints and mammalian adaptations.
- Concepts of Stenophagy and euryphagy.

- Population dynamics of mammals; rates of natality, mortality, immigration and emigration.
- Population modeling concepts in mammals; mammalian crowding and scuffles with respect to various environments.
- Communication and social organization; chemical signaling in mammals, types and causes of occurrence, communication skills and emergence of mammalian call notes.
- Mammalian Adaptations; concept of torpor formation, aestivation, hibernation, acoustic lateris systems in mammals, Concept of molecular basis of mammalian adaptations.
- Behavior of mammals; home range, territoriality, predation pressure, evolutionary arms races and competition for resources.

Teaching Methodology:

- Student-centered teaching through communicative approach
- Multimedia-based lectures
- Computer-facilitated lessons and strategies
- Classroom dynamics through maximization of interactive learning
- Field visits to zoological museums and zoos 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	Course orientation/Introduction, history of mammalogy
Week 2	Basic characteristics of mammals; diversified habitats for mammals in Pakistan and various continents
Week 3	Mammalian phylogeny; dentition and dental formulae, cranial characteristics

Week 4	Evolution of mammals, Concepts of viviparity and ovoviviparity.
Week 5	Concept of biogeography; mammalian radiations, biogeography of mammals of Pakistan, occurrence, habits and varied habitats, importance to ecosystems and negative values
Week 6	Food and feeding strategies; preferred food sources of mammals, foraging habits
Week 7	Diurnal and nocturnal feeding regimes of mammals; ecological constraints and mammalian adaptations
Week 8	Concepts of Stenophagy and euryphagy
Week 9	Midterm Examination
Week 10	Population dynamics of mammals; rates of natality, mortality, immigration and emigration
Week 11	Population modeling concepts in mammals; mammalian crowding and scuffles with respect to various environments.
Week 12	Communication and social organization; chemical signaling in mammals, types and causes of occurrence, communication skills and emergence of mammalian call notes.
Week 13	Social organization in mammals Play, types and functions of play
Week 14	Mammalian Adaptations; concept of torpor formation, aestivation, hibernation, acoustic laterlis systems in mammals, Concept of molecular basis of mammalian adaptations.
Week 15	Behavior of mammals; home range, territoriality, predation pressure, evolutionary arms races and competition for resources.
Week 16	Final Examination

Reference Books (latest Editions) :

25. Vaghuan, T. A., J. M. Ryan and N. J. Czaplewski. 2010. Mammalogy. 5th Ed. The John Hopkins University Press, New York, USA.
26. Feldhamer, G. A., L. C. Drickamer, S. H. Vessey, J. F. Merritt and C. Krajewski. 2007. Mammalogy: Adaptation, Diversity, Ecology. 3rd Ed. The John Hopkins University Press, New York, USA.
27. Genoways, H.H., 2000. Current Mammalogy. Plennium Press, New York.
28. Ryan, J.M., 2018. Mammalogy Techniques Lab Manual. Johns Hopkins University Press.
29. Nowak, R.M. and Walker, E.P., 1999. Walker's Mammals of the World (Vol. 1). JHU press.
30. Wilson, D.E., Wilson, D.E. and Mittermeier, R.A., 2011. Handbook of the mammals of the world, volume 2: hoofed mammals. Barcelona, Spain: Lynx Editions.

ZOOL411 ADVANCED MEDICAL PROTOZOOLOGY

Course Title	:	ADVANCED MEDICAL PROTOZOOLOGY
Course Code	:	ZOOL411
Offered to	:	Undergraduate Students at Hazara University
CrHr	:	3 (2+1)
Pre-requisite	:	Animal diversity I

Course Objective:

1. Develop and basic concept of medical important protozoa
2. Study the factors that affect geographical distribution of protozoan diseases in animals

Course Learning Outcomes:

Analyze the important classes of clinical disease parasites;

1. Identify taxonomically various medically important protozoa both in the environment and in host tissues;
2. Apply knowledge on life cycles of common disease-causing protozoan to their control;
3. analyze mechanisms of host-parasite interactions relating to the diseases caused;
4. Relate pathologic changes in tissues caused by protozoa to clinical manifestations of disease.
5. Assess factors that affect geographical distribution of protozoan diseases;
6. Evaluate the economic and public health importance of parasites;
7. Suggest preventive and management measures of diseases and other problems caused by the parasites;
8. Diagnose protozoan infections;
9. Apply principles learnt to research on protozoan infections;
10. Apply the techniques and skills learnt to identify taxonomically the vectors of protozoan pathogens.

Course Outline:

- Taxonomy, morphology and life cycles,
- biochemistry, physiology,
- ecology of protozoan parasites of human and domestic stock in the genera:
 - Entamoeba, Endolimax, Iodamoeba,
 - Dientamoeba, Acanthamoeba, Naegleria,
 - Balantidium, Trypanosoma, Leishmania,
 - Theileria, Vaccines: development,

- New approaches to vaccine development.
- Babesia, Giardia, Trichomonas,
- Plasmodium, Chilomastix, Isospora, Eimeria, Toxoplasma and Sarcocystis.

Practical:

1. Study of prepared slides for Protozoa of medical and veterinary importance
2. Preparation of permanent slides and mounts of parasitic Protozoa.
3. Analysis of human faeces and domesticated animals for the presence of protozoans by using standard laboratory techniques.
4. Preparation of blood/exudates smears and diagnosis of blood parasites by light microscopy and rapid diagnostic tests (RDTs).

Lecturing

- ☐ Written Assignments
- ☐ Field Visits
- ☐ Report Writing

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

- Quizzes - 10%
- Assignments/ Presentation or case study - 10 %
- Midterm Examination - 30%
- Final Examination - 50%
- **Practical**
- Written (Slides preparation+ Dissections) 50%
- Collection of Insects 20%
- Practical Book 20%
- Viva 10%
-

Week-Wise Distribution:

Week#	Topic to be covered
Week 1	Course Orientation/Introduction Session,
Week 2	Taxonomy of protozoa
Week 3	morphology and life cycles
Week 4	Biochemistry of protozoa
Week 5	physiology, ecology of protozoan parasites of human and domestic stock(i)
Week 6	physiology, ecology of protozoan parasites of human and domestic stock(ii)
Week 7	protozoan parasites of human and domestic stock in the genera: Entamoeba, Endolimax
Week 8	protozoan parasites of human and domestic stock in the genera: Iodamoeba, Dientamoeba

Week 9	Midterm Examination
Week 10	protozoan parasites of human and domestic stock in the genera: Acanthamoeba, Naegleria
Week 11	protozoan parasites of human and domestic stock in the genera: Balantidium, Trypanosoma
Week 12	protozoan parasites of human and domestic stock in the genera: Leishmania, Babesia, Giardia
Week 13	protozoan parasites of human and domestic stock in the genera: Trichomonas, Plasmodium,
Week 14	protozoan parasites of human and domestic stock in the genera: Chilomastix, Isospora, Eimeria,
Week 15	protozoan parasites of human and domestic stock in the genera: Toxoplasma and Sarcocystis.
Week 16	Final Examination

Reference Books (latest Editions) :

1. Foundations of Parasitology by L.S. Roberts and J. J. Janory
Animal Parasitology by J.D Smith
2. Microbiology and Microbial infections 10th Edition by Topley and Wilson
General Parasitology by T.C. Cheng
3. Medical Parasitology by K.J. Ryan and C.G. Ray Eds : An introduction to infectious diseases 4thEdn. McGraw, US

ZOOL429 ADVANCED MEDICAL HELMINTHOLOGY

Course Title	:	Advanced Medical Helminthology
Course Code	:	ZOOL429
Offered to	:	Undergraduate Students at Hazara University
CrHr	:	3 (2+1)
Pre-requisite	:	Animal diversity I

Course Objective:

3. To equip students with advanced knowledge on biology, host-parasite interactions and diseases of helminthes, particularly,
4. Nematodes, Trematodes and Cestodes which cause diseases in humans and animals in different parts of the world or are of economic importance.

Course Learning Outcomes:

Analyze the important classes of clinical disease parasites;

1. Identify taxonomically various medically important helminthes of the Phyla; Platyhelminthe and Nematoda.
2. Apply knowledge on life cycles of helminthes to their control;
3. Analyze mechanisms of host-parasite interactions of helminthes relating to the diseases caused;
4. Relate pathologic changes in tissues caused to clinical manifestations of disease;
5. Assess factors that affect geographical distribution of helminthes parasites;
6. Evaluate the economic and public health importance of helminthes parasites;
7. Suggest preventive and management measures of diseases and other problems caused by the helminthes;
8. Diagnose helminthic infections;
9. Apply principles learnt to research on helminthic parasites;
10. Apply the techniques and skills learnt to identify taxonomically the vectors of helminthic parasites.

Course Outline:

- Taxonomy,
- morphology and life cycles, biochemistry,
- ecology and physiology of helminthic parasites of humans and domestic animals.
- Pathology and diseases, treatment and control. Genera: Taenia, Echinococcus, Hymenolepis,
- Dipylidium, Diphylobothrium,
- Moniezia, Stilesia, Schistosoma, Clonorchis, Opisthorchis,

- Heterophyes, Metagonimus, Fasciolopsis, Fasciola. Intestinal nematodes. Blood and tissue nematodes.

Practical:

5. Study of prepared slides for Protozoa of medical and veterinary importance
6. Preparation of permanent slides and mounts of parasitic Protozoa.
7. Analysis of human faeces and domesticated animals for the presence of protozoans by using standard laboratory techniques.
8. Preparation of blood/exudates smears and diagnosis of blood parasites by light microscopy and rapid diagnostic tests (RDTs).

Lecturing

- ☐ Written Assignments
- ☐ Field Visits
- ☐ Report Writing

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

- Quizzes - 10%
- Assignments/ Presentation or case study - 10 %
- Midterm Examination - 30%
- Final Examination - 50%
- **Practical**
- Written (Slides preparation+ Dissections) 50%
- Collection of Insects 20%
- Practical Book 20%
- Viva 10%
-

Week-Wise Distribution:

Week#	Topic to be covered
Week 1	Course Orientation/Introduction Session,
Week 2	Taxonomy of helminths
Week 3	morphology and life cycles of helminths
Week 4	Biochemistry of helminths
Week 5	biochemistry, ecology and physiology of helminthic parasites of humans and domestic animals (i)
Week 6	biochemistry, ecology and physiology of helminthic parasites of humans and domestic animals (ii)
Week 7	Pathology and diseases, treatment and control (i)
Week 8	Pathology and diseases, treatment and control (ii)

Week 9	Midterm Examination
Week 10	Genera: Taenia, Echinococcus, Hymenolepis
Week 11	Genera: Dipylidium, Diphylobothrium, Moniezia,
Week 12	Genera: Stilesia, Schistosoma, Clonorchis, Opisthorchis
Week 13	Genera: Heterophyes, Metagonimus
Week 14	Genera: Fasciolopsis, Fasciola.
Week 15	Intestinal nematodes and Blood and tissue nematodes.
Week 16	Final Examination

Reference Books (latest Editions) :

4. Manson's tropical diseases. By Farrar, Jeremy, -- editor. | Manson, Patrick, -- Sir, -- 1844-1922. --Tropical diseases.Edition statement:23rd edition .
5. Foundations of Parasitology by L.S. Roberts and J. J. Janory Parasitology Publication: London Hodder Arnold 2005 . 889 p.:ill.Availability: Items available: Main Campus Health Sciences [QR 251 .P3 2005] (1),
6. Parasitology by Marquardt, William C.Publication: New York Macmillan 1985 . 636p.
7. Animal Parasitology by J.D Smith
8. Medical Parasitology by K.J. Ryan and C.G. Ray Eds : An introduction to infectious diseases 4thEdn. McGraw, US

ZOOL431 Endocrinology

Course Title : Endocrinology
Course Code : ZOOL431
Offered to : undergraduate Students at Hazara University
CrHr : 3 (2+1)
Pre-requisite : Animal form and function I and II

Course Objectives:

- To discuss the definition of hormone in terms of its general properties.
- To differentiate among endocrine, paracrine and autocrine system.
- To describe different classes and chemical structure of hormone.
- To explain the roles of the endocrine system in maintain homeostasis, integrating growth and development, responding to environmental insult and promote successful reproduction.
- To identify the glands, organs, tissues and cell that synthesize and secrete hormones, hormone precursors and associated compounds.
- To describe synthesis and mode of secretion of hormone, regulation of hormone secretion of hormone, including the principles of negative and positive feedback mechanism.
- To explain the importance of patterns of hormone secretion such as pulsatile, diurnal, cyclic and how hormones are transported in the blood and consequences of reversible binding of many hormones by plasma proteins
- To explain the basis of hormone assays and assessment of biological activity
- To discuss the metabolism, clearance and excretion of hormones and their metabolic derivatives
- To define and discuss the physiological actions of hormone relating them whenever possible to human disorders
- To explain the consequences of under and overproduction of hormones to determine the pathophysiological basis and consequences of specific endocrine disorders.
- To compare and contrast the different mechanism of action of hormones: i.e. those exerted by modulation of gene expression, those activated by changes in protein activity.

Course Learning Outcomes (CLOs)

At the end of course the students are able to:

- 1. Explain the roles of the endocrine system in maintain homeostasis, integrating growth and development, responding to environmental insult and promote successful reproduction.
- 2. Discuss the definition of hormone in terms of its general properties.
- 3. Differentiate among endocrine, paracrine and autocrine system.
- 4. Describe different classes and chemical structure of hormone.
- 5. Identify the glands, organs, tissues and cell that synthesize and secrete hormones, hormone precursors and associated compounds.
- 6. Describe synthesis and mode of secretion of hormone.
- 7. Explain how the secretion of hormone is regulated, including the principles of negative and positive feedback mechanism.

- 8. Explain the importance of patterns of hormone secretion such as pulsatile, diurnal and cyclic.
- 9. Explain how hormones are transported in the blood and consequences of reversible binding of many hormones by plasma proteins
- 10. Explain the basis of hormone assays and assessment of biological activity
- 11. Describe how hormones are metabolism, clearance and excretion of hormones and their metabolic derivatives.
- 12. Explain the consequences of under and overproduction of hormones to determine the pathophysiological basis and consequences of specific endocrine disorders.
- 13. Compare and contrast the different mechanism of action of hormones: i.e. those exerted by modulation of gene expression, those activated by changes in protein activity.
- 14. Evaluate and assess scientific literature about endocrine function and pathology

INTRODUCTION:

Course Contents

1. An overview of general concepts and principles of endocrinology:
 - a. The endocrine system; Type of hormones; Endocrine and nervous system relationship;
 - b. General principles in function, interaction, nature, synthesis, transport of hormones;
 - c. General concept of feedback, biorhythms, pathology and assessment of endocrine function;
2. Hypothalamus and pituitary:
 - a. Hypothalamic hormones: Origin, chemistry and actions and mechanism of action;
 - b. Anterior pituitary & hormones: Hypothalamic pituitary regulation,
 - c. General chemistry, Physiological action, mechanism of action and metabolism of prolactin-growth hormone family,
 - d. glycoprotein hormone family, corticotrophins and other proopiomelanocortin peptides; e. posterior pituitary: Release, regulation and actions of vasopressin and oxytocin.
 - f. Causes and effect of over and under production of hypothalamic and pituitary hormones
 - g. Hypothalamic, pituitary and thyroid, adrenocortical, gonadal and other axis.
3. Thyroid gland:
 - a. Anatomy and histology of gland; Formation and secretion of thyroid hormones; Thyroid hormones in peripheral tissues, Function of thyroid hormone,
 - b. Mechanism of action; regulation and factors affecting thyroid function.
 - c. Causes and effect of Hypothyroidism and hyperthyroidism
4. Calcitrophic and Mineral Metabolism Hormones:
 - a. Chemistry, physiological actions, mechanism of action and
 - b. metabolism of parathyroid hormone,
 - c. Causes and effect of over and under production of hormone
 - d. Calcitonin and calciferols; action and mechanism of action
 - e. Homeostasis of calcium, phosphate and magnesium.
5. Pancreatic Hormones and Regulatory Peptides of the Gut:
 - a. Anatomy and histology for sources of the hormones; Chemistry,
 - b. Physiological roles and mechanism of action of insulin and glucagon;
 - c. Physiological roles of gut peptides.
 - d. Causes and effect of over and under secretion of pancreatic hormones

- e. Glucose homeostasis
- 6. Adrenal Medulla and Catecholamines:
 - a. Chromaffin cell and organization; Structure of adrenal medulla;
 - b. Biosynthesis, storage, release and metabolism;
 - c. Adrenergic receptors and mechanism of action;
 - d. Disorder of Adrenal medulla (pheochromocytoma)
- 7. Adrenal Cortex:
 - a. Anatomy and Steroid biochemistry;
 - b. Physiological actions of corticoid hormones and mechanism of action;
 - c. Regulation and metabolism of glucocorticoids,
 - d. Mineralocorticoids and adrenal sex steroids.
 - e. Disorder of adrenal cortex hormones
- 8. Testes: Androgenic tissue:
 - a. Anatomy, structure, chemistry, synthesis and transport of hormone,
 - b. Metabolism, action and mechanism of action.
 - c. Testicular disorder
- 9. Ovaries:
 - a. Ovarian Anatomy, hormones: Steroid biochemistry and biosynthesis;
 - b. Transport, metabolism, action and mechanism of action.
 - c. Cyclic changes, menopause
 - d. Ovarian disorder
- 10. Endocrinology of Pregnancy:
 - a. Hormones in conception and implantation;
 - b. Hormonal actions and
 - c. Adaptation in pregnancy and parturition.
- 11. Fetus Endocrinology
 - a. Endocrinology of developing fetus
- 12. Endocrinology of Lactation:
 - a. Hormones in lactation.
- 13. Endocrinology of development of growth
 - a. Growth and Puberty
 - b. Disorders of growth and puberty
- 14. Endocrinology of
 - a. Growth and pineal gland.
- 15. Functional diversity of vertebrate hormones
 - a. Functional diversity of hormones in different vertebrates
- 16. Overview of Endocrine Mechanisms in Invertebrates
 - a. Hormones of invertebrates

S. No	Lab/Practicals Detail
Lab 1	Demonstration of endocrine glands and associated structures in dissections, transparencies, computer projections etc;

Lab 2	Histological and ultrastructure features of endocrine glands;
Lab 3	Experiments to demonstrate physiological roles of hormones of different endocrine glands;
Lab 4	Experiments to demonstrate regulation of hormones' releases
Lab 5	Experiments to demonstrate functional diversity of hormones in different vertebrates
Lab 6	Experiments on endocrine mechanism in vertebrates.
Lab 7	Experiment on recognition and response of receptors
Lab 8	Studies of disorders of pituitary by observing anatomical and histological features
	Midterm Examination
Lab 9	Studies of thyroid status in deficient and excess hormone functions
Lab 10	Studies of type 1 and type 2 diabetes mellitus: Epidemiology of the types in population, studies of management of the type 2
Lab 11	Model studies of Ovarian and Testicular disorders
Lab 12	Model studies of obesity and anorexia;
Lab 13	Studies of hormonal status in puberty
Lab 14	Studies of hormonal status in aging.
	Final Examination

Teaching Methodology:

- Lecturing
- Written Assignments
- Guest Speaker
- Research project
- Presentation

Marks Distribution:

Theory: Total 100 Marks (75%)

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

Lab Task: Total 100 Marks (25%)

- Performance/ Practical note book/ Collection/ Viva

Week-Wise Distribution:

Week#	Topic to be covered
Week 1	1. An overview of general concepts and principles of endocrinology: a. The endocrine system; Type of hormones; Endocrine and nervous system relationship; b. General principles in function, interaction, nature, synthesis, transport of hormones; c. General concept of feedback, biorhythms, pathology and assessment of endocrine function;
Week 2	2. Hypothalamus and pituitary: a. Hypothalamic hormones: Origin, chemistry and actions and mechanism of action; b. Anterior pituitary & hormones: Hypothalamic pituitary regulation, c. General chemistry, Physiological action, mechanism of action and metabolism of prolactin-growth hormone family, d. glycoprotein hormone family, corticotrophins and other proopiomelanocortin peptides; e. posterior pituitary: Release, regulation and actions of vasopressin and oxytocin. f. Causes and effect of over and under production of hypothalamic and pituitary hormones g. Hypothalamic, pituitary and thyroid, adrenocortical, gonadal and other axis.
Week 3	3. Thyroid gland: a. Anatomy and histology of gland; Formation and secretion of thyroid hormones; Thyroid hormones in peripheral tissues, Function of thyroid hormone, b. Mechanism of action; regulation and factors affecting thyroid function. c. Causes and effect of Hypothyroidism and hyperthyroidism
Week 4	4. Calcitropic and Mineral Metabolism Hormones: a. Chemistry, physiological actions, mechanism of action and b. metabolism of parathyroid hormone, c. Causes and effect of over and under production of hormone d. Calcitonin and calciferols; action and mechanism of action e. Homeostasis of calcium, phosphate and magnesium.
Week 5	5. Pancreatic Hormones and Regulatory Peptides of the Gut: a. Anatomy and histology for sources of the hormones; Chemistry, b. Physiological roles and mechanism of action of insulin and glucagon; c. Physiological roles of gut peptides. d. Causes and effect of over and under secretion of pancreatic hormones e. Glucose homeostasis
Week 6	6. Adrenal Medulla and Catecholamines: a. Chromaffin cell and organization; Structure of adrenal medulla; b. Biosynthesis, storage, release and metabolism;

	c. Adrenergic receptors and mechanism of action; d. Disorder of Adrenal medulla (pheochromocytoma)
Week 7	. Adrenal Cortex: a. Anatomy and Steroid biochemistry; b. Physiological actions of corticoid hormones and mechanism of action; c. Regulation and metabolism of glucocorticoids, d. Mineralocorticoids and adrenal sex steroids. e. Disorder of adrenal cortex hormones
Week 8	. Testes: Androgenic tissue: a. Anatomy, structure, chemistry, synthesis and transport of hormone, b. Metabolism, action and mechanism of action. c. Testicular disorder
Week 9	Midterm Examination
Week 10	9. Ovaries: a. Ovarian Anatomy, hormones: Steroid biochemistry and biosynthesis; b. Transport, metabolism, action and mechanism of action. c. Cyclic changes, menopause d. Ovarian disorder
Week 11	10. Endocrinology of Pregnancy: a. Hormones in conception and implantation; b. Hormonal actions and c. Adaptation in pregnancy and parturition.
Week 12	11. Fetus Endocrinology a. Endocrinology of developing fetus
Week 13	12. Endocrinology of Lactation: a. Hormones in lactation.
Week 14	Endocrinology of development of growth a. Growth and Puberty b. Disorders of growth and puberty c. Growth and pineal gland.
Week 15	Functional diversity of hormones in different vertebrates Hormones of invertebrates
Week 16	Final Examination

S. No	Week wise Lab/Practicals Detail
Week 1	Demonstration of endocrine glands and associated structures in dissections, transparencies, computer projections etc;
Week 2	Histological and ultrastructure features of endocrine glands;

Week 3	Experiments to demonstrate physiological roles of hormones of different endocrine glands;
Week 4	Experiments to demonstrate regulation of hormones' releases
Week 5	Experiments to demonstrate functional diversity of hormones in different vertebrates
Week 6	Experiments on endocrine mechanism in vertebrates.
Week 7	Experiment on recognition and response of receptors
Week 8	Studies of disorders of pituitary by observing anatomical and histological features
Week 9	Midterm Examination
Week 10	Studies of thyroid status in deficient and excess hormone functions
Week 11	Studies of type 1 and type 2 diabetes mellitus: Epidemiology of the types in population, studies of management of the type 2
Week 12	Model studies of Ovarian and Testicular disorders
Week 13	Model studies of obesity and anorexia;
Week 14	Studies of hormonal status in puberty
Week 15	Studies of hormonal status in aging.
Week 16	Final Examination

Text Books:

1. Greenspan, F.S. and Stewler, G.J., 2011. Basic and clinical endocrinology, 9th Edition. Prentice Hall International Inc., London.
2. Bentley, P.J., 1998. Comparative Vertebrate Endocrinology. 3rd Ed. Cambridge University Press, Cambridge.
3. Sam A., Meeran K. Endocrinology and Diabetes. Lecture notes. WileyBlackwell (2009) (basic science and clinical context).
4. Laycock J, Meeran K. Integrative Endocrinology. Wiley-Blackwell (2013).
5. Rang H, Dale M and Ritter, J: Pharmacology, 4th ed., (1999). (relevant for drug information) 2nd Edition. The Oxford Textbook of Endocrinology and Diabetes DOI: 10.1093/med/9780199235292.003.0134
6. Yen & Jaffe's Reproductive Endocrinology: Physiology, Pathophysiology, and Clinical Management. Saunders – all editions are excellent (even the older editions)
7. Johnson MH. Essential Reproduction. 7th Ed. Wiley-Blackwell (2013) (relevant for some general background info on reproduction pitched for undergraduate students).

8. Chandra S. Negi, introduction to endocrinology
9. Charles Brook, Nicholas Marshall, essential endocrinology
10. Noris, vertebrate endocrinology

Additional Readings:

1. Wilson, J.D., Foster, D.W., Kronenberg, H.M. and Larsen, P.R., 1998. Williams textbook of endocrinology, 9th Edition. W.D. Saunders Company, Philadelphia.
2. DeDroot, L.J., Jameson, J.L. et al., 2012 Endocrinology, Vol.I, II & III, th Edition. W.B. Saunders, Philadelphia.
3. Giffin, J.E. and Ojeda, S.R., 2000. 4th Edition. Textbook of Endocrine Physiology. Oxford University Press, Oxford.
4. Neal, J.M., 2000. Basic Endocrinology: An interactive approach. Blackwell Science Inc., London.

ZOOL 425 Integrated Pest Management

Course Title	:	INTEGRATED PEST MANAGEMENT
Course Code	:	ZOOL 425
Offered to	:	Undergraduate Students at Hazara University
CrHr	:	3 (2+1)
Pre-requisite	:	None

Course Objective:

The objectives of the course are:-

1. Acquire knowledge of insect pests of crops, vegetables, fruits, stored grains and household pests.
2. Identification of insect pests, their control methods and pesticide application equipments.
3. Introduction with entomological cottage industries

Course Learning Outcomes:

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

1. ACQUIRE the basic knowledge about pest of economic importance.
2. UNDERSTAND the relationship of various crops and pest population.
3. SOLVE the problems using integrated pest management.
4. ANALYZE the problems of pesticides resistance mechanism.
5. EVALUATE the problems using practical knowledge in Entomology.
6. DEMONSTRATE methods to enhance the productivity of agricultural crops through insect pest management.

Course Outline:

- Introduction;
- causes of success and economic importance of insects;
- principles and methods of insect control i.e. cultural, biological,
- physical, mechanical, reproductive, legislative, chemical and bio-technological control; introduction to IPM;
- insecticides, their classification,
- formulations and application equipments; identification,
- life histories, mode of damage and control of important insect pests of various crops,
- fruits, vegetables, stored grains,

- household, termites and locust; introduction to entomological industries: apiculture, sericulture and lac-culture.

Practical:

1. Collection, identification and mode of damage of insect pests of various crops,

Fruits

Vegetables,

Stored grains and household

2. Insecticide formulations, their dilutions and safe handling;

3. Use of application equipments, instructions for apiculture, sericulture and lac-culture.

Teaching Methodology:

- ☐ Lecturing
- ☐ Written Assignments
- ☐ Guest Speaker
- ☐ Field Visits
- ☐ Report Writing

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

- Quizzes - 10%
- Assignments/ Presentation or case study - 10 %
- Midterm Examination - 30%
- Final Examination - 50%
- **Practical**
- Written (Slides preparation+ Dissections) 50%
- Collection of Insects 20%
- Practical Book 20%
- Viva 10%
-

Week-Wise Distribution:

Week#	Topic to be covered
Week 1	Course Orientation/Introduction Session, Introduction to Integrated pest Management, causes of success and economic importance of insects.
	Practical: Collection, identification and mode of damage of insect pests of various crops, Fruits, Vegetables, Stored grains and household (i)
Week 2	principles and methods of insect control
	Practical: Collection, identification and mode of damage of insect pests of various crops, Fruits, Vegetables, Stored grains and household (ii)
Week 3	Methods of insect control i.e. cultural,
	Practical: Collection, identification and mode of damage of insect pests of various crops, Fruits, Vegetables, Stored grains and household (iii)
Week 4	Methods of insect control i.e. Biological
	Practical: Collection, identification and mode of damage of insect pests of various crops, Fruits, Vegetables, Stored grains and household (iv)
Week 5	Methods of insect control i.e. Physical
	Practical: Collection, identification and mode of damage of insect pests of various crops, Fruits, Vegetables, Stored grains and household (v)
Week 6	Methods of insect control i.e. Mechanical and Reproductive
	Practical: Collection, identification and mode of damage of insect pests of various crops, Fruits, Vegetables, Stored grains and household (vi)
Week 7	Methods of insect control i.e. Legislative and Chemicals
	Practical: Collection, identification and mode of damage of insect pests of various crops, Fruits, Vegetables, Stored grains and household (vii)

Week 8	Methods of insect control i.e. Bio-technological control
	Practical: Collection, identification and mode of damage of insect pests of various crops, Fruits, Vegetables, Stored grains and household (viii)
Week 9	Midterm Examination
Week 10	introduction to IPM; insecticides their classification, formulations and application equipment's
	Practical: 1. Collection, identification and mode of damage of insect pests of various crops, Fruits, Vegetables, Stored grains and household (ix).
Week 11	Identification, life histories, mode of damage of insects pest
	Practical: Insecticide formulations, their dilutions and safe handling (i).
Week 12	Control of important insect pests of various crops, fruits and vegetables,
Week 13	Control of important insect pests of stored grains
	Practical: Insecticide formulations, their dilutions and safe handling (ii).
Week 14	Control of household insects
	Practical: Insecticide formulations, their dilutions and safe handling (iii).
Week 15	Control of termites and locust.
	Practical: Insecticide formulations, their dilutions and safe handling (iv) .
Week 16	Final Examination

Reference Books (latest Editions) :

31. Atwal, A.S. 2005. Agricultural Pests of Southeast Asia and their Management. Kalyani Publishers, Ludhiana.
32. 2. Awastheir, V.B. 2009. Introduction to General and Applied Entomology. Scientific Publisher, Jodhpur, India. 13
33. 3. Duncton, P.A. 2007. The Insect: Beneficial and Harmful Aspects. Kalyani Publishers Ludhiana.
34. 4. Gullan, P. J. and Cranstan, P. S. 2010. The Insects: An Outline of Entomology. 4th edition. Wiley-Blackwell. A John Wiley & Sons, Ltd., Publication, UK.
35. 5. Lohar, M. K. 2001. Applied Entomology, 2nd Ed. Department of Entomology, Sindh Agriculture University Tandojam Sindh, Pakistan.

36. 6. Mathews, G.A. 2004. Pesticide Application Methods, 3 rd. Ed. John Wiley & Sons, Inc. N.Y. 7. Pedigo, L.P. and Marlin, E. R. 2009. Entomology and Pest Management, 6 th Edition, Person Education Inc., Upper Saddle River, New Jersey 07458, U.S.A.
37. 7. Pfadt, E.R. 1985. Fundamentals of Applied Entomology, 4 th Ed. The McMillan Co., N. Y.
38. 8. Robinson, D.H. 2006. Entomology Principles and Practices. Agro-bios.
39. 9. Shah, H.A. and Saleem, M.A. 2002, Applied Entomology, 3rd Ed. Izhar Sons Printers, Lahore.
40. 10. Srivastava, K.P. 2005. Text Book of Applied Entomology. Kalyani Publishers, New Delhi. 12. Romoser, W. S. and Stoffolano, J. G. 1998, The Science of Entomology, WCB McGraw-Hill.

ZOOL433 Insect Ecology

Course Title	:	INSECT ECOLOGY
Course Code	:	ZOOL433
Offered to	:	Undergraduate Students at Hazara University
CrHr	:	3 (2+1)
Pre-requisite	:	None

Course Objective:

5. Develop and basic concept of insect ecology
6. Study the interaction of insects with various ecosystems

Course Learning Outcomes:

The students should be well versed with the basic concepts of insect ecology, succession, population, ecosystem and insect-ecosystem interactions

Course Outline:

- Overview of insect ecology;
- divisions of ecology; habitat and niche;
- intra and interspecific interactions;
- natural and agro-ecosystems; flow of energy in ecosystem;
- trophic relations: food chain, food web and food mesh concepts;
- ecological succession; population and its characteristics like natality,
- mortality, migration, dispersal, key factors,
- density dependent and density independent factors,
- Introduction to life tables and diversity indices.

Practical:

9. Maintenance and measurement of a biotic factors (temperature, humidity, light, wind etc) with different instruments
10. population sampling, estimation and
11. construction of life tables.

Lecturing

- ☐ Written Assignments
- ☐ Field Visits
- ☐ Report Writing

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

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

- Midterm Examination - 30%
- Final Examination - 50%
- **Practical**
- Written (Slides preparation+ Dissections) 50%
- Collection of Insects 20%
- Practical Book 20%
- Viva 10%
-

Week-Wise Distribution:

Week#	Topic to be covered
Week 1	Course Orientation/Introduction Session,
Week 2	Overview of insect ecology (i)
Week 3	Overview of insect ecology (ii)
Week 4	divisions of ecology
Week 5	habitat and niche;
Week 6	intra and interspecific interactions;
Week 7	natural and agro-ecosystems;
Week 8	flow of energy in ecosystem; trophic relations:
Week 9	Midterm Examination
Week 10	food chain, food web and food mesh concepts;
Week 11	ecological succession
Week 12	population and its characteristics like natality, mortality, migration
Week 13	dispersal, key factors
Week 14	density dependent and density independent factors,
Week 15	introduction to life tables and diversity indices.
Week 16	Final Examination

Reference Books (latest Editions) :

9. Bourtzis, K. and Miller, T. 2003. Insects Symbiosis. CRC Press.
10. Huffaker, C.B. and Robert, L.R. 1984. Ecological Entomology. Wiley Intersciences.
- Odum, E. P. and Gary W.B. 2005. Fundamentals of Ecology. Thomson Brooks/Cole 10 Davis Drive Belmont, CA 94002 USA
11. Price, P. W., Denno, R.F. Eubanks, M.D. Finke, D.L. and Kaplan, I. 2011. Insect Ecology: Behaviour, Populations and Communities, Cambridge University Press, Cambridge, UK, 801 pages.
12. Rockwood, L.L. 2006. Introduction to Population Ecology. Wiley, John & Sons.
13. Romser, W.S. and Stoffolano, J. G. 1998. The Science of Entomology. 4th Edition, WCB McGraw-Hill.
14. Schowalter, T.D. 2006 Insect Ecology: An Ecosystem approach. 2nd Ed. Press is an imprint of Elsevier.
15. Southwood, T.R.E. and Henderson, P.A. 2000. Ecological Methods. 3rd Ed. Blackwell Science.
16. Symondson, W.O.C. and Liddell, J.E. 1996. The Ecology of Agricultural Pests, Biochemical Approaches. Chapman and Hall, London, UK
17. Vandermeer, J.H. and Goldberg, D.E. 2003. Population Ecology: First Principles, Princeton University Press.
18. Yazdani, S.S. and Agarwal, M.I. 1997. Elements of Insect Ecology. Narosa Publishing House, New Delhi.

ZOOL427 Wildlife Parasitology

Course Title	:	Wildlife Parasitology
Course Code	:	ZOOL427
Offered to	:	Undergraduate Students at Hazara University
Cr Hr	:	3(3+0)
Pre-requisite	:	None

Course Objective:

The objectives of the course are:-

- Provide knowledge regarding different modes of transmission of wildlife parasites along with their pathology, life cycles and host parasite relationship
- Impart advance knowledge on various important wildlife parasites
- Give understanding about host parasite relationship and control measure.

Course Learning Outcome (CLOs)

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

- Acquire knowledge regarding different modes of transmission of wildlife parasites along with their pathology, life cycles and host parasite relationship
- Examine about host parasite relationship and control measure

Course Contents:

- An overview of Wildlife in Pakistan
- Parasites of wild animals and birds
- Role of wild animals and birds in dissemination of parasitic disease of domestic animals and man
- Pathogenesis
- Diagnosis and control of ecto and endo-parasites of wild animals and birds.

Teaching Methodology:

- Student-centered teaching through communicative approach
- 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, Introduction to Wildlife parasitology.
Week 2	An overview of Wildlife in Pakistan
Week 3	Parasites of wild animals
Week 4	Parasites of wild birds
Week 5	Role of wild animals in dissemination of parasitic disease of domestic animals
Week 6	Role of wild animals in dissemination of parasitic disease of man
Week 7	Role of wild birds in dissemination of parasitic disease of man
Week 8	Role of wild birds in dissemination of parasitic disease of domestic animals
Week 9	Midterm Examination
Week 10	Pathogenesis
Week 11	Continue
Week 12	Diagnosis and control of ecto-parasites of wild animals
Week 13	Diagnosis and control of ecto-parasites of wild birds

Week 14	Diagnosis and control of endo-parasites of wild animals
Week 15	Diagnosis and control of endo-parasites of wild birds
Week 16	Final Examination

Reference Books (latest Editions):

- Fowler, M.E., 1990. Zoo and Wild Animal Medicine Current Therapy Saunders, W.B. Company, Philadelphia, USA.
- Levine, N.D., 1990. Veterinary Protozoology. The Iowa State University press. Ames, Iowa, USA.
- Soulsby, E.J.L., 1986 Helminths. Arthropods. And Protozoa of Domesticated Animals. 7th Ed. Bailliere and Tindall, London.
- Davis, J.W. and R.C. Anderson. 1971. Parasitic Disease of wild Mammals, The Iowa State University Press, Ames, USA.

ZOOL438 Vector Biology

Course Title : Vector Biology
 Course Code : ZOOL438
 Offered to : Undergraduate Students at Hazara University
 CrHr : 3 (3+0)
 Pre-requisite : ZOOL355, ZOOL363, ZOOL364, ZOOL471

Course Objective:

The objective of this course is

- to give the students an overview of the insect vectors that pose the greatest threats to human health, learn about their basic ecology and behavior,
- the pathogens they transmit, the diseases caused by those pathogens, and the fascinating biology behind these vector-pathogen-host interactions, learn also about current methods being implemented around the globe to control vector borne disease transmission.

Course Learning Outcome (CLOs)

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

- Describe the basic biology (life cycle, reproduction, host-seeking behavior) of major insect vectors and pests.
- Describe the major diseases caused by vector borne pathogens.
- Explain major concepts in vector biology including vector competence, extrinsic/intrinsic incubation period, entomological inoculation rate and vectorial capacity.
- Explain the transmission cycles of pathogens vectored by major arthropod vectors including mosquitoes and ticks.
- Explain the role of ecology and environmental factors (including climate change) on vector borne disease transmission.
- Explain and discuss the main findings and implications from scientific publications in the field of public health entomology.
- Infer probable effects of vector control methods on vector borne disease transmission rates.

Course Contents:

- Introduction, history of mammalogy; basic characteristics of mammals; diversified habitats for mammals in Pakistan and various continents.
- Mammalian phylogeny; dentition and dental formulae, cranial characteristics, evolution of mammals. Concepts of viviparity and ovoviviparity.
- Concept of biogeography; mammalian radiations, biogeography of mammals of Pakistan, occurrence, habits and varied habitats, importance to ecosystems and negative values.
- Food and feeding strategies; preferred food sources of mammals, foraging habits, diurnal and nocturnal feeding regimes of mammals; ecological constraints and mammalian adaptations.
- Concepts of Stenophagy and euryphagy.
- Population dynamics of mammals; rates of natality, mortality, immigration and emigration.
- Population modeling concepts in mammals; mammalian crowding and scuffles with respect to various environments.
- Communication and social organization; chemical signaling in mammals, types and causes of occurrence, communication skills and emergence of mammalian call notes.
- Mammalian Adaptations; concept of torpor formation, aestivation, hibernation, acoustic lateralis systems in mammals, Concept of molecular basis of mammalian adaptations.
- Behavior of mammals; home range, territoriality, predation pressure, evolutionary arms races and competition for resources.

Teaching Methodology:

- Student-centered teaching through communicative approach
- Multimedia-based lectures

- Computer-facilitated lessons and strategies
- Classroom dynamics through maximization of interactive learning
- Field visits to zoological museums and zoos 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	Course orientation/Introduction to mosquitoes (Culicidae), External morphology, Life cycle, Classification of mosquitoes, medical importance, Mosquito control
Week 2	Black flies (Simuliidae), External morphology, Life cycle, Medical importance, Control
Week 3	Phlebotomine sand flies (Phlebotominae), External morphology, Life cycle, medical importance, Control
Week 4	Biting midges, External morphology, Life cycle, medical importance, Control
Week 5	Horse Flies (Tabanidae), Tse tse flies (Glossinidae) External morphology, Life cycle, medical importance, Control
Week 6	House flies and stable flies (Muscidae) and latrine flies (Fanniidae), the common house fly (<i>Musca domestica</i>), the greater house fly (<i>Muscina stabulans</i>), the stable fly (<i>Stomoxys calcitrans</i>), the lesser or little house fly and the latrine fly (<i>Fannia</i> species)
Week 7	Flies and myiasis, Types of myiasis, Classification, Calliphoridae: non-metallic flies, Calliphoridae: metallic flies, Sarcophagidae: flesh flies, Oestridae: bot flies, Other myiasis-producing flies
Week 8	Fleas (Siphonaptera), External morphology, Life cycle, Medical importance, Tunga penetrans, Control of fleas Sucking lice (Anoplura), The body louse (<i>Pediculus humanus</i>), The head louse (<i>Pediculus capitis</i>), The pubic louse (<i>Phthirus pubis</i>)
Week 9	Midterm Examination
Week 10	Bedbugs (Cimicidae), External morphology, Life cycle, Medical importance, Control Triatomine bugs (Triatominae), External morphology, Life cycle, Medical importance, Control

Week 11	Cockroaches (Blattaria), External morphology, Life cycle, Medical importance, Control Soft ticks (Argasidae), External morphology, Internal anatomy, Life cycle 229 Medical importance, Control
Week 12	Hard ticks (Ixodidae), External morphology, Life cycle, Behaviour and habits, Medical importance and Control
Week 13	Scabies mites (Sarcoptidae), External morphology, Life cycle, Recognition of scabies, Treatment of scabies
Week 14	Scrub typhus mites (Trombiculidae), External morphology, Life cycle, Ecology, Medical importance and Control
Week 15	Demodicidae: follicle mites (Demodex species), Pyroglyphidae: house-dust mites, (Dermatophagoides and Euroglyphus species), Life cycle, Ecology, Medical Importance and Control
Week 16	Final Examination

Reference Books (latest Editions) :

41. Marquardt, W.H. ed., 2004. Biology of disease vectors. Elsevier.
42. Eldridge, B.F. and Edman, J.D. eds., 2012. Medical entomology: a textbook on public health and veterinary problems caused by arthropods. Springer Science & Business Media.
43. Ree, H.I., 2005. Medical entomology.
44. Ryan, J.M., 2018. Mammalogy Techniques Lab Manual. Johns Hopkins University Press.
45. Patton, W.S. and Cragg, F.W., 1913. A textbook of medical entomology. Christian literature society for India.
46. Ward, R.D., 2008. Service MW: Medical entomology for students.

ZOOL429 Pathology

Course Title	:	Pathology
Course Code	:	ZOOL-429
Offered to	:	Undergraduate Students at Hazara University
Cr Hr	:	3 (2+1)
Pre-requisite	:	None

Course Objective:

The objectives of the course are:-

- To provide knowledge about insect vectors, disease borne pests of veterinary and human importance
- To understand their life cycles as they carry viruses and other organisms during transmission of diseases.
- To impart knowledge about their control.

Course Learning Outcome (CLOs)

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

- ACQUIRE the basic knowledge of Pathology.
- UNDERSTAND the concepts of pests and diseases.
- ANALYZE the control methods.
- EVALUATE the problems related to pathology etc.

Course Contents:

- General introduction to medical and veterinary entomology: phylum arthropoda, salient features of insects, classification, general morphology and physiology of insects,
- modifications in mouthparts and appendages of insects, metamorphosis and its types.
- Insects of medical and veterinary importance: mosquitoes, human louse, houseflies, fleas, bugs, mites and ticks: life cycles, diseases and their control. Insect venoms; bees, wasps, ants. Insect toxins, arthropod allergens.
- Insect pest management: definition, principles and methods of insects control, components of pest management, techniques, general measures to control insects, economics of pest management.

Teaching Methodology:

- Student-centered teaching through communicative approach
- 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, Introduction to Pathology.
Week 2	General introduction to medical and veterinary entomology.
Week 3	Phylum arthropoda, salient features of insects, classification.
Week 4	General morphology and physiology of insects.
Week 5	Modifications in mouthparts and appendages of insects.
Week 6	Metamorphosis and its types.
Week 7	Insects of medical and veterinary importance: mosquitoes, human louse, houseflies, fleas, bugs, mites and ticks.
Week 8	Life cycles, diseases and their control.
Week 9	Midterm Examination
Week 10	Insect venoms; bees, wasps, ants. Insect toxins
Week 11	Insect pest management.
Week 12	Allergens definition, principles and methods of insects control, ..

Week 13	Arthropod components of pest management
Week 14	Techniques, general measures to control insects
Week 15	Economics of pest management.
Week 16	Final Examination

Reference Books (latest Editions):

1. Roy, D. N. and Brown, A.W.A .2004. Entomology. Biotech .Books, New Delhi.
2. Chandler, A.C. and Read, C.P. 1961. Introduction to Parasitology. 10th ed. Wiley Toppan, New York, USA
3. Rozendael, J. A. 1999. Vector Control. A I. T. B. S. publishers, New Delhi.
4. Service, M.W. 1996. Medical Entomology. Chapman and Hall, USA
5. Pedigo, L. P. 2003. Entomology and Pest Management. 4th ed. Pearson Education, Singapore, Pvt. Ltd

ZOOL443 Ornithology

Course Title	:	Ornithology
Course Code	:	ZOOL443
Offered to	:	Undergraduate Students at Hazara University
CrHr	:	3 (2+1)
Pre-requisite	:	None

Course Objective:

The course will

- Provide knowledge about bird diversity
- Avian anatomy, physiology and adaptations
- Bird behavior and socioeconomic and ecological importance

Course Contents:

- Introduction to ornithology, class Aves, taxonomy of birds up to orders, families and major species; evolution of birds; biology of fossil birds; archaeopteryx, archaeornithes, neoornithes; morphology and surface anatomy of bird, and development structure of feathers, plumage;
- structure of bones; basic embryology of birds; internal anatomy of birds; systems physiology; blood circulatory, cardiovascular physiology, heart, blood cells and hemodynamics; respiratory system, air sacs, ventilation of lungs, metabolic rates, oxygen consumption; urinary system, kidney physiology and production of solid or semisolid excreta, brain physiology and anatomy, special senses, olfaction, vision, taste; digestive system, anatomy, guts and feeding strategies; morphological and physiological adaptations of birds to flying, kinds of flight, mechanisms of aerodynamics;
- reproductive organs anatomy and physiology, egg laying and breeding seasons; bird migration, song production, bird behavior, courtship, mating, egg incubation strategies, brood parasitism; predator-prey relationship; homing behavior; learning, imprinting; nest building; bird parasite; endangered species of birds; bird conservation and sanctuaries. Introduction, evolution, geographical distribution.
- Classification Characteristics of birds, external features, identification of sex and age, reproduction and development, behaviour (migration, territoriality), populations and their regulation. Anatomical, physiological adaptations to their environment,
- reproductive strategies, food/feed, communication (vocal, behavioral). Anatomy & physiology of game and predatory species. Birds of Pakistan: Aquatic, Forest and Game birds and birds of prey. Birds as pests.

Teaching Methodology:

- Student-centered teaching through communicative approach

- 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	Course Orientation/Introduction Session, Introduction to ornithology, class Aves, taxonomy of birds up to orders, families and major species.
Week 2	evolution of birds; biology of fossil birds; archaeopteryx, archaeornithes, neoornithes.
Week 3	morphology and surface anatomy of bird, and development structure of feathers, plumage, structure of bones; basic embryology of birds.
Week 4	Internal anatomy of birds; systems physiology; blood circulatory, cardiovascular physiology, heart, blood cells and hemodynamics; respiratory system, air sacs, ventilation of lungs, metabolic rates, oxygen consumption.
Week 5	urinary system, kidney physiology and production of solid or semisolid excreta, brain physiology and anatomy.
Week 6	Special senses, olfaction, vision, taste; digestive system, anatomy, guts and feeding strategies; morphological and physiological adaptations of birds to flying, kinds of flight, mechanisms of aerodynamics.

Week 7	Reproductive organs anatomy and physiology, egg laying and breeding seasons; bird migration, song production, bird behavior, courtship, mating, egg incubation strategies, brood parasitism.
Week 8	Predator-prey relationship; homing behavior; learning, imprinting; nest building; bird parasite; endangered species of birds.
Week 9	Midterm Examination
Week 10	Bird conservation and sanctuaries. Introduction, evolution, geographical distribution.
Week 11	Classification Characteristics of birds, external features, identification of sex and age
Week 12	Reproduction and development, behaviour (migration, territoriality), populations and their regulation.
Week 13	Anatomical, physiological adaptations to their environment, reproductive strategies,
Week 14	Food/feed, communication (vocal, behavioral). Anatomy & physiology of game and predatory species.
Week 15	Birds of Pakistan: Aquatic, Forest and Gamebirds and birds of prey. Birds as pests.
Week 16	Final Examination

Reference Books

1. Howell, S. N. G. 2010. Peterson Reference Guide to Molt in North American Birds (Peterson Reference Guides. Amazon Co.
2. Kaiser, G. W. 2008. The Inner Bird: Anatomy and Evolution. Amazon Co.
3. Richard Grimmett, Carol Inskipp and Tim Inskipp 2008. Birds of India: Pakistan, Nepal, Bangladesh, Bhutan, Sri Lanka, and the Maldives. Princeton Book Co.
4. A J Urfi 2009. Birds of India: A Literary Companion, OUP.
5. Frank B. Gill. 2004. Ornithology. 2nd Ed. **W. H. Freeman & Co.**

6. Handbook of Bird Biology by Cornell Lab of Ornithology. Princeton University Press. New Jersey. 2004
7. Rank B. Gill. 2004. Ornithology: Ecology and Evolution of Darwin's Finches. 99 ed. (rev). Princeton. W. H. Freeman.
8. David Allen Sibley and Alfred A. Knopf 2003. *The Sibley Field Guide to Birds of Eastern North America*. New York Press
9. David Allen Sibley and Alfred A. Knopf 2002. *Sibley's Birding Basics* New York Press.
10. Salim Ali and S. Dillon Ripley 2001. Handbook of the Birds of India and Pakistan: Together with Those of Bangladesh, Nepal, Bhutan and Sri Lanka/. Reprint. New Delhi, Oxford University Press, 10 Vols.
11. Noble S. Proctor, Patrick Lynch, Patrick J. Lynch, Patrick J. Lynch 1998. Manual of Ornithology: Avian Structure and Function. Yale University Press.
12. Audubon Handbook: How to identify birds? 88th ed. McGraw-Hill Publishing Company.

ZOOL415 Parasitology

Course Title	:	Parasitology
Course Code	:	ZOOL415
Offered to	:	Undergraduate Students at Hazara University
CrHr	:	3 (2+1)
Pre-requisite	:	None

Course Objective:

The course aims to focus on:

- the general principles and concepts of animal parasitology, classify major animal parasites of animals and humans,
- describe many of the disease conditions that animal parasite cause and to consider measures that may lead to control of these disease agents.

Course Learning Outcome (CLOs)

Upon completion of this course you should be able to:

- Discuss the concept of parasitism and other animal associations; explain the concept of harm; understand the basic features and characteristics of hosts.
- Tell the advantages and disadvantages of parasitic lifestyle; discuss the economic consequences of parasitic diseases and difficulties associated with eliminating/controlling parasitic diseases.
- Tell the major types of protozoan parasites, their adaptive strategies and damage; discuss fungal and plant parasites.
- Articulate major helminth and arthropod parasites, their taxonomy and harms caused.
- Discuss the major means of transmission of parasites and the factors that influence parasite transmission

Course Contents:

- **Introduction to parasitology:** Some basic definitions. Parasitic ecology and evolution.
- **Immunity.** Susceptibility and resistance, innate defence mechanisms. Acquired immune response in vertebrates. Immunity in invertebrates. Immunodiagnosis, pathogenesis of parasitic infections.
- **Parasitic protozoa, form, function and classification.**
- **Arthropods,** Vectors of diseases. parasitic insects; bugs, fleas, flies, mosquito, lice, ticks and mites.
- **Helminths and their pathology:** Host parasite relationships and control of parasitic helminthes with particular reference to Helminths of medical and veterinary importance.

Teaching Methodology:

- Student-centered teaching through communicative approach

- 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 Parasitology , Basic concepts , terminologies and branches. Associations (symbiosis, commensalism, mutualism and parasitism)
Week 2	Classification of parasites Ectoparasites, endoparasite, temporary parasites, permanent parasites, (brief account and examples), Classification of hosts : Definitive, intermediate and paratenic hosts, Host-parasite relationships, Morphology and physiology of parasites
Week 3	Immunoparasitology: immunity and immune responses of host, Types of immunity in general (innate and acquired immunity)
Week 4	Protozoology: Protozoan parasites of man and other animals. Classification, life cycle, habitat, morphology, epidemiology and pathology of infections e.g., Entamoeba spp.
Week 5	Giardia spp. And trypanosoma morphology, epidemiology and pathology of infections.
Week 6	Trypanosoma, Leshmania morphology, epidemiology and pathology of infections.
Week 7	Plasmodium morphology, epidemiology and pathology of infections.

	Helminthology
Week 8	Helminth parasites of man and other animals. General account of Platyhelminthes (Trematode, nematode and cestode.)
Week 9	MID TERM EXAM
Week 10	Morphology, epidemiology, biology, diagnosis, pathology and treatment of Trematode: Fasciola hepatica
Week 11	Cestodes: Morphology, epidemiology, biology, diagnosis, pathology and treatment of taenia.
Week 12	Nematodes: Morphology, epidemiology, biology, diagnosis, pathology and treatment of Ascaris, Trichuris
Week 13	Medical and Veterinary Entomology: Biology and life cycles e.g. lice, Ticks, mites, mosquitoes, fleas, flies, bugs etc.
Week 14	Arthropods as disease transmitters/vectors.
Week 15	Arthropods as disease transmitters/vectors.
Week 16	FINAL TERM EXAM
Week #	Practicals (LAB)
Week 1	Preparation of temporary and permanent slides of medical and veterinary importance.
Week 2	Identification of parasitic protozoan and local helminthes of medical and veterinary importance.
Week 3	Methods of collection, preservation and transportation of parasitic material.
Week 4	Qualitative faecal examination for helminth ova
Week 5	Quantitative faecal examination for helminth ova.
Week 6	Study of different types of protozoans by using permanent slides.
Week 7	Study of different types of helminthes by using permanent slides.
Week 8	Collection, preservation and preparation of slides of local helminthes.
Week 9	MID TERM EXAM
Week 10	Identification of insects of medical and veterinary importance

Week 11	Identification of insects of medical and veterinary importance
Week 12	Identification of Line drawings of Arthropods
Week 13	Identification of Line drawings of Protozoans
Week 14	Identification of Line drawings of Helminthes.
Week 15	Dissection of Crow
Week 16	FINAL TERM EXAM

Books Recommended:

1. Miller. A.S and Harley, J.B 1999 & 2002 Zoology 4th and 5th Edition (international) Singapore. McGraw Hill.
2. Pechinik J.A 2000 “Biology of Vertebrates” 4th Edition (international) McGraw Hill.
3. Hickman, C.P, Roberts, L.S and Larson A, 2001 “Integrated Principles of Zoology”. 11th Edition (International) Singapore. McGraw Hill.
4. Miller, S.A 2002 General Zoology Laboratory Manual 5th Edition (International) Singapore McGraw Hill.
5. Hickman, C.P and Kats .H.L 2000 Laboratory Studies in integrated Principles of Zoology. Singapore McGraw Hill.

ZOOL435 MOLECULAR GENETICS

Course Title	:	Molecular Genetics
Course Code	:	ZOOL435
Offered to	:	Undergraduate Students at Hazara University
CrHr	:	3 (2+1)
Pre-requisite	:	Cell Biology

Course Objective:

- **The objectives of the course are:-** to enable the students to understand organization of genome of various organism,
- to develop understanding of different types of DNA damages and Repair, to enable the students to understand the gene expression and its control

Course Learning Outcomes: (CLOs)

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

- ACQUIRE the basic knowledge of genome of various organisms
- UNDERSTAND the key features involved DN damage and Repair
- SOLVE the problem by using advance molecular biology Techniques.
- ANALYZE the problem various available techniques.

Course Contents:

- Plant and animal viruses (DNA and RNA)
- Transposition: transposable elements, detection of transposition in
- bacteria, types of bacterial transposons, modes of transposition in bacteria.
- Genetic phenomena mediated by transposons, transposable elements in
- prokaryotes and eukaryotes.
- Gene expression in pro- and eukaryotes.
- Genetic transformation (all kinds). Regulation of simple and complex
- transcription unit.
- Current developments in molecular genetics: molecular techniques viz.
- Southern, Northern and Western blotting, PCR, RFLP, AFLP's, RAPDs,
- Micro-sattelites, SNPs

Teaching Methodology:

- Student-centered teaching through communicative approach
- 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	Plant And Animal Viruses (DNA And RNA
Week 2	Transposition: Transposable Elements
Week 3	Detection Of Transposition In Bacteria, Types Of Bacterial Transposons
Week 4	Modes Of Transposition In Bacteria.
Week 5	Genetic Phenomena Mediated By Transposons,
Week 6	Transposable Elements In Prokaryotes And Eukaryotes.
Week 7	Gene Expression In Pro- And Eukaryotes.
Week 8	Genetic Transformation (All Kinds).
Week 9	Mid Term Exam
Week 10	Regulation Of Simple And Complex Transcription Unit
Week 11	Current Developments In Molecular Genetics: Molecular Techniques Viz.
Week 12	Molecular Techniques Viz. Southern, Northern And Western Blotting
Week 13	PCR, RFLP,
Week 14	AFLP's, RAPDs,
Week 15	Micro-sattelites, SNPs
Week 16	Final Term Exam
Week #	Practical (Lab)

Week 1	1. Isolation of nucleic acids
Week 2	2. Qualitative and quantitative measurement of concentration, digestion with specific restriction enzymes and gel electrophoresis.
	2. Qualitative and quantitative measurement of concentration, digestion with specific restriction enzymes and gel electrophoresis
Week 3	3. Plasmid isolation and characterization.
Week 4	Plasmid isolation and characterization.
Week 5	4. Denaturation and renaturation of DNA.
Week 6	Denaturation and renaturation of DNA.
Week 7	5. Orientation with different molecular techniques including PCR,
Week 8	5. Orientation with different molecular techniques including PCR,
Week 9	MID TERM EXAM
Week 10	5. Orientation with different molecular techniques including PCR,
Week 11	RFLP technique
Week 12	AFLPs technique
Week 13	RAPDs, technique etc
Week 14	AFLPs technique
Week 15	RAPDs, technique etc
Week 16	FINAL TERM EXAM

Reference Books:

1. Miller.A.S and Harley, J.B 1999 & 2002 Zoology 4th and 5th Edition (international) Singapore. McGraw Hill.
2. Pechinik J.A 2000 “Biology of Vertebrates” 4th Edition (international) McGraw Hill.
3. Hickman, C.P, Roberts, L.S and Larson A, 2001 “Integrated Principles of Zoology”. 11th Edition (International) Singapore. McGraw Hill.
4. Miller,S.A 2002 General Zoology Laboratory Manual 5th Edition(International) Singapore McGraw Hill.
5. Hickman, C.P and Kats .H.L 2000 Laboratory Studies in integrated Principles of Zoology. Singapore McGraw Hill.

ZOOL434 Cancer Biology

Course Title	:	Cancer Biology
Course Code	:	ZOOL434
Offered to	:	Undergraduate Students at Hazara University
Cr Hr	:	3 (2+1)
Pre-requisite	:	None

Course Objective:

The objectives of the course are:-

- To enhance the knowledge in the area of Cancer Biology.
- To provide core concepts involved in the transformation of normal cell in to cancer cell.
- To introduce the major signaling circuitry programs contributing towards cancer.

Course Learning Outcome (CLOs)

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

- ACQUIRE the advanced knowledge of Cancer Biology. 240
- UNDERSTAND the concepts of transformation of normal cell in to tumor cell.
- ANALYZE the signaling pathways contributing towards Cancer.
- EVALUATE the problems related to genetic mutations and tumor suppressor genes, etc.

Course Contents:

- Introduction of Cancer, General features and types of cancers,
- The nature of Cancer, Arise of Cancer from normal and specialized cells.
- e. Monoclonal growth of tumor cells. Physical and chemical carcinogens g. Mutagens causing cancers. Tumor Viruses a. RNA viruses b. DNA Viruses causing cancer.
- Transformation of cells by tumor viruses. Cellular oncogenes: a. Oncogenes in the cell. Proto-oncogenes, c. Activation of proto-oncogenes, d. myc oncogene
- Growth factors, Receptors, and Cancer a. Receptors and their ligands, b. Growth factor genes, c. EGF receptor, d. TGF
- Signaling Circuitry programs a. Introduction to signaling pathway, b. The Ras protein c. Tyrosine phosphorylation d. Cascade of kinases. Cell Cycle. Cell cycle regulation, c. Tumor suppressor genes, d. Apoptosis. e. Significance of apoptosis f. Extrinsic and Intrinsic apoptosis.

Teaching Methodology:

- Student-centered teaching through communicative approach
- 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, Introduction to Cancer Biology.
Week 2	Introduction of Cancer, General features and types of cancers.
Week 3	The nature of Cancer, Arise of Cancer from normal and specialized cells.
Week 4	Monoclonal growth of tumor cells. Physical and chemical carcinogens g. Mutagens causing cancers.
Week 5	Tumor Viruses a. RNA viruses b. DNA Viruses causing cancer. Transformation of cells by tumor viruses.
Week 6	Cellular oncogenes: a. Oncogenes in the cell. b. Proto-oncogenes, c. Activation of proto-oncogenes, d. myc oncogene.
Week 7	Growth factors, Receptors, and Cancer a. Receptors and their ligands.
Week 8	Growth factor genes, c. EGF receptor, d. TGF 5. Signaling Circuitry programs.
Week 9	Midterm Examination
Week 10	Introduction to signaling pathway.
Week 11	The Ras protein c. Tyrosine phosphorylation d. Cascade of kinases.

Week 12	Cell Cycle, Cell cycle regulation
Week 13	Tumor suppressor genes
Week 14	Apoptosis., Significance of apoptosis.
Week 15	Extrinsic and Intrinsic apoptosis.
Week 16	Final Examination

Reference Books (latest Editions):

1. Zhang, W., & Fuller, G. N. (Eds.). (2004). Genomic and Molecular NeuroOncology. Jones & Bartlett Learning.
2. Cooper, G. M. (1995). Oncogenes. Jones & Bartlett Learning.
3. Hicky, R., Clark, R. L., & Cumbley, R. W. (1986). Year book of cancer. Chicago: Year book.
4. Weinberg, R. (2013). The biology of cancer. Garland science.
5. Hejmadi, M. (2009). Introduction to cancer biology. Bookboon

ZOOL427 WILDLIFE PARASITOLOGY

Course Title	:	Wildlife Parasitology
Course Code	:	ZOOL427
Offered to	:	Undergraduate Students at Hazara University
CrHr	:	3 (2+1)
Pre-requisite	:	None

Course Objective:

- To give knowledge to the students about parasites of wild animals and birds fauna as previously this field of study was ignored.
- To impart tools of parasites survey of wild fauna and methods of parasites collection to students in field study.

Course Contents:

- **Overview of wildlife:** A brief out line of wild-life in Pakistan; introduction and classification.
- **Introduction to wildlife parasitology:** Host parasite relationship; Occurrence and prevalence of parasites in Wild animals such as Mammals with exception to Carnivora; Birds; and Reptiles excluding Crocodilla; Pathogenesis of parasitic infection; Diagnosis, Prevention and Treatments.
- **Diseases dissemination:** Role of wild animals in spreading of parasitic diseases to Domestic Animals and Man; Control of Ecto and Endo-parasites of wild animals and birds; Zoonotic and Epizootic of wild-wide importance.

Teaching Methodology:

- Student-centered teaching through communicative approach
- 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	Course Orientation/Introduction Session, A brief out line of wild-life in Pakistan;
Week 2	Introduction and classification.
Week 3	Host parasite relationship
Week 4	Occurrence and prevalence of parasites in Wild animals such as Mammals with exception to Carnivora.
Week 5	Occurrence and prevalence of parasites in Wild animals such as Birds.
Week 6	Occurrence and prevalence of parasites in Wild animals such as Reptiles excluding Crocodilla.
Week 7	Palaeogeography: Theories of continental drift and plate tectonics; Pangea.
Week 8	Pathogenesis of parasitic infection; Diagnosis, Prevention and Treatments
Week 9	Midterm Examination
Week 10	Pathogenesis of parasitic infection; Diagnosis, Prevention and Treatments
Week 11	Role of wild animals in spreading of parasitic diseases to Domestic Animals.
Week 12	Role of wild animals in spreading of parasitic diseases to Man.
Week 13	Control of Ecto and Endo-parasites of wild animals
Week 14	Control of Ecto and Endo-parasites of d birds
Week 15	Zoonotic and Epizootic of wild-wide importance.
Week 16	Final Examination

Reference Books

1. Bush, A. O., Fernandez J. C., Esch, G. W. and Seed, J. R. 2001. Parasitism: The diversity and Ecology of animal Parasites. Cambridge University Press, Cambridge, UK.
2. Fowler, M. E. 1999. Zoo and wild animal medicine: Current Theraphy-4 w. b. Saunders Company Philadelphia, USA.
3. Smyth, J. D. 1994. Introduction to animal Parasitology. 3rd Edition Cambridge University Press, Cambridge, UK.
4. Davis, J.W. and Anderson, R. C. 1971. Parasitic diseases of Wild Mammals. The Iowa State University Press, Ames, Iowa, USA.
5. Soluby, E. J. L. 1986. Helminths, Arthropods and Protozoa of Domesticated Animals. 7th Edition Bailliere and Tindal, London.
6. Lavin. N. D. `990. Veterinary Parasitology. The Iowa State University Press. Ames, Iowa, USA.

ZOOL424 CONSERVATION BIOLOGY

Course Title	:	Conservation Biology
Course Code	:	ZOOL424
Offered to	:	Undergraduate Students at Hazara University
CrHr	:	3 (2+1)
Pre-requisite	:	None

Course Objective:

Course Objectives:

The objective of this course is

1. to enable the student to understand and investigate the diversity of living world,
2. to understand the effect of human activities on species, communities and ecosystems;
and
3. to develop a practical interdisciplinary approach to protect and restore biological diversity

Course Learning Outcomes:

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

1. Acquire theoretical knowledge about the phenomena that affect the maintenance, loss, and restoration of biological diversity.
2. Understand the ecological and evolutionary principles of biological diversity which influence the conservation of wildlife at spatial and temporal scales in Pakistan as well as abroad.
3. Solve the conservation issue by applying the scientific principles and modern technologies.
4. Analyse, interpreting and synthesize data and other information about the determinants of the conservation problems.
5. Evaluate the conservation actions taken by the biologists for solving the conservation problems across biological scales (genes to landscapes) and geographical scales (local to global).
6. Demonstrate sound research skills based on ecological and evolutionary principles in investigating problems in conservation biology.

Course Outline:

1. Introduction to Conservation Biology:

- a. Definition,
- b. History and
- c. Scope.

2. Biodiversity:

- a. Species Diversity; Genetic Diversity; Ecosystem Diversity;
- b. Measurement of Biological Diversity;
- c. An Overview of World's Biodiversity;
- d. The Value of Biodiversity

3. Threats to Biodiversity:

- a. Human Population Growth;
- b. Habitat Destruction; Habitat Fragmentation;
- c. Environmental Degradation and Pollution;
- d. Global Climate Change;
- e. Overexploitation;
- f. Invasive Species

4. Extinctions:

- a. Extinction and Mass Extinctions;
- b. Rates of Extinction; Island Biogeography;
- c. Vulnerability to Extinction;
- d. Problems of Small Populations; Minimum Viable Population (MVP);
- e. Loss of Genetic Diversity; Effective Population Size;
- f. Demographic and Environmental Stochasticity

5. Conserving Populations and Species:

- a. Applied Population Biology; Monitoring populations; Population viability analysis; Metapopulations,

- b. International agreements for conservation of fauna and flora; Role of national and International Laws in Protection of Species;
- c. Ex Situ Conservation Strategies; Zoos; Aquariums; Botanical gardens; Seed banks.
- d. Protected Areas and their Establishment and categories;
- e. Managing Protected Areas; Challenges to Protected Areas Management.
- f. Unprotected Public and Private Lands
- g. Ecosystem Management h. Integration of Local Community in Conservation
- i. Restoring Damaged Ecosystems
- 6. Sustainable Development:
 - a. Challenges Involve in Conservation and Sustainable Development at the Local Level
 - b. International Approaches to Sustainable Development
 - c. Funding for Conservation by the World Bank and international NGOs;
 - d. Conservation Education and the Role of Conservation Biologists

Practicals:

- 1. Conservation issues in protected areas of Pakistan.
- 2. Study of the role of local community in protected areas of Pakistan.
- 3. Challenges to sustainable development and their solution in Pakistan.

Teaching Methodology

- ☐ Lecturing
- ☐ Written assignments
- ☐ Guest speaker
- ☐ Field visits
- ☐ Report writing
- ☐ Assessment

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

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

- **Practical**
- Written (Slides preparation+ Dissections) 50%
- Collection of Insects 20%
- Practical Book 20%
- Viva 10%
-

Week-Wise Distribution:

Week#	Topic to be covered
Week 1	Course Orientation/Introduction Session, Introduction to Conservation Biology: a. Definition, b. History and c. Scope.
	Practical: Conservation issues in protected areas of Pakistan (i)
Week 2	Biodiversity: a. Species Diversity; Genetic Diversity; Ecosystem Diversity b. Measurement of Biological Diversity;
	Practical: Conservation issues in protected areas of Pakistan (ii)
Week 3	Biodiversity: c. An Overview of World's Biodiversity d. The Value of Biodiversity
	Practical: Conservation issues in protected areas of Pakistan (iii)
Week 4	Threats to Biodiversity: a. Human Population Growth, b. Habitat Destruction; Habitat Fragmentation.
	Practical: Conservation issues in protected areas of Pakistan (iv)
Week 5	Overexploitation f. Invasive Species,
	Practical: Conservation issues in protected areas of Pakistan (v)
Week 6	Extinctions: a. Extinction and Mass Extinctions, b. Rates of Extinction; Island Biogeography
	Practical: Study of the role of local community in protected areas of Pakistan (i).
Week 7	Vulnerability to Extinction; Problems of Small Populations; Minimum Viable Population (MVP);
	Practical: Study of the role of local community in protected areas of Pakistan (ii).

Week 8	Loss of Genetic Diversity; Effective Population Size; Demographic and Environmental Stochasticity
	Practical: Study of the role of local community in protected areas of Pakistan (iii).
Week 9	Midterm Examination
Week 10	Conserving Populations and Species: Applied Population Biology; Monitoring populations; Population viability analysis; Metapopulations,
	Practical: Study of the role of local community in protected areas of Pakistan (iii).
Week 11	International agreements for conservation of fauna and flora; Role of national and International Laws in Protection of Species; c. Ex Situ Conservation Strategies; Zoos; Aquariums; Botanical gardens; Seed banks.
	Practical: Insecticide formulations, their dilutions and safe handling (i). Study of the role of local community in protected areas of Pakistan (vi).
Week 12	d. Protected Areas and their Establishment and categories; e. Managing Protected Areas; Challenges to Protected Areas Management.
Week 13	Unprotected Public and Private Lands, Ecosystem Management
	Practical: Study of the role of local community in protected areas of Pakistan (v).
Week 14	Integration of Local Community in Conservation Restoring Damaged Ecosystems
	Practical: Insecticide formulations, their dilutions and safe handling (iii).
Week 15	Sustainable Development: a. Challenges Involve in Conservation and Sustainable Development at the Local Level b. International Approaches to Sustainable Development c. Funding for Conservation by the World Bank and international NGOs; d. Conservation Education and the Role of Conservation Biologists
	Practical: Challenges to sustainable development and their solution in Pakistan.
Week 16	Final Examination

Reference Books (latest Editions) :

1. 1. Richard B. Primack, 2012. A Primer of Conservation Biology; 5th Edition: Sinauer Associates, Inc. Publishers Sunderland, MA U.S.A.
2. 2. Groom, M.J., G.K. Meffe and C.R. Carroll, 2006, Principles of Conservation Biology, 3rd edition, Sinauer Associates, Sunderland, MA.
3. 3. Malcolm L. Hunter, Jr. 2001. Fundamentals of Conservation Biology, 2nd Edition. Blackwell Science Inc.
4. 4. Mills, L.S. 2007. Conservation of Wildlife Populations: Demography, Genetics and Management. Blackwell Publishing, USA.
5. 5. Richard B. Primack. 2002. Essentials of Conservation Biology. 3rd Edition. Sinauer Associates Inc. Publishers, Sunderland, Massachusetts, U.S.A.6. Mathews, G.A. 2004. Pesticide Application Methods, 3 rd. Ed. John Wiley & Sons, Inc. N.Y. 7. Pedigo, L.P. and Marlin, E. R. 2009. Entomology and Pest Management, 6 th Edition, Person Education Inc., Upper Saddle River, New Jersey 07458, U.S.A.
6. 7. Pfadt, E.R. 1985. Fundamentals of Applied Entomology, 4 th Ed. The McMillan Co., N. Y.
7. 8. Robinson, D.H. 2006. Entomology Principles and Practices. Agro-bios.
8. 9. Shah, H.A. and Saleem, M.A. 2002, Applied Entomology, 3rd Ed. Izhar Sons Printers, Lahore.
9. 10. Srivastava, K.P. 2005. Text Book of Applied Entomology. Kalyani Publishers, New Delhi. 12. Romoser, W. S. and Stoffolano, J. G. 1998, The Science of Entomology, WCB McGraw-Hill.

ZOOL422 Ichthyology

Course Title	:	Ichthyology
Course Code	:	ZOOL422
Offered to	:	Undergraduate Students at Hazara University
CrHr	:	3 (2+1)
Pre-requisite	:	None

Course Objective:

1. To improve the skill of understanding of fish identification and classification.
2. To provide the concrete knowledge about anatomy of the fish.
3. To explain the morphology and physiology of most important commercial fishes.

Course Learning Outcomes:

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

1. **Classify** the most important commercial fish species.
2. **UNDERSTAND** the concepts of basic internal and external morphology and physiology.
3. **SOLVE** the challenges in field of fish taxonomy and providing them concept of latest keys of identification.
4. **ANALYZE** the morphological and taxonomical features of various species.
5. **EVALUATE** the problems in identification of fishes.
6. **DEMONSTRATE** Fishes should be dissected to show all the key features in identifying the fishes and also show all the external and internal organs for better understanding.

Course Contents:

Brief history, Taxonomy, Biology of commercial food fishes of Pakistan (morphology, anatomy, ecology and distribution) Scales in fishes (Structure, types, importance in identification, classification and age determination): Fish Fins, types of fins in fishes. Physiology of digestion (food, feeding habits, absorption, conversion.). Cardiovascular system. Respiration (structure of gills, other types of respiration.): Sensory system and communication in fish: Acoustico-lateralis system, sound reception and production. Excretion & Osmoregulation (renal. gill, differences between fresh water & marine fishes.); Physiology of gas bladder. Reproduction (development of ovary and testes, sex difference, sexual maturity, fecundity, breeding habits, parental care,) fish migration Process of aestivation in fish. Fish ecology (effects of different factors on fish development and distribution especially the effects of temperature, light etc.).

Teaching Methodology:

- Student-centered teaching through communicative approach
- 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	Course Orientation/Introduction Session, Introduction to Ichthyology: General Characteristics & Classification
Week 2	Biology of commercial food fishes of Pakistan (morphology, anatomy, ecology and distribution)
Week 3	Scales in fishes (Structure, types, importance in identification, classification and age determination)
Week 4	Fish Fins, types of fins in fishes, Fish byproducts.
Week 5	Physiology of digestion (food, feeding habits, absorption, conversion.)
Week 6	Cardiovascular system
Week 7	Respiration (structure of gills, other types of respiration.)
Week 8	Sensory system and communication in fish: Acoustico-lateralis system, sound reception and production.
Week 9	Midterm Examination

Week 10	Excretion & Osmoregulation (renal. gill, differences between fresh water & marine fishes.)
Week 11	Physiology of gas bladder: Use of gas by the fish as a source of static lift. Gas in the gas bladder: Loss, retention and secretion of gas.
Week 12	Reproduction (development of ovary and testes, sex difference
Week 13	sexual maturity, fecundity, breeding habits, parental care
Week 14	Fish migration, Process of aestivation in fish
Week 15	Fish ecology (effects of different factors on fish development and distribution especially the effects of temperature, light etc.).
Week 16	Final Examination

Reference Books

1. Lagler, K.F., J.E. Baradach and R.R. Miller. 2009. Ichthyology. John Wiley and Sons, Inc., New York, USA.
2. Moyle, P.B. and J.J. Cech. 2008. Fishes: An Introduction to Ichthyology. 6th Ed. Prentice Hall, New Jersey, USA.
3. David, H. 2003. The Physiology of Fishes 3rd Ed. CRC Press, UK.
4. Smith, L.S. 2002. Introduction to Fish Physiology. 2nd Ed. Argent Labs. Washington DC, USA.

ZOOL423 INTRODUCTORY FRESHWATER BIOLOGY

Course Title	:	INTRODUCTORY FRESHWATER BIOLOGY
Course Code	:	ZOOL423
Offered to	:	Undergraduate Students at Hazara University
CrHr	:	3 (2+1)
Pre-requisite	:	None

Course Objective:

The course aims to:

7. Develop concepts about importance of Fresh water Biology.
8. Study the important freshwater resources of Pakistan
9. . Demonstrate about identifications and various aquatic bodies their fuana

10. Course Learning Outcomes:

After studying this course the students would be able to:

- name and describe important freshwater resources of Pakistan
- explain the zonation of different aquatic habitats.
- describe the fauna and flora of freshwater bodies

Course Outline:

- Brief description of freshwater resources of Pakistan,
- types of freshwater habitats and their zonation.
- Study of life form, structure, reproduction and economic significance of Bacteria and Cyanobacteria (Nostoc, Anabaena and Oscillatoria) with specific reference to biofertilizers,
- pathogenicity and industrial importance.
- Freshwater Algae: Chlorophyta (Chlamydomonas, Spirogyra, Volvox); Charyophyta (Chara); Xanthophyta (Vaucheria);
- Bacillariophyta (Pinnularia); Phaeophyta (Ectocarpus);
- Rhodophyta (Batrachospermum).
- Study of life form, structure, reproduction and economic significance of Protozoan, Shrimps, Crayfish, Snails, Crustaceans, Molluscs.

Practical:

1. Study of preserved invertebrate species and their classification upto class level.
2. Study of various economic common freshwater algae and animal forms given in theory.

3. Collection, identification and preservation of different groups of freshwater animals and plants.

- ☐ Lecturing
- ☐ Written Assignments
- ☐ Guest Speaker
- ☐ Field Visits
- ☐ Report Writing

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

- Quizzes - 10%
- Assignments/ Presentation or case study - 10 %
- Midterm Examination - 30%
- Final Examination - 50%
- **Practical**
- Written (Slides preparation+ Dissections) 50%
- Collection of Insects 20%
- Practical Book 20%
- Viva 10%
-

Week-Wise Distribution:

Week#	Topic to be covered
Week 1	Course Orientation/Introduction Session, Brief description of freshwater resources of Pakistan.
	Practical: Study of various economic common freshwater algae and animal forms given in theory.(i)
Week 2	Brief description of freshwater resources of Pakistan
	Practical: Study of various economic common freshwater algae and animal forms given in theory. (ii)
Week 3	types of freshwater habitats and their zonation.

	Practical: Study of various economic common freshwater algae and animal forms given in theory. (iii)
Week 4	Study of life form aquatic life form.
	Practical: Study of various economic common freshwater algae and animal forms given in theory. (iv)
Week 5	structure, reproduction and economic significance of Bacteria and Cyanobacteria (Nostoc, Anabaena and Oscillatoria) with specific reference to biofertilizers
	Practical: Study of various economic common freshwater algae and animal forms given in theory. (v)
Week 6	pathogenicity and industrial importance.
	Practical: Study of various economic common freshwater algae and animal forms given in theory. (vi)
Week 7	. Freshwater Algae: Chlorophyta (Chlamydomonas, Spirogyra, Volvox); Charophyta (Chara);
	Practical: Study of various economic common freshwater algae and animal forms given in theory. (vii)
Week 8	Xanthophyta (Vaucheria); Bacillariophyta (Pinnularia);
	Practical: Collection, identification and preservation of different groups of freshwater animals and plants. (i)
Week 9	Midterm Examination
Week 10	Phaeophyta (Ectocarpus); Rhodophyta (Batrachospermum),
	Practical: Collection, identification and preservation of different groups of freshwater animals and plants. (ii) .
Week 11	Study of life form, structure, reproduction and economic significance of Protozoan,
	Practical: Collection, identification and preservation of different groups of freshwater animals and plants.. (iii)
Week 12	Study of life form, structure, reproduction and economic significance of Protozoan,
Week 13	Study of life form, structure, reproduction and economic significance of Protozoan,

	Practical: Collection, identification and preservation of different groups of freshwater animals and plants.. (iv)
Week 14	Shrimps, Crayfish, Snails, Crustaceans, Molluscs.
	Practical: Collection, identification and preservation of different groups of freshwater animals and plants. (v).
Week 15	Shrimps, Crayfish, Snails, Crustaceans, Molluscs.
	Practical: Collection, identification and preservation of different groups of freshwater animals and plants. (vi) .
Week 16	Final Examination

Reference Books (latest Editions) :

47. Moss, B.R., 2010. Ecology of Fresh Waters: A View for the Twenty-First Century. 4th ed. Wiley-Blackwell, USA.
48. Bronmark, C. and Hansson, L., 2005. The Biology of Lakes and Ponds. Oxford University Press, UK.
49. J.G. Needham, J.G., 1962. Guide to the Study of Freshwater Biology 5th ed. McGraw-Hill , USA. Maitland, P.S., 1990. Biology of Fresh Waters. Springer , USA

ZOOL301 EVOLUTION

Course Title	:	EVOLUTION
Course Code	:	ZOOL301
Offered to	:	Undergraduate Students at Hazara University
CrHr	:	3 (2+1)
Pre-requisite	:	None

Course Objective:

The objective of the course are

- To show how natural selection ultimately underpins all biological processes and how evolution has generated biological diversity.
- To understand relationship between evolutionTo investigate the theoretical basis and methods of modern biological systematics and classification. and systematics concepts

Course Learning Outcome (CLOs)

At the end of the course, the student will be able to:

1. ACQUIRE an enhanced knowledge and appreciation of evolutionary biology and systematics.
2. UNDERSTAND cogent and critical arguments based on the course material.
3. SOLVE the problems of evolution and taxonomy using different theoretical concepts and methods.
4. ANALYZE and report on experiments and observations in whole-organism biology.
5. EVALUATE the problems by integratingconcepts, theories and techniques of the subject.
6. DEMONSTRATE the change in characters of the organisms and their grouping on the basis of these characters from lower to higher categories and phonetic and phylogenetic relationships between organisms.

Course Contents:

- To investigate the theoretical basis and methods of modern biological systematics and classification.
- Learning Outcomes:
- At the end of the course, the student will be able to:
- ACQUIRE an enhanced knowledge and appreciation of evolutionary biology and systematics.
- UNDERSTAND cogent and critical arguments based on the course material.

- SOLVE the problems of evolution and taxonomy using different theoretical concepts and methods.
- ANALYZE and report on experiments and observations in whole-organism biology.
- EVALUATE the problems by integrating concepts, theories and techniques of the subject.
- DEMONSTRATE the change in characters of the organisms and their grouping on the basis of these characters from lower to higher categories and phenetic and phylogenetic relationships **between organisms**.

Course Outline:

Evolution

- The causes of micro-evolution; Hardy-Weinberg equilibrium, Mutation, Gene flow, Genetic drift, Nonrandom breeding, and natural selection.
- Types of natural selection: directional, disruptive and stabilizing selection.
- Causes of polymorphism in populations: Density dependent selection and Heterozygote advantage.
- General selection model: one locus and two locus selection model, Genetic load, Cost of selection, Hitch-hiking, Linkage disequilibrium. and shifting balance theory.
- Units of selection: allele, cell line, organisms, kin group and group.
- Sexual selection: Theories of sexual selection; Darwin, Fisher and Zahavi.
- Macroevolution: Evolutionary developmental biology: allometry, heterochrony, Evolutionary innovation and origin of higher taxa.
- Rates of evolution; Evolutionary trends and laws, Gradualism and punctuated equilibrium.

Principles of Systematics

- Concepts of taxon, phenon and category.
- Species concepts and its problems: Typological; Nominalistic, Biological, Evolutionary.
- Subspecies, Polytypic species and Superspecies: concept and problems
- Modes of speciation: Allopatric, Sympatric, Parapatric
- Intrapopulation variation: Types and application
- Taxonomic characters: Different kinds of taxonomic characters. Weightage of taxonomic characters. Classification and its types; Phenetic, Cladistic and evolutionary classification.
- Taxonomic collections and the process of identification.

- The rules of zoological nomenclature: interpretation and application of the code (stability, priority, first revisor principle) range of authority of code; concept of availability, type method formation of specific names, synonym, homonym.

Practicals:

1. Calculation of gene and genotype frequency for generations.
2. To calculate deviation of genotype from Hardy Weinberg equilibrium.
3. Simulate to check the effects of natural selection and genetic drift in changing environments. Simulation of assess the role population size in evolution.
4. Discussion on the evidences of evolution, role of biodiversity in evolution.
5. Simulation experiment to show the process of coevolution.
6. The study of a group of organisms while utilizing key.
7. Collection, preservation, labelling and identification of a group of specimens according to expertise available in the institute.
8. Preparation of bracket and indent key.
9. Phylogeny Reconstruction using phenetic (Similarity and dissimilarity matrix and unweighted pair group method) and cladistic (compatibility method) analysis to a group of mock “organisms”.

Teaching Methodology:

- Lecturing
- Field visits
- Assignments
- Report writing

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%
- **Practical**
- Written (Slides preparation+ Dissections) 50%

- Collection of Insects 20%
- Practical Book 20%
- Viva 10%

Week-Wise Distribution:

Week#	Topic to be covered
Week 1	Course Orientation/Introduction Session, Introduction to evolution, The causes of micro-evolution; Hardy-Weinberg equilibrium, Mutation, Gene flow, Genetic drift, Nonrandom breeding, and natural selection.
	Practical: Calculation of gene and genotype frequency for generations.
Week 2	Types of natural selection: directional, disruptive and stabilizing selection. Causes of polymorphism in populations: Density dependent selection and Heterozygote advantage.
	Practical: To calculate deviation of genotype from Hardy Weinberg equilibrium.
Week 3	General selection model: one locus and two locus selection model, Genetic load, Cost of selection, Hitch-hiking, Linkage disequilibrium. and shifting balance theory.
	Practical: Simulate to check the effects of natural selection and genetic drift in changing environments. Simulation of assess the role population size in evolution.
Week 4	Units of selection: allele, cell line, organisms, kin group and group. Sexualselection: Theories of sexual selection; Darwin, Fisher and Zahavi.
	Practical: Discussion on the evidences of evolution, role of biodiversity in evolution.
Week 5	Macroevolution: Evolutionary developmental biology: allometry, heterochrony, Evolutionary innovation and origin of higher taxa.
	Practical: Simulation experiment to show the process of coevolution.
Week 6	Rates of evolution; Evolutionary trends and laws, Gradualism and punctuated equilibrium.
	Practical: The study of a group of organisms while utilizing key.
Week 7	Concepts of taxon, phenon and category. Species concepts and its problems: Typological; Nominalistic, Biological, Evolutionary.
	Practical: Collection, preservation, labelling and identification of a group of specimen according to expertise available in the institute.
Week 8	Subspecies, Polytypic species and Superspecies: concept and problems
	Modes of speciation: Allopatric, Sympatric, Parapatric Practical: Preparation of bracket and indent key.

Week 9	Midterm Examination
Week 10	Intrapopulation variation: Types and application Taxonomic characters: Different kinds of taxonomic characters. Weightage of taxonomic characters.
	Practical: Phylogeny Reconstruction using phenetic (Similarity and dissimilarity matrix and unweighted pair group method) and cladistic (compatibility method) analysis to a group of mock “organisms”.
Week 11	Classification and its types; Phenetic, Cladistic and evolutionary classification.
	Practical: Practice for running dichotomous key
Week 12	Taxonomic collections and the process of identification.
Week 13	The rules of zoological nomenclature
	Practical: Practice for running Bracket key
Week 14	interpretation and application of the code (stability, priority, first revisor principle)
	Practical: Application of various phylogenetic software (i)
Week 15	range of authority of code; concept of availability, type method formation of specific names, synonym, homonym.
	Practical: Application of various phylogenetic software (ii)
Week 16	Final Examination

Reference Books (latest Editions) :

1. Ridley, M. 2004. Evolution, 3rd edition. Blackwell Science.
2. Mayr, E. and Ashlock, P.D., (Latest edition). Principles of Systematic Zoology, McGraw-Hill Inc. New York.

Additional Readings

1. Freeman, S. and Herron, J. C. 2004. Evolutionary analysis, 3rd ed. Pearson Prentice Hall.
2. Futuyma, D. J. 1997. Evolutionary Biology, 3rd ed. Sinauer Associates, Inc. Sunderland, Massachusetts.
3. Stearns, S. C. and Hoekstra, R. F. 2000. Evolution, an introduction. Oxford University Press.
4. Strickberger, (3rd or latest edition) Evolution. Jones and Barrett Publishers.

5. Simpson, G.G., (Latest edition). Principles of Animal Taxonomy, Columbia University Press, N.Y.

1. 6. Soka, R., and Snaeth P.H.A. (Latest edition). Principles of numerical taxonomy. W.H. Freeman and company, London.

2. 7. Kapoor, V.C. Principles and practices of animal Taxonomy. Science Publishers, 2nd Ed.

ZOOL445 Conservation Biology of wildlife

Course Title	:	Conservation Biology of wildlife
Course Code	:	ZOOL445
Offered to	:	Undergraduate Students at Hazara University
Cr Hr	:	3(3+0)
Pre-requisite	:	None

Course Objective:

The objectives of the course are:-

- Understand the principles and advanced techniques of conservation biology in conservation management of wildlife.
- Identify different factors involved in the depletion of wildlife resources.
- Develop the personal skill sand capabilities to apply these principles and techniques for the protection and restoration of wildlife and their habitats.

Course Learning Outcome (CLOs)

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

- GAIN THE theoretical knowledge about the principles and advanced techniques of conservation biology used for conservation management of wildlife.
- DETERMINE different threats and the underlying climatic and anthropogenic factors to the wildlife resources.
- DEMONSTRATE sound research skills based on ecological and evolutionary principles in investigating problems in conservation biology of wildlife.
- RESOLVE the conservation issue of wildlife by applying the scientific principles though modern techniques and technologies

Course Contents:

- **Introduction:** a. An Overview of the Wildlife Biodiversity b. The Importance of Wildlife Biodiversity c. Conservation values and ethics d. Techniques involved in Measurement of Biological Diversity;
- **Threats and challenges involved in Wildlife conservations** a. Mass Extinction and Global Climate Changes, b. Habitat Degradation and Loss, c. Habitat Fragmentation d. Island Biogeography, e. Overexploitation, f. Species invasion g. Inbreeding and Out breeding Depressions, h. Loss of Genetic Variability, i. Human factors; economic factors, politics and cultures.
- **Assessment of Extinction Vulnerability of Wild Populations:** a. Monitoring techniques for wildlife populations 320 b. Risk assessment, diagnosis of declines, c. Population viability analysis;

- **Approaches to conserve wildlife** a. Species and Landscape Approaches to Conservation b. Ecosystem Approaches to Conservation c. Protected Areas and their management d. Restoration of Damaged Ecosystems and Endangered Populations e. Sustainable Development

Teaching Methodology:

- Student-centered teaching through communicative approach
- 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, Introduction to Conservation Biology of wildlife
Week 2	An Overview of the Wildlife Biodiversity, The Importance of Wildlife Biodiversity, Conservation values and ethics
Week 3	Techniques involved in Measurement of Biological Diversity
Week 4	Threats and challenges involved in Wildlife conservations, Mass Extinction and Global Climate Changes

Week 5	Habitat Degradation and Loss, c. Habitat Fragmentation d. Island Biogeography, e. Overexploitation, f. Species invasion
Week 6	Inbreeding and Out breeding Depressions, h. Loss of Genetic Variability, i. Human factors; economic factors, politics and cultures.
Week 7	Assessment of Extinction Vulnerability of Wild Populations: Monitoring techniques for wildlife populations
Week 8	Risk assessment, diagnosis of declines, c. Population viability analysis
Week 9	Midterm Examination
Week 10	Approaches to conserve wildlife, Species and Landscape Approaches to Conservation
Week 11	Ecosystem Approaches to Conservation
Week 12	Protected Areas and their management
Week 13	Restoration of Damaged Ecosystems
Week 14	Endangered Populations
Week 15	Sustainable Development
Week 16	Final Examination

Reference Books (latest Editions):

- Richard B. Primack, 2012. A Primer of Conservation Biology; 5th Edition: Sinauer Associates, Inc. Publishers Sunderland, MA U.S.A.
- Groom, M.J., G.K. Meffe and C.R. Carroll, 2006, Principles of Conservation Biology, 3rd edition, Sinauer Associates, Sunderland, MA.
- Caughley, G. and A. Gunn. Conservation biology in theory and practice. Blackwell Science Publication.
- Eric. G. Bolen and William L. Robinson. 1995. Wildlife Ecology and Management. 3rd Edition. Prentice Hall, Upper Saddle River, New Jersey.
- Hosetti, B. B. and Venkateshwarlu, M. 2001. Trends in Wildlife Biodiversity, Conservation and Management. Daya Publishing House Delhi-11035.

- Malcolm L. Hunter, Jr. 2001. Fundamentals of Conservation Biology, 2nd Edition. Blackwell Science Inc.
- Mills, L.S. 2007. Conservation of Wildlife Populations: Demography, Genetics and Management. Blackwell Publishing, USA.
- Richard B. Primack. 2002. Essentials of Conservation Biology. 3rd Edition. Sinauer Associates Inc. Publishers, Sunderland, Massachusetts, U.S.A. 321
- Soule, M. E. 1987. Viable populations for Conservation. Cambridge University Press. Cambridge.
- Soule, M.E. and B.A. Wilcox. 1980. Conservation Biology. Sinauer Associates Inc. Sunderland. Massachusetts.

ZOOL442 Fish and Aquatic Toxicology

Course Title : Fish and Aquatic Toxicology
Course Code : ZOOL442
Offered to : Undergraduate Students at Hazara University
Cr Hr : 3(3+0)
Pre-requisite : None

Course Objective:

The objectives of the course are: -

- To review the basic toxicological principles of uptake, elimination, and bioaccumulation, emphasizing processes unique to aquatic organisms.
- To learn the relationships between abiotic and biotic processes of aquatic environments and their effects on contaminant distribution and subsequent exposure, accumulation, and toxicity in aquatic environments.
- To become familiar with the concept of risk assessment and to extend its use to assess ecological risks resulting from aquatic pollution.

Course Learning Outcome (CLOs)

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

- ACQUIRE the knowledge of the various toxic agents and their sources in aquatic ecosystem
- UNDERSTAND the effects of toxic substances on fishes and other aquatic organisms
- SOLVE the pollution problems in aquatic system
- ANALYZE the toxicity on different organs of fish
- EVALUATE the bioaccumulation pattern of pollutants in aquatic organisms
- 6. DEVELOP critical thinking to solve aquatic pollution problems

Course Contents:

- **Introduction to Aquatic Toxicology** a. History of Aquatic Toxicology b. Main Present and Future Challenges c. Classification and Types of Toxicity d. Effects of Aquatic Toxicology on Organisms e. Bioindicators and Biomarkers
- **Sources and Causes of Aquatic Contamination** a. Major Sources of Pollutants b. Transport of Pollutants in the Environment c. Metals, Metalloids, and Organometallic Compounds d. Other Inorganic Compounds, Including Factors Causing Eutrophication e. Organic Compounds f. Nanomaterials g. Radiation h. Genetic Modification
- **Uptake, Distribution, Detoxification and Excretion of Compounds in Aquatic Organisms** a. Uptake of Compounds by Organisms b. Distribution and Storage Sites of Chemicals in Organisms c. Biotransformation and Detoxification d. Cellular Excretion

e. Excretion from Gills, Kidney and Other Excretory Organs f. Excretion in Bile Via the Intestine g. Excretion From Multicellular Plants and Algae

- **General Principles of Toxicology in Fishes** a. Bioavailability of Chemical Contaminants in Aquatic Systems b. Toxicokinetics in Fishes c. Toxicodynamics in Fishes d. Biotransformation in Fishes e. Bioaccumulation of Toxicity in Fishes f. General approaches to diagnosis and treatment of toxicity
- **Toxicity in Fishes** a. Toxicity caused by metal and non-metals, b. Phytotoxins c. Drug toxicity and toxicity caused by agrochemicals. d. Mycotoxins e. Bacterial toxins
- **Key Target System in Fish and Organismal Effects** a. Liver Toxicity in Fishes b. The Osmoregulatory System of Fish c. Toxic Responses of the Fish Nervous System d. The Endocrine System 333 e. The Immune System of Fish: A Target Organ of Toxicity f. Chemical Carcinogenesis in Fishes g. Toxicity Resistance in Fishes.

Teaching Methodology:

- Student-centered teaching through communicative approach
- 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, Introduction to Fish and Aquatic Toxicology

Week 2	Introduction to Aquatic Toxicology a. History of Aquatic Toxicology b. Main Present and Future Challenges.
Week 3	Classification and Types of Toxicity, Effects of Aquatic Toxicology on Organisms.
Week 4	Bioindicators and Biomarkers
Week 5	Major Sources of Pollutants b. Transport of Pollutants in the Environment c. Metals, Metalloids, and Organometallic Compounds d. Other Inorganic Compounds.
Week 6	Factors Causing Eutrophication, Organic Compounds, Nanomaterials., Radiation, Genetic Modification.
Week 7	Uptake of Compounds by Organisms b. Distribution and Storage Sites of Chemicals in Organisms c. Biotransformation and Detoxification
Week 8	Cellular Excretion, Excretion from Gills, Kidney and Other Excretory Organs, Excretion in Bile Via the Intestine, Excretion From Multicellular Plants and Algae
Week 9	Midterm Examination
Week 10	Bioavailability of Chemical Contaminants in Aquatic Systems b. Toxicokinetics in Fishes c. Toxicodynamics in Fishes
Week 11	Biotransformation in Fishes e. Bioaccumulation of Toxicity in Fishes f. General approaches to diagnosis and treatment of toxicity.
Week 12	Toxicity caused by metal and non-metals, b. Phytotoxins c. Drug toxicity and toxicity caused by agrochemicals. d. Mycotoxins e. Bacterial toxins
Week 13	Liver Toxicity in Fishes b. The Osmoregulatory System of Fish c. Toxic Responses of the Fish Nervous System.
Week 14	Endocrine System and Immune System of Fish: A Target Organ of Toxicity
Week 15	Chemical Carcinogenesis in Fishes g. Toxicity Resistance in Fishes.
Week 16	Final Examination

Reference Books (latest Editions):

- Marquardt, H., Schafer, S.G., McClellan, R. and Welsch, F., 1999. Toxicology, Academic press, San Diego.
- Rand, G.M., Fundamentals Of Aquatic Toxicology: Effects, Environmental Fate And Risk Assessment. 2 nd Edition.
- Nikinmaa, M., 2014. An Introduction to Aquatic Toxicology. 1st Edition. Academic Press.
- Giulio, R.T.D. and Hinton, D.E., 2008. The Toxicology of Fishes. CRC Press, Taylor and Francis Group.
- Whitacre, D. M. (Editor) 2012. Reviews of Environmental Contamination and Toxicology. Vol. 223. Springer, Switzerland.

ZOOL437Aquaculture

Course Title	:	Aquaculture
Course Code	:	ZOOL437
Offered to	:	Undergraduate Students at Hazara University
Cr Hr	:	3(3+0)
Pre-requisite	:	None

Course Objective:

The objectives of the course are:-

- To increase the understanding about fin fish and shell fish aquaculture.
- To teach about different aquatic species, their rearing facilities and management by using basic techniques.
- To impart knowledge about site selection and construction of fish farm, problems and management of fish farm.

Course Learning Outcome (CLOs)

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

- Illustrate the basic knowledge of fin fish and shell fish, fisheries and aquaculture
- Identify fish species on the basis of biological characteristics.
- Solve problems of appropriate site selection, designing and pond construction; selection of suitable fish species for sustainable aquaculture.
- Recognize the problems of fish pond and solve them by using different strategies.
- Formulate and prepare aqua feed, induced breeding techniques, diagnosis and control of diseases in commercially important fish species.
- Demonstrate aquaculture sites individually and drawings of aquaculture facilities, aquatic resources and integrated aquaculture management.

Course Contents:

- **Introduction** a. Introduction to fish, fishery and aquaculture. b. History and present status of aquaculture (National and International). c. Introduction and biology of cultivable fin and shell fishes. d. Introduction to aquatic resources of Pakistan (Lentic and lotic environment).
- **Aquaculture (fin fish culture)** a. Introduction and role of aquaculture, types of culture systems (Ponds, Raceways, cages, pen, raft and line culture). b. Site selection, design and construction of fish ponds. c. Pond problems; aquatic vegetation and their control, fish predators, water quality and management, fish disease and their control. d. Types of fish feed, characteristics of artificial feed, methods of feeding, types and use of fertilizers. e. Artificial fish breeding techniques f. Integrated aquaculture

- **Shell fish culture** a. Introduction of shrimp and prawn culture, crabs, lobsters and scallops culture etc. b. Mari-culture: Substrate system, sea water ponds. Aquaculture in fresh and brackish waters. c. Aquaculture in practice: Culture of algae, seaweeds.

Teaching Methodology:

- Student-centered teaching through communicative approach
- 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, Introduction to Aquaculture.
Week 2	Introduction to fish, fishery and aquaculture.
Week 3	History and present status of aquaculture (National and International).
Week 4	Introduction and biology of cultivable fin and shell fishes.
Week 5	Introduction to aquatic resources of Pakistan (Lentic and lotic environment).
Week 6	Aquaculture (fin fish culture): Introduction and role of aquaculture, types of culture systems (Ponds, Raceways, cages, pen, raft and line culture).

Week 7	Site selection, design and construction of fish ponds. c. Pond problems; aquatic vegetation and their control, fish predators, water quality and management, fish disease and their control.
Week 8	Types of fish feed, characteristics of artificial feed, methods of feeding, types and use of fertilizers.
Week 9	Midterm Examination
Week 10	Artificial fish breeding techniques, Integrated aquaculture
Week 11	Shell fish culture Introduction of shrimp and prawn culture, crabs, lobsters and scallops culture etc.
Week 12	Mari-culture: Substrate system, sea water ponds.
Week 13	Aquaculture in fresh waters.
Week 14	Aquaculture in brackish waters.
Week 15	Aquaculture in practice: Culture of algae, seaweeds.
Week 16	Final Examination

Reference Books (latest Editions):

- Stickney R.R. 2016. Aquaculture an introductory text, CABI.
- Fitzsimmons, K., R.S.N. Janjua and M. Ashraf, 2015. Aquaculture Handbook—Fish Farming and Nutrition in Pakistan.
- Metha, V. 2009. Fisheries and Aquaculture Biotechnology. 2nd Ed. Campus Books International, New Delhi, India.
- Sharma, O. P. 2009. Handbook of Fisheries and Aquaculture. Agrotech Publishing Academy, Udaipur, New Delhi, India.
- Stickney, R. R. 2009. Aquaculture: An Introductory Text. CABI Publishing, London, UK.
- Ali, S.S. and Narejo, N.T., 2009. Fundamentals of Ichthyology. Sindh University Press, Jamshoro.
- Pandey, B. N., S. Deshpande and P. N. Pandey. 2007. Aquaculture. APH Publishing Corporation, New Delhi, India.
- Pillay, T. V. R. 2005. Aquaculture: Principles and Practices. 2nd Ed. Blackwell Sciences Limited. UK.

- Parker, R. O. 2004. Aquaculture Science 4th Ed. Delmar Learning, London, UK. 10. NIIR 2003. Hand Book on Fisheries & Aquaculture Technology. Asia Pacific Business Press Inc., Delhi. 11. Huet, M. and Timmermans, J. (2002). Text book of Fish Culture. Blackwell Science Ltd. UK. 12. Shammi, Q.J. and Bhatnagar, S. 2002. Applied Fisheries, Agro bios, India. 13. Ali, S.S. 1999. Fresh Water Fisher Biology. Naseem Book Depot, Hyderabad.

ZOOL313 PRINCIPLES OF SYSTEMATICS

Course Title	:	PRINCIPLES OF SYSTEMATICS
Course Code	:	ZOOL313
Offered to	:	Undergraduate Students at Hazara University
CrHr	:	3 (2+1)
Pre-requisite	:	None

Course Objective:

The course aims to:

- Develop concepts about importance of the systematics.
- Study the history of systematics with basic rules
- . Demonstrate about identifications and naming of the organisms according to international code of zoological nomenclature. Vide in-depth knowledge of taxonomy in animal sciences

11. Course Learning Outcomes:

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

1. ACQUIRE the basic knowledge aboutpest of economic importance.
2. UNDERSTANDthe relationship of various crops and pest population.
3. SOLVE the problems using integrated pest management.
4. ANALYZE the problems of pesticides resistance mechanism.
5. EVALUATE the problems problems using practical knowledge in Entomology.
6. DEMONSTRATEmethods to enhance the productivity of agricultural crops through insect pest management.

Course Outline:

Importance and applications of systematics: Taxonomy in Animal science, systematics as a profession and its future perspectives.

2. History of taxonomy: systematics, basic terminology of systematics, theories of biological classifications.
3. Taxonomic characters: Kinds and weightage, micro taxonomy, taxonomic categories: specific category, intraspecific category, higher categories; Species concept.
4. Typological species concept: Nominalist species concept, biological species concept, Evolutionary species concept. Kinds of different species, Speciation,

5. Taxonomic procedures, taxonomic collection; their preservation and duration, Taxonomic keys, different kinds of keys and their merits and demerits.
6. Formation of specific names, brief concept of cladistics, phylogenetics. Theory and practice of cladistics and phylogenetic systematics.
7. Systematics publications: International code of zoological nomenclature; its objective, principles, interpretation, application of important rules, with reference to: Zoological nomenclature, law of priority and validity of names.

Practical:

1. Study of preserved invertebrate species and their classification upto class level.
2. Collection, preservation and identification of common species with the help of keys.
3. Preparation of keys for the identification of specimens.
4. Methods of statistical analysis of samples from populations T-test, Analysis of variance etc. Teaching Methodology:
 - Lecturing
 - Written Assignments
 - Guest Speaker
 - Field Visits
 - Report Writing

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

- Quizzes - 10%
- Assignments/ Presentation or case study - 10 %
- Midterm Examination - 30%
- Final Examination - 50%
- **Practical**
- Written (Slides preparation+ Dissections) 50%
- Collection of Insects 20%
- Practical Book 20%
- Viva 10%

Week-Wise Distribution:

Week#	Topic to be covered
Week 1	Course Orientation/Introduction Session, Importance and applications of systematics: Taxonomy in Animal science, systematics as a profession and its future perspectives.
	Practical: Study of preserved invertebrate species and their classification upto class level. (i)
Week 2	Taxonomy in Animal science, systematics as a profession and its future perspectives.
	Practical: Study of preserved invertebrate species and their classification upto class level. (ii)
Week 3	History of taxonomy: systematics, basic terminology of systematics, theories of biological classifications.
	Practical: Study of preserved invertebrate species and their classification upto class level. (iii)
Week 4	, theories of biological classifications.
	Practical: Study of preserved invertebrate species and their classification upto class level. (iv)
Week 5	Taxonomic characters: Kinds and weightage, micro taxonomy, taxonomic categories:
	Practical: Collection, preservation and identification of common species with the help of keys (i)
Week 6	specific category, intraspecific category, higher categories; Species concept
	Practical: Collection, preservation and identification of common species with the help of keys (ii)
Week 7	Typological species concept: Nominalist species concept, biological species concept,
	Practical: Collection, preservation and identification of common species with the help of keys (iii)
Week 8	Evolutionary species concept. Kinds of different species, Speciation,

	Practical: Collection, preservation and identification of common species with the help of keys (iv)
Week 9	Midterm Examination
Week 10	Taxonomic procedures, taxonomic collection; their preservation and duration, Practical: 1. Preparation of keys for the identification of specimens. (i) .
Week 11	Taxonomic keys, different kinds of keys and their merits and demerits. Practical: Preparation of keys for the identification of specimens. (ii)
Week 12	Formation of specific names, brief concept of cladistics, phylogenetics.
Week 13	Theory and practice of cladistics and phylogenetic systematics. Practical: Preparation of keys for the identification of specimens. (iii)
Week 14	Systematics publications: International code of zoological nomenclature; its objective, principles, Practical: Methods of statistical analysis of samples from populations T-test, Analysis of variance etc. (i).
Week 15	interpretation, application of important rules, with reference to: Zoological nomenclature, law of priority and validity of names Practical: Methods of statistical analysis of samples from populations T-test, Analysis of variance etc. (ii) .
Week 16	Final Examination

Reference Books (latest Editions):

1. Wiley, E. O. and Lieberman, B. S. 2011. Phylogenetics: Theory and practice of phylogenetic systematics. 2nd Ed. Wiley-Blackwell.
2. Hill, New York.
3. Mayer, E. and Asblock, P.D. Principles of Systematic Zoology. 1991. McGraw-Hill, New York
4. Mayr, E. Animal Species and Evolution, 1985. Harvard University Press.
5. Heywood, V.H. Taxonomy and Ecology. 1975. Academic Press, London.
6. Whili, M.J.D. Modes of Speciation, 1978. W.H. Freeman and Co., San Francisco.

ZOOL436 ENTOMOLOGY

Course Title	:	Entomology
Course Code	:	ZOOL436
Offered to	:	Undergraduate Students at Hazara University
CrHr	:	3 (2+1)
Pre-requisite	:	None

Course Objective:

The objectives of the course are: -

1. To describe the reasons for evolutionary success of insects.
2. To establish the understanding about body structure of insects.
3. To familiarize the students about different physiological processes of insect.
4. To introduce concepts of insect ecology

Course Learning Outcome (CLOs)

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

1. ACQUIRE the basic knowledge of the body structure of insects.
2. UNDERSTAND the role of structures in different life processes of insects.
3. CLASSIFY the insects at order level.
4. ASSOCIATE the insect structure, physiology and ecological interactions with their abundance and huge diversity.
5. DIFFERENTIATE the structural differences between different insects.
6. ANALYZE the impact of environmental factors on insect life.

Course Contents:

1. Morphology

- a. General characteristics of insects. Relationship with other Arthropods, splitting up into different evolutionary lines, Reasons for success of the insects in diverse environments.
- b. Hard Parts: General segmentation, tagmatosis and organization.
- c. Integument: Cuticle: Detailed structure along with its biochemistry. Epidermal layer; its structure and function. Basement membrane, Cuticular outgrowths and appendages sclerotization.
- d. Colors of Insects.

- e. Head: cephalization, sclerites, modifications.
- f. Antennae: Typical Antenna and its types.
- g. Mouthparts: Mouthparts and their types. Different modes of ingestion and types of mouthparts.
- h. Neck: Sclerites.
- i. Thorax: Sclerites: legs, their different modifications and functions
- j. Wings: Origin; Different regions. Development and basal attachments, main veins and their branches (generalized insects), Modifications of wings and wing coupling.
- k. Flight: Types of flight.
- l. Abdomen: Secondary appendages and external genitalia.

2. Physiology

- a. Soft Parts: Muscular system; basic structure, types of muscles; muscle contraction and its energetics.
- b. Comparative structure of all the systems, e.g., digestive, excretory, respiratory, incubatory, reproductive and nervous system and their physiology.
- c. Sense organs: sound and light producing organs.
- d. Exocrine and endocrine glands including pheromones and their functions.
- e. Development: Embryogenesis, Different types of metamorphosis, apolysis and ecdysis and the role of endocrine secretions.

3. Ecology

- a. Population dynamics: Density dependent and density independent factors regulating insect population.
- b. Life history and life tables.
- c. Carrying capacity r and k selection.
- d. Food chains.
- e. Predation and competition.
- f. Insect defenses and adaptations.
- g. Diapause.
- h. Insect communication.

Practical:

1. Preparation of permanent slides. All the hard parts (antennae, mouth parts, wings, legs and genitalia).
2. Dissection of insects to study different systems especially digestive, reproductive system of the available representative insects preferably following insects. American Cockroach, Grasshopper.
3. Field visits for collection of different developmental stages of insects belonging to different orders.
4. Field visits and report writing of ecological interactions of different insects.

Teaching Methodology:

- ☐ Lecturing
- ☐ Written Assignments
- ☐ Field Visits
- ☐ Report Writing
- ☐ Practical observations

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%
- **Practical**
- Written (Slides preparation+ Dissections) 50%
- Collection of Insects 20%
- Practical Book 20%
- Viva 10%
-

Week-Wise Distribution:

Week#	Topic to be covered
Week 1	Course Orientation/Introduction Session, Introduction to Entomology, General characteristics of insects. Relationship with other Arthropods, splitting up in to different evolutionary lines, Reasons for success of the insects in diverse environments
	Practical: General Orientation of insect's body parts (i)
Week 2	Hard Parts: General segmentation, tagmatosis and organization. Integument: Cuticle: Detailed structure along with its biochemistry. Epidermal layer; its structure and function. Basement membrane, Cuticular outgrowths and appendages and sclerotization. Colors of Insects.
	Practical: General Orientation of insect's body parts (ii)
Week 3	Head: cephalization, sclerites, modifications. Antennae: Typical Antenna and its types.
	Practical: General Orientation of insects body parts (iii)
Week 4	Mouthparts: Mouthparts and their types. Different modes of ingestion and types of mouthparts.
	Practical: Dissection of any typical insects and study its visceral organ
Week 5	Neck: Sclerites. Thorax: Sclerites: legs, their different modifications and functions
	Practical: Dissection and study Digestive system
Week 6	Wings: Origin; Different regions. Development and basal attachments, main veins and their branches (generalized insects),
	Practical: Dissection and study Nervous system
Week 7	Modifications of wings and wing coupling. Flight: Types of flight.
	Practical: Dissection and study Reproductive system
Week 8	Abdomen: Secondary appendages and external genitalia.
	Practical: Dissection and study Reproductive system
Week 9	Midterm Examination

Week 10	Soft Parts: Muscular system; basic structure, types of muscles; muscle contraction and its energetics.
	Practical: 1. Field visits for collection of different developmental stages of insects belonging to different orders.
Week 11	Comparative structure of all the systems, e.g., digestive, excretory, respiratory, incubatory, reproductive and nervous system and their physiology.
	Practical: 2. Field visits for collection of different developmental stages of insects belonging to different orders.
Week 12	Development: Embryogenesis, Different types of metamorphosis, apolysis and ecdysis and the role of endocrine secretions.
Week 13	Population dynamics: Density dependent and density independent factors regulating insect population. Life history and life tables.
	Practical: 3. Field visits for collection of different developmental stages of insects belonging to different orders.
Week 14	Carrying capacity r and k selection. Food chains. Predation and competition.
	Practical: Preparation of permanent slides. All the hard parts (antennae, mouth parts, wings, legs and genitalia).
Week 15	Insect defenses and adaptations. Diapause. Insect communication
	Practical: Field visits and report writing of ecological interactions of different insects.
Week 16	Final Examination

Reference Books (latest Editions) :

1. Schowalter, T.D., 2017. Insect Ecology: An Ecosystem Approach. Academic Press.
2. Ambrose, D.P., 2015. The Insects: Structure Functions and Biodiversity. Kalyani publishers, Ludhiana, India.
3. Atwal, A.S., 2015. Agricultural Pests of Southeast Asia and their Management. Kalyani Publishers, Ludhiana.
4. Chapman, R. F., 2013. The Insects-Structure and Function. 5th Edition. Cambridge University Press, New York.

5. Gullan, P. J. and Cranstan, P. S., 2014. The Insects: An Outline of Entomology. 4th edition. Wiley-Blackwell. A John Wiley & Sons, Ltd., Publication, UK.
6. Miller, S.A., 2002. General Zoology Laboratory Manual. 5th Ed. (International), Singapore: McGraw Hill.
7. Pedigo, L.P. and Marlin, E. R. 2009. Entomology and Pest Management, 6th Edition, Person Education Inc., Upper Saddle River, New Jersey 07458, U.S.A.
8. Price, P.W., Denno, R.F., Eubanks, M.D., Finke, D.L., and Kaplan, I., 2011. Insect Ecology: Behavior, Populations, and Communities. Cambridge University Press.
9. Richards, O.W. and Davies, R.J. Imm's General Textbook of Entomology. 1977. Vol-. Chapman & Hall, London.

ZOOL311 Physiology

Course Title	:	Physiology
Course Code	:	ZOOL311
Offered to	:	Undergraduate Students at Hazara University
CrHr	:	3 (2+1)
Pre-requisite	:	None

Course Objective:

At the end of the course the student will be able to:

- Understand on the molecular and cellular mechanisms of physiological function as the basis of unity in diverse animals e.g. membrane excitability, exchange of respiratory gases, removal of nitrogenous wastes tissue, osmotic and organ physiological mechanisms underlying animal homeostasis and temperature effects.
- Grasp the development of performing the function developed at molecular and cellular level in the complexity of the animals such as chemical & nervous integration, respiratory and excretory functions.
- Know the strategy acquired to perform the functions in diverse environment such as in dry & aquatic and cold and hot at molecular and cellular level and regulations to achieve strategy by chemical and nervous regulation at organ levels.
- Comprehend the concepts in homeostasis and integration in sustaining the life in constantly changing conditions.

Course Learning Outcome (CLOs)

Following the completion of this course, each student should have:

- An understanding of critical concepts, processes, and factual information in the performance of functions and changing conditions.
- A knowledge of resources for finding the solution for strategies to sustain diverse forms of animal life kept and in wild in normal and abnormal conditions. 3. The ability to utilize knowledge of animal physiology in critical study and for making intelligent decisions in professional life.

Course Contents:

Central themes in Physiology: Homeostasis, Concepts of conformity and regulation; physiological adaptations.

Membrane Physiology: Ionic distribution across membrane, Resting membrane potentials: Electrogenic ion pump, Donnan equilibrium, Ion channels

Nerve and Muscle Physiology: Action potentials in neurons; Electrical and chemical synaptic transmission; Neurotransmitters; Excitatory and inhibitory postsynaptic potentials; tetany; Muscles: Structure, types, components, muscle proteins, molecular basis of muscle contraction: sarcoplasmic reticulum and role of calcium, muscle action potentials, isometric and isotonic contraction, leverage factor, muscle fatigue.

Endocrine Physiology: Gland types; Hypothalamus, Pituitary, Thyroid, Parathyroid, Pineal, Pancreatic Islets, Gastric glands, Adrenal, Ovary, Testis and Placenta; Overview of hormones; types, peptide and steroid hormones, chemistry, synthesis and roles. Hormone receptors and signal transduction. Feedback mechanisms.

Cardiovascular Physiology: Electrical activity of heart: Autorhythmicity, Electrocardiography, Kymography; Hemodynamics, Relationship between blood flow, pressure and resistance. Control of cardiac activity, cardiac output and peripheral circulation.

Respiratory Physiology: Respiratory epithelia, gas exchange in gills and lungs; Transport of O₂ and CO₂, Structure of alveoli, lung volumes and capacities, surfactants, control of breathing; hypoxia; Hypercapnia etc., air breathing in divers.

Renal Physiology: Osmoregulation: Osmoregulation in aquatic and terrestrial animals; Kidney and Vertebrate nephron as osmoregulatory and

excretory organ: Glomerular filtration, Tubular absorption and secretion; Nitrogenous waste products; Patterns of nitrogenous excretion and their phylogenetic significance.

Physiology of Digestion: Physiologic anatomy of digestive tract (mammalian model), Regulation of digestive secretions; Absorption

of water, ions and nutrients; Potential and Movements in gastrointestinal tract; Control of motility. Deglutition, Peristalsis, Absorption, Assimilation and defecation.

Teaching Methodology:

- 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#	Topic to be covered
Week 1	Central themes in Physiology: Homeostasis,
Week 2	Membrane Physiology
Week 3	Electrogenic ion pump, Donnan equilibrium, Ion channels
Week 4	Action potentials in neurons; Electrical and chemical synaptic transmission
Week 5	Muscle Physiology
Week 6	molecular basis of muscle contraction
Week 7	Endocrine Physiology: Gland types; Hypothalamus

Week 8	Pituitary Glands
Week 9	Midterm Examination
Week 10	Thyroid, Parathyroid, Pineal
Week 11	Pancreatic Islets, Gastric glands, Adrenal, Ovary, Testis and Placenta
Week 12	Overview of hormones; types, peptide and steroid hormones, chemistry, synthesis and roles. Hormone receptors and signal transduction
Week 13	Respiratory Physiology: Respiratory epithelia, gas exchange in gills and lungs
Week 14	Renal Physiology: Osmoregulation: Osmoregulation in aquatic and terrestrial animals;
Week 15	Physiology of Digestion: Physiologic anatomy of digestive tract Cardiovascular Physiology: Electrical activity of heart
Week 16	Final Examination

Reference Books (latest Editions) :

1. Guyton, A.C., Hall, J.E. 2013. Textbook of Medical Physiology, 10th Ed. W.B. Saunders Company, Philadelphia. Sherwood 2013
2. Tharp, G., Woodman, D. 2010. Experiments in Physiology, 10th Ed. Benjamin Cummings.
3. Fox, S. 2010. Laboratory manual of human physiology. McGraw-Hill Sciences.
4. Randall, D., Burggren, W., French, K., Fernald, R. 2002. Eckert Animal Physiology: Mechanisms and Adaptations, 5th Ed. W.H. Freeman and Company, New York
5. Bullock, J., Boyle, J., Wang, M.B. Physiology, 4th Ed. 2001. Lippincott, Williams and Wilkins, Philadelphia.
6. Berne, R.M., Levy, M.N. 2000. Principles of Physiology, 3rd Ed. St. Louis, Mosby.
7. Withers, P.C. 1992. Comparative Animal Physiology. Saunders College Publishing, Philadelphia.

8. Schmidt-Nelsen, K. 1997. *Animal Physiology, Adaptation and Environment*, 5th Edition. Cambridge University Press, Cambridge.

ZOOL428 ZOOLOGICAL TECHNIQUES

Course Title	:	Zoological techniques
Offered to	:	Undergraduate Students at Hazara University
CrHr	:	3(2+1)
Pre-requisite	:	None

Course Objectives:

The course aims to:

- Familiarize the students with advance biological equipments and technique
- Develop basic understanding of the equipment handling in research.
- Develop scientific and technical expertise, culture and work habits.

Course Learning Outcomes:

After studying this course students must be able to:

- Understand advanced biological techniques
- Apply practical and research skills
- Operate and use the lab equipment efficiently.

Course Outlines:

- UV Spectroscopy/Separations, Flame Atomic Absorption Spectroscopy,
- Spectrofluorimetry, Thin Layer Chromatography (TLC), Gas Chromatography,
- High Performance Liquid Chromatography (HPLC), Amino acid sequencing,
- Blotting techniques, Centrifugation techniques, PCR, DNA Sequencing,
- Electrophoresis, Isoelectric Focusing Apparatus, Lyophilizer, Microarray
- Technology, Microscopy, Microtomy, Nuclear Magnetic Resonance
- Instrument, principles and application, Geographic Information Systems and
- Remote sensing, ELISA, Cell culture.

Week-Wise Distribution:

Week#	Topic to be covered
Week 1	UV Spectroscopy/Separations
Week 2	Flame Atomic Absorption Spectroscopy, Spectrofluorimetry
Week 3	Thin Layer Chromatography (TLC), Gas Chromatography, High Performance Liquid Chromatography (HPLC),
Week 4	Amino acid sequencing,
Week 5	Blotting techniques,
Week 6	Centrifugation techniques,
Week 7	PCR,
Week 8	DNA Sequencing,
Week 9	Midterm Examination
Week 10	Electrophoresis,
Week 11	Isoelectric Focusing Apparatus, Lyophilizer,
Week 12	Microarray Technology, Microscopy,
Week 13	Nuclear Magnetic Resonance Instrument, principles and application
Week 14	Geographic Information Systems and Remote sensing,
Week 15	ELISA, Cell culture.
Week 16	Final Examination

Practicals

1. Observation of wet mounts of human cheek cells employing bright and dark field microscopy
2. Measurement of cell size: bacterial and eukaryotic
3. Recording of microscopic observations with the help of camera lucida
4. Liquid handling: proper use of pipettes and micropipettes
5. Histological preparations: skeletal muscle, intestine liver and testes
6. Handling of centrifuge machines
7. Thin layer chromatography of amino acids
8. Spectrophotometric estimation of glucose
9. Spectrophotometric estimation of total proteins
10. Preservation of representative animals of various phyla
11. Electrophoretic separation of proteins
12. Electrophoretic separation of DNA

Books Recommended:

1. Chemical Analysis: Modern instrumentation, methods and techniques, Francis Rouessac and Annick Rouessac, John Wiley & Sons, 2000, ISBN 0-471-97261-4.
2. Principles of Instrumental Analysis (5th ed), Douglas A. Skoog, F. James Holler and Timothy A. Nieman, Brooks Cole, 1997, ISBN 0-03-002078-6.
3. Spectrometrische analysetechnieken, M.T.C. de Loos - Vollebregt, Heron reeks - Bohn Stafleu Van Loghum, 2004, ISBN 90-313-4142-8.

Scheme of Studies for MS/M.Phil. Zoology

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	26
Total		50

Scheme of Studies for PhD Zoology

Semester	Subject	Credits
First	Course I (University Course-1)	3
	Course II (University Course-II)	3
	Course III	3
	Total	09
Second	Course IV	3
	Course V	3
	Course VI	3
	Total	09
Third-Fourth	Thesis	26
Total		44

LIST OF PROPOSED COURSES AND COURSE CODES FOR MPHIL IS GIVEN BELOW

Course Code	Course Title	Credit Hours
HBS600	Research Methodology for Health & Biological Sciences (Compulsory course)	3+0
STAT500	Advance Data Analysis for Health & Biological Sciences (Compulsory course)	3+0
ZOOL704	Advances in Immunology	3+0
ZOOL705	Advances in Aquaculture	3+0
ZOOL706	Advances in Cell Biology	3+0
ZOOL707	Advances in Ecology	3+0
ZOOL708	Advances in Helminthology and Protozoology	3+0
ZOOL709	Advances in Protozoology	3+0
ZOOL710	Advances in Helminthology	3+0
ZOOL711	Advanced Cell and Molecular Biology*	3+0
ZOOL712	Advances in Wildlife*	3+0
ZOOL713	Applied Genetics*	3+0
ZOOL714	Applied Microbiology*	3+0
ZOOL715	Applied Reproductive Physiology	3+0
ZOOL716	Aqua Culture Biotechnology	3+0
ZOOL717	Aquaculture	3+0
ZOOL718	Aquaculture and Fisheries*	3+0
ZOOL719	Aquaculture Biotechnology	3+0

ZOOL720	Aquaculture System Management	3+0
ZOOL721	Bacterial Genetics*	3+0
ZOOL722	Biology of Birds and Mammals In Pakistan*	3+0
ZOOL723	Biological Toxicology*	3+0
ZOOL724	Cellular and Molecular Physiology	3+0
ZOOL725	Classification of Insects and Pest Management	3+0
ZOOL726	Clinical Bacteriology	3+0
ZOOL727	Clinical Endocrinology	3+0
ZOOL728	Clinical Immunology	3+0
ZOOL729	Clinical Teratology*	3+0
ZOOL730	Conservation Biology of Wildlife*	3+0
ZOOL731	Diagnostic Parasitology	3+0
ZOOL732	Environmental Toxicology	3+0
ZOOL733	Epidemiology of Animal Parasite	3+0
ZOOL734	Fish and Aquatic Toxicology	3+0
ZOOL735	Fish Nutrition and Health	3+0
ZOOL736	Fish Requirements*	3+0
ZOOL737	Fishing Gear Technology	3+0
ZOOL738	Freshwater Biology	3+0
ZOOL739	General Pharmacogonosy	3+0

ZOOL740	General Toxicology	3+0
ZOOL741	Herpetology	3+0
ZOOL742	Human Genetics*	3+0
ZOOL743	Industrial Biotechnology	3+0
ZOOL744	Lab and Biosafety*	3+0
ZOOL745	Medical Biotechnology*	3+0
ZOOL746	Medical and Veterinary Parasitology	3+0
ZOOL747	Medical Microbiology*	3+0
ZOOL748	Medical Parasitology*	3+0
ZOOL749	Medical Virology	3+0
ZOOL750	Mendelian Genetics	3+0
ZOOL751	Molecular Endocrinology	3+0
ZOOL752	Molecular Entomology*	3+0
ZOOL753	Molecular Evolution	3+0
ZOOL754	Molecular Parasitology	3+0
ZOOL755	Molecular Physiology*	3+0

HBS600 Research Methodology for Health and Biological Sciences

Program	M.Phil/PhD (preferably 1 st semester)
Semester	Spring 2021
Course Code	HBS600
Course Title	Research Methodology for Health and Biological Sciences
Credit Hours	3 (3+0)
Prerequisites by Course(s) and Topics	None
Logistics/Key dates/Schedule for lectures	As per timetable
Grading Policy/Assessment with Weights	In accordance with HU Policy, the percentage allocated for each type of assessment is given below. Midterm : 30% Quiz : 10% Assignment : 10% Final/Terminal : 50% Exam
Teacher Name	Dr. Isfahan Tauseef
Description/Summary of course	The significance of research lies in its quality and not in quantity. Paying due attention to designing and adhering to the appropriate methodology is the single most important aspect for improving the quality of research. Several research studies are undertaken and accomplished year after year in the field of Biological and Health Sciences. However, in most cases, very little attention is paid to this important dimension i.e. Research Methodology. Keeping this in view, this course has been designed to enable Health and Biological sciences researchers in developing the most appropriate methodology for their research studies and to make them familiar with the art of using different research methods and techniques. The course would develop the scientific curiosity, creativity and independent thinking required of a successful scientist. The topics are well arranged in a coherent manner and will present an overview of the research methodology, performing literature review, the technique of defining a research problem, various research designs and other relevant topics. Finally, the course will also train the students to apply theoretical knowledge towards scientific writing of proposal and other scientific documents.
Learning Objectives	The objectives of this course are: To impart knowledge regarding selection of a research topic, literature survey and selection of most appropriate methodology for conducting a research

Learning Outcomes	• To equip the students with necessary skills required for developing research proposals and designing experiments. After completing this course, the students will be expected to: • Acquire necessary skills and theoretical/practical knowledge of various research designs and methods used in biological/health sciences. • Think critically, select a scientific question and search literature using various sources/databases dedicated for biological science research. • Design the experiments independently and select the appropriate methods/techniques. • Develop a “Pre-Proposal Proposal” in the field of interest.
Textbook/Reference Material	• Kumar, R. (2019). Research Methodology; A step-by-step guide for Beginners, 5th edition SAGE Publications. London. Thousand Oaks. New Dehli. • Laake, P., Benestad, H. B. and Olsen, B. R. (2015) Research Methodology in the Medical and Biological Sciences, Elsevier Ltd. 84 Theobald’s Road, London WC1X 8RR, UK. • Sahu, P.K (2013). Research Methodology: A Guide for Researchers in Agricultural Science, Social Science and Other Related Fields. ISBN 978-81-322-1019-1. Springer • Sing, Y. K. (2006). Fundamental of Research Methodology and Statistics. New Age Inter. Publishers. • Kothari, C. R. (2008). Research Methodology, Methods and Techniques. 4th Edition, New Age International (Pvt.) Ltd. • Leedy, P.D and Ormrod, J.F (2009). Practical Research: Planning & Design. Merrill publications. • Graziano and Ranlin (2006). Research methods: A process of Inquiry. Pearson New International Edition. Pearson Education Limited, Edinburgh Gate, Harlow, UK. • Fink, A.G. (2004). Conducting Research Literature Reviews: From the Internet to Paper. Saga Publications.
Other Course Materials	The relevant lecture material i.e., notes, slides etc. will be added week-wise before/after the delivery of scheduled lecture (as and when found appropriate by the instructor). The students are advised to regularly visit the University LMS/CMS for the access of uploaded material.
Lab work (if applicable)	NA
Other Rules	NA

Major topics to be covered:

- Research Methodology; An introduction: Introduction to research, explanation of research terms and basic concepts, reason to perform and types/classification of research.
- Research in Health and Biological Sciences; Planning, Process, Project Development, and Important Steps.
- Getting started with research: Sources for perceiving a research problem, Criteria for Selection of Problem, Characteristics of a Good research problem, important steps in Formulation/Defining, and Refinement of a Problem for Research, Importance of a Clearly Defined Research Problem.
- Introduction to Critical Thinking; Critical Appraisal & Study Skills; How to read scientific material?
- Basic E-Library Skills, Extensive literature review to validate the problem and to develop new research ideas.
- Defining hypothesis and Conceptualizing a research design; Research design and its types
- Designing and structuring different sections of the synopsis/research proposal for thesis and research grants, Fine-tuning Research proposal
- Experimental design and investigation, Methodology for experiments
- Methods of Data Collection and type of data sources (Primary and Secondary)
- Data recording, processing and statistical analysis using different software.
- Interpretation, presentation (tables & figures) and displaying of results and their discussion.
- Thesis (dissertation) and research article write up.
- Selection of relevant and suitable forum/journal for publishing/presentation of research (talks, poster)
- Ethical issues and considerations, acknowledgments, conflict of interest, ownership of data, similarity index and its software, plagiarism issues and how to avoid plagiarism.

Handouts on Arrival of Research Students

- Role and responsibilities of Research Student and Supervisor

Week-wise distribution of course contents

Week	Activity	Course Topic	Details of Topics
1	Class Work	Research Methodology; An introduction	• Introduction to research • Explanation of research terms and basic concepts • Meaning of Research • Reasons to Perform Research/Objectives/Purpose • Motivation of Research • Types and classification of Research in Biological Sciences • Characteristics of a good research • Principles of Research
2	Class Work	Research in Health and Biological Sciences; Planning, Process, Project Development, and Important Steps	• Research in Biological Sciences • Biological Scientists - What They Do? • Research in Health Sciences; What Health Scientists Explore? • The planning and Research Process in Health and Biological Sciences • Project Development and Steps/Levels/Phases in Research
3	Class Work	Getting started with research	• What Is A Research Problem? • The starting point: Perceiving and selecting a research problem • Source/ways for perception/selection of a research problem • Criteria for Selection of Problem • Characteristics of a Good research problem • Formulation/Defining, and Refinement of a Problem for Research; important steps • Importance of a Clearly Defined Research Problem

4	Class Work & Practice session	Literature Review	• Meaning of review of literature and why it matters? • Need and Objectives of review of literature • Procedure and sources of review of literature • Using the libraries for Literature survey • Online tools for literature survey • How literature review helps to check the validity of a proposed project?
5	Class Work & Practice session	Introduction to Critical Thinking	• Critical thinking and its importance • Study Skills • How to Read and Understand a Scientific Paper? • Critical appraisal of a scientific article
6	Class Work & Practice session	Basic E-Library Skills	• Extensive literature review to validate the problem and to develop new research ideas
7	Class Work	Defining hypothesis and conceptualizing a research design	• What is a research hypothesis? • Kinds of hypothesis • Role of hypothesis in research • Characteristics of a good research hypothesis • Meaning and need of research design • Research design and its types • Features and characteristics of a good research design • Steps in research design
8	Class Work	Designing and structuring different sections of the synopsis/research proposal	• How to write a synopsis/research proposal for thesis and research grants • Designing and structuring different sections of the synopsis • Major sections of a synopsis • Fine-tuning a research proposal • Use of Endnote for bibliography
Mid-Term Examination/Mid-Semester Break for students			
9	Class Work	Experimental design and investigation	• Experimental design • Basic principles for experimental designs • Important experimental designs • Methodology for experimentation and investigation

10	Class Work	Data Collection and data sources	• What is data? • Nature of data (Qualitative & Quantitative data) • Need for data collection • Methods/tools for Data Collection • Type of data sources • Primary data • Secondary data • Ethical consideration in data collection
11	Class Work & Assignment	Data recording, processing, and statistical analysis	• Effective recording of data • Need for analysis of data • Data processing and types of statistical analyses • Common software for data analysis
12	Class Work & Quiz	Interpretation and presentation of data	• Text and illustrative methods for Presentation of data • Displaying of results through tables, figures, videos, chart and other methods • Meaning of interpretation • Discussion
13	Class Work	Thesis (dissertation) and research article write up	• Types of Scientific research reports • Need and significance of scientific reports • Format and major sections of thesis (dissertation) • Layout and general format of a research report • Writing abstract and research articles
14	Class Work	Selection of relevant/suitable scientific forum/journal for publishing/presentation	• Types of scientific forums • Selection of relevant and suitable Scientific forums • Selection of journal for publishing • Conference/Seminar/symposium and workshops • Scientific presentation/talk • Poster presentation
15	Class Work	Ethical issues and considerations	• A brief introduction to research ethics • Scientific conduct and misconduct • Acknowledgments • Conflict of interest • Ownership of data • Similarity index and its software • Plagiarism issues • How to avoid plagiarism

Final Term Examination and Results

STAT500 Advance data analysis

Course Title	:	Advance data analysis
Course Code	:	STAT500
Offered to	:	Graduate Students at Hazara University
CrHr	:	3 (3+0)
Pre-requisite	:	None

Course Objective:

- To illustrate the importance of statistical analysis
- To describe the methods for data collection, summarization, and analysis by using a statistical software

Course Learning Outcome (CLOs)

- To provide sufficient background and situation experience to judge when an applied technique will likely lead to incorrect conclusions.
- To develop the student's ability to recognize which types of statistical methods are best suited to which types of problems.

Course Contents:

- Data and types of data
- Some statistical concepts
- Common statistical measures
- Bivariate statistics
- Contingency tables.
- Statistical tests for continuous variables
- R software/Minitab/SPSS for data analysis
- Linear regression and ANOVA techniques
- Model fitting
- Model results and diagnostics
- Regression generalizations and modeling
- Multivariate statistics procedures/Data mining procedures
- Graphical options in statistical methods
- Simulation Data
- Simulated data applications

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#	Topic to be covered
Week 1	Data and types of data
Week 2	Some statistical concepts
Week 3	Common statistical measures
Week 4	Bivariate statistics
Week 5	Contingency tables.
Week 6	Statistical tests for continuous variables
Week 7	R software/Minitab/SPSS for data analysis
Week 8	Linear regression and ANOVA techniques
Week 9	Midterm Examination
Week 10	Model fitting
Week 11	Model results and diagnostics
Week 12	Regression generalizations and modeling
Week 13	Multivariate statistics procedures/Data mining procedures
Week 14	Graphical options in statistical methods
Week 15	Simulation Data Simulated data applications
Week 16	Final Examination

Recommended Books:

1 Pardo, S. Statistical Analysis of empirical data: Methods for applied sciences (First edition), Springer, 2020

2 Burr IW. Applied statistical methods (First edition), Elsevier, 2014

- 3 James G, Witten D, Hastie T, Tibshirani R. An introduction to statistical learning (Second edition), Springer; 2009.
- 4 Chaudhuri A, Stenger H. Survey sampling: theory and methods (Second edition) CRC Press; 2020
- 5 Bethea RM. Statistical methods for engineers and scientists (Third edition); CRC Press, 2019

ZOOL713 Applied Genetics

Course Title	:	Applied Genetics
Course Code	:	ZOOL713
Offered to	:	Graduate Students at Hazara University
CrHr	:	3 (3+0)
Pre-requisite	:	None

Course Objective:

The course aims at

- to impart knowledge about the continuity of the life from one generation to other generation, to know the mechanisms involving nucleus, chromosomes and genes etc

Course Learning Outcome (CLOs)

On completion of the course, the student should be able to:

- explain how genetics can help plant and animal conservation as well as be used to study living organisms
- describe the different methods utilized in genetic improvement of plants and animals and explain their advantages and disadvantages
- communicate effectively with professional scientists using relevant written language
- compile logical arguments to answer a question or put forward a point of view.

Course Contents:

- Nucleic acids. Plant and animal viruses (DNA and RNA) and their importance in molecular biology.
- Tumor viruses, retroviruses, conjugation, gene mapping, transformation and transduction, Integration of viral DNA, consequences of Integration.
- Transposition: transposable elements, detection of transposition in bacteria, types of bacterial transposons, modes of transposition in bacteria.
- Genetic phenomena mediated by transposons, transposable elements in prokaryotes and eukaryotes.
- Gene expression in pro- and eukaryotes.
- Genetic transformation (all kinds).
- Regulation of simple and complex transcription unit.
- Advances in genetics: molecular techniques viz. Southern, Northern and Western blotting, PCR, RFLP, AFLP's, RAPDs, Micro-sattelites, SNPs.

Practicals

1. Isolation of nucleic acids

2. Qualitative and quantitative measurement of concentration, digestion with specific restriction enzymes and gel electrophoresis.
3. Plasmid isolation and characterization.
4. Denaturation and renaturation of DNA.
5. Applications of different molecular techniques including PCR, RFLP, AFLPs, RAPDs, etc.

Teaching Methodology:

- Student-centered teaching through communicative approach
- 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	Course Orientation/Introduction Session
Week 2	Nucleic acids structure and functions.
Week 3	Plant and animal viruses (DNA and RNA) and their importance in molecular biology.
Week 4	Tumor viruses, retroviruses, conjugation.
Week 5	Gene mapping, transformation and transduction.
Week 6	Integration of viral DNA, consequences of Integration.

Week 7	Transposition: transposable elements, detection of transposition in bacteria, types of bacterial transposons, modes of transposition in bacteria.
Week 8	Genetic phenomena mediated by transposons, transposable elements in prokaryotes and eukaryotes.
Week 9	Midterm Examination
Week 10	Gene expression in pro- and eukaryotes.
Week 11	Genetic transformation (all kinds).
Week 12	Transformation, transduction, conjugation and cross-phylogenetic transfer.
Week 13	Gene mapping by conjugation and transduction.
Week 14	Advances in genetics: molecular techniques viz. Southern, Northern and Western blotting, PCR.
Week 15	Advances in genetics: molecular techniques viz. RFLP, AFLP's, RAPDs, Micro-satellites, SNPs.
Week 16	Final Examination

Reference Books (latest Editions) :

7. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J.D., 2002. Molecular biology of the cell. Garland Pub. Inc., London.
8. Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. and Inglis, C.H.S.L.P., 2008. Molecular biology of the gene. San Francisco, CA, USA:: Pearson/Benjamin Cummings.
9. Snyder, L., Champness, W. and Champness, W., 2007. Molecular genetics of bacteria (Vol. 3). Washington, DC: Asm Press.
10. Casali, P., 2014. Lewin's Genes XI.

ZOOL721 Bacterial Genetics

Course Title	:	Bacterial Genetics
Course Code	:	ZOOL721
Offered to	:	Graduate Students at Hazara University
CrHr	:	3 (3+0)
Pre-requisite	:	None

Course Objective:

The course aims at

- to impart knowledge about the continuity of the life from one generation to other generation,
- to know the mechanisms involving nucleus, chromosomes and genes etc

Course Learning Outcome (CLOs)

On completion of the course, the student should be able to:

- explain the processes behind mutations and other genetic changes
- identify and distinguish genetic regulatory mechanisms at different levels
- solve theoretical and practical problems in genetic analysis particularly concerning genetic mapping and strain construction
- identify genes and mutations in non-annotated sequence data from databases by means of relevant bioinformatics programs
- plan basic experiments in microbial genetics concerned with clarifying phenotypes and their relationship with the genotype
- use common methods in microbial genetics
- describe and summaries experimental work in a correct way in a laboratory notebook.

Course Contents:

- Nucleic acids structure and functions.
- DNA replication: replicon origins, events that occur at the replication fork, the structure and functions of DNA polymerases, and replication strategies.
- Control of DNA replication: dichotomous replication in prokaryotes.
- Control of gene expression in prokaryote: polycistrons, transcriptional initiation and termination, the operon, catabolite repression and attenuation control.
- Protein synthesis - mRNA translation: Genetic code - non universality, codon usage.
- Events on ribosomes (c.f. prokaryotes), ribosome structure function relationships, organelle and archaebacterial systems.
- Plasmids, episomes and transposons.
- DNA mutagenesis and mutagenic agents, repair and mutation suppression.

- Genetic recombination: generalized recombination, site specific recombination and Illegitimate recombination.
- Gene transfer mechanisms and their role in evolution.
- Transformation, transduction, conjugation and cross-phylogenic transfer.
- Gene mapping by conjugation and transduction.
- Circular chromosomal maps of bacteria.
- Introduction to genetic rearrangements.

Practicals

1. Plasmid extraction.
2. Nucleic acid extraction (DNA & RNA).
3. Transformation, transduction, conjugation.
4. Catabolite repression through growth curve.
5. Beta galactosidase assay.

Teaching Methodology:

- Student-centered teaching through communicative approach
- 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	Course Orientation/Introduction Session
Week 2	Nucleic acids structure and functions.
Week 3	DNA replication: replicon origins, events that occur at the replication fork, the structure and functions of DNA polymerases, and replication strategies.
Week 4	Control of DNA replication: dichotomous replication in prokaryotes.
Week 5	Control of gene expression in prokaryote: polycistrons, transcriptional initiation and termination, the operon, catabolite repression and attenuation control.
Week 6	Protein synthesis - mRNA translation: Genetic code - non universality, codon usage.
Week 7	Events on ribosomes (c.f. prokaryotes), ribosome structure function relationships, organelle and archaeobacterial systems.
Week 8	Plasmids, episomes and transposons.
Week 9	Midterm Examination
Week 10	DNA mutagenesis and mutagenic agents, repair and mutation suppression.
Week 11	Genetic recombination: generalized recombination, site specific recombination and Illegitimate recombination.
Week 12	Gene transfer mechanisms and their role in evolution.
Week 13	Transformation, transduction, conjugation and cross-phylogenic transfer.
Week 14	Gene mapping by conjugation and transduction.
Week 15	Circular chromosomal maps of bacteria, Introduction to genetic rearrangements.
Week 16	Final Examination

Reference Books (latest Editions) :

11. Pierca, B. A., 2005. Genetics. A conceptual approach, W. H. Freeman and Company, NY.
12. Griffiths, A. J. F., Wessler, S. R., Lewontin, R. C., Gelbart, W. M., Suzuki, D.T. and Miller, J. H., 2005, Introduction to Genetic Analysis, W. H. Freeman and Company.
13. Hartl, D. L. and Jones, E. W., 2005, Genetics - Analysis of Genes and Genomes, Jones and Bartlett Publishers. Sudbury, U.S.A.
14. Ignacimuthu, S., 2005, Basic Bioinformatics, Narosa Publishing House, India.
15. Lwein, B., 2004, Gene VIII, Pearson Education Int.
16. Primrose, S. B., and Twyman, R. M., 2006. Principles of Gene Manipulation and Genomics. Blackwell Scientific Publications.
17. Wilson, J. and Hunt, T., 2004. Molecular Biology of the cell – the problems book, Garland publishing Inc.
18. Jack, J. P., 2005. An Introduction to Human Molecular Genetics, 2nd edition New Jersey.
19. Ringo, J., 2004. Fundamental Genetics, Cambridge University Press.

ZOOL742 Human Genetics

Course Title	:	Human Genetics
Course Code	:	ZOOL742
Offered to	:	Graduate Students at Hazara University
CrHr	:	3 (2+1)
Pre-requisite	:	None

Course Objective:

This course aims

- to enhance knowledge pertaining to different inheritance patterns in humans (autosomal dominant, autosomal recessive, X-linked inheritance, and mitochondrial/maternal inheritance).
- It will also emphasize on concepts such as gene mapping/linkage analysis, human genome project, and implications of different mutations on human health. T
- his course will further enhance students' knowledge about various sequencing methodologies and relevant databases/in-silico tools used in human genetics.

Course Learning Outcome (CLOs)

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

- Outline basic knowledge of human genetics and different terminologies.
- Differentiate between different modes of inheritance in humans
- Understand the roles of different mutation types on human health
- Comprehend on human genome project and its role in modern genetics
- Know about various sequencing methodologies used in this era

Course Contents:

- Human Genome Project (HGP)- Impact of human genes on health
- Somatic Cell Karyotyping
- Single Gene Traits (also called Monogenic or Mendelian traits) in humans
- Complex Traits versus Multifactorial traits
- Quantitative traits
- Sex limited versus sex-influenced traits
- Extensions/Exceptions to Mendelian Principles
- Pedigree analysis for determination of the mode of inheritance of a trait/disease in humans
- Linkage analysis and gene mapping
- Sequencing technologies and databases used in human genetics

Teaching Methodology:

- Student-centered teaching through a communicative approach
- Multimedia-based lectures
- Computer-facilitated lessons and strategies for *in-silico* analysis
- 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#	Topic to be covered
Week 1	Course Orientation/Introduction Session, Brief history about genetics and an Introduction to different terminologies used in Human Genetics course
Week 2	Human genome project (HGP)-Ethical and legal concerns and implications on human health
Week 3	Discrimination between Mendelian and Non-Mendelian Traits along with different modes of inheritance (autosomal dominant, autosomal recessive, X-linked inheritance, and mitochondrial/maternal inheritance).
Week 4	Construction and use of pedigree analysis to differentiate between different modes of inheritance followed by human monogenic disorders/traits
Week 5	Exceptions to Mendelian inheritance- variable expressivity and incomplete penetrance, Genetic heterogeneity
Week 6	Exceptions to Mendelian inheritance-Phenocopies versus pleiotropy, multiple alleles
Week 7	Quantitative traits/multifactoriel traits versus Qualitative (Explantations with examples)

Week 8	Complex traits (Traits with unknown genetic etiologies)
Week 9	Midterm Examination
Week 10	Gene mapping and linkage analysis
Week 11	Sex-limited versus sex-influenced traits (explanations with examples)
Week 12	Various sequencing methodologies such as Sanger Sequencing and Next-generation sequencing (NGS)
Week 13	Databases and in-silico tools used in human genetics
Week 14	Somatic Cell Karyotyping for detection of gross chromosomal deletions/re-arrangements
Week 15	Mutation types (missense, nonsense, insertion-deletions (indels), frameshift mutations and splicing defects)
Week 16	Final Examination

Practicals:

- Study of different qualitative and quantitative traits.
- Pedigree analysis.
- Analysis of sex chromosomes in Inter-phase nuclei.
- Karyotyping of normal and abnormal human chromosomes.
- Screening of metabolic and other disorders.
- Dermatology of normal and mentally retarded individuals.
- Problems solving on genetic counseling.

Books Recommended:

- Strachan, T., A. P. Read, Human Molecular Genetics, 3rd edition, Garland Science/Taylor & Francis. 2003.
- Ehrlich P.R., Human Natures: Genes, Cultures, and the Human Prospect, 1st edition, Penguin USA Paper, 2002.
- Relethford J. H., Genetics and the Search for Modern Human Origins, Wiley-Liss 2001.
- 4. Annual Review of Genomics and Human Genetics (Annual Review of Genomics and Human Genetics, Vol 2, Annual Reviews, 2001.

ZOOL712 ADVANCES in wild life

Course Title	:	Advances in wild life
Course Code	:	Zool-712
Offered to	:	Graduate Students at Hazara University
CrHr	:	3 (2+1)
Pre-requisite	:	None

Course Objectives:

Course Objectives: The objective of this course is

- To enable the student to understand philosophy and significance of wildlife conservation
- To understand the wildlife management rules and regulations in Pakistan
- To understand how National and International agencies are involved in conservation and management of wildlife
- To understand the process of wildlife conservation
- To know the wildlife requirements
- To elaborate the threats to the wild animals and their management.

Course Learning Outcomes (CLOs)

At the end of course the students are able to:

- Acquire theoretical knowledge about the identification, distribution, status, conservation and management of amphibians, reptiles, birds and mammals of major importance in Pakistan
- Understand the protected area system (game reserves, wildlife sanctuaries and national parks)
- Solve the threats to wildlife by applying the scientific principles and modern technologies (sustainable development through local community participation).
- Analyze, interpret and synthesize data and other information about the population of wildlife
- Evaluate the conservation management by government department, national and international organizations
- Demonstrate the ecological assessment and importance of wildlife to certain area.
- Enable to identify and classify the wild animals on the basis of molecular taxonomy.

Course Outline

1. Wildlife of Pakistan
 - a. Introduction
 - b. Basic concepts and terminologies
 - c. Wildlife requirements, Wildlife cover, Food and water
 - d. Identification
 - e. Distribution
 - f. Conservation and Management of fishes, amphibians, reptiles, birds and mammals of major importance in Pakistan
2. Philosophy and significance of wildlife conservation,
 - a. Types of conservation: In situ and ex situ conservation
 - b. Conservation Status
 - c. IUCN categories for different groups of taxa
3. Biodiversity and sustainability of wildlife. Species approach, Ecosystem approach

4. Wildlife rules and regulations in Pakistan
 - a. Provincial Rules
 - b. Federal Management of Wildlife (NCCW)
5. National and International agencies involved in conservation and management of wildlife
 - a. National Organizations
 - b. International Organizations
6. Protected Areas in Pakistan
 - a. Sanctuaries
 - b. Game Reserves
 - c. National Parks
 - d. Community game reserves
7. Ramsar convention
 - a. Wetlands
 - b. Ramsar Criteria
 - c. Ramsar Sites of Pakistan
8. Threatened species of Pakistan.
 - a. Vulnerable
 - b. Endangered
 - c. Critically Endangered
9. Molecular basis of taxonomy of wild animals
 - a. Basic concepts
 - b. Sampling from wild animals
 - c. Phylogenetic studies based on Genomic and mitochondrial DNA

Teaching Methodology

- Lecturing
- Written assignments
- Guest speaker
- Field visits
- Report writing

Assessment

Marks Distribution:

Theory: Total 100 Marks (75%)

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

Practical: Total 100 Marks (25%)

- Performance/ Field visit note book/Animal distribution maps/ Collection/ Viva

Week-Wise Distribution:

Week#	Topic to be covered
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Week 1	Introduction, Basic concepts and terminologies Wildlife requirements, Wildlife cover, Food and water Identification, Distribution Conservation and Management of fishes, amphibians, reptiles, birds and mammals of major importance in Pakistan
Week 2	Philosophy and significance of wildlife conservation, Types of conservation: In situ and ex situ conservation Conservation Status IUCN categories for different groups of taxa
Week 3	Classification and distribution of (Amphibian and reptiles)
Week 4	Classification and distribution of (Birds)
Week 5	Classification and distribution of (Mammals)
Week 6	Classification and distribution of (Mammals)
Week 7	Biodiversity and sustainability of wildlife. Species approach, Ecosystem approach Current issue to wildlife and their possible solutions
Week 8	Wildlife rules and regulations in Pakistan a. Provincial Rules b. Federal Management of Wildlife (NCCW)
Week 9	Midterm Examination
Week 10	National and International agencies involved in conservation and management of wildlife a. National Organizations b. International Organizations
Week 11	Protected Areas in Pakistan a. Sanctuaries b. Game Reserves
Week 12	Protected Areas in Pakistan c. National Parks d. Community game reserves
Week 13	Ramsar convention a. Wetlands b. Ramsar Criteria c. Ramsar Sites of Pakistan
Week 14	Threatened species of Pakistan. a. Vulnerable b. Endangered c. Critically Endangered
Week 15	Molecular basis of taxonomy of wild animals Basic concepts, Sampling from wild animals Phylogenetic studies based on Genomic and mitochondrial DNA
Week 16	Final Examination

Practical:

1. Visit to protected areas of Pakistan (Captive, Semi-captive and Wild Areas)
2. Ecological Indices
3. Animal Distribution Maps
4. Phylogenetic analysis of NCBI retrieved data

Text and Reference Books:

1. Miller, A.S. and Harley, J.B., 1999 & 2002. Zoology, Latest Edition (International).
Singapore: McGraw-Hill.
2. Ali. S.S. 2005 Wildlife of Pakistan.
3. Odum, E.P., 1994. Fundamentals of Ecology, W.B. Saunders.
4. Smith, R.L. 1980. Ecology and Field Biology, Harper and Row.
5. Roberts, T. J., 1991, 1992. The Birds of Pakistan, Vol. I1 and II. Oxford University Press
6. Roberts, T. J., 1997. The Mammals of Pakistan, Oxford University Press
7. Robinson, W.L. and Bolen, E.G., 1984. Wildlife Ecology and Management. McMillan,
Cambridge.
8. Wildlife of the Punjab, Punjab Wildlife Department.
9. Khan M. S. 2011, Amphibian and Reptiles of Pakistan
10. Mirza Z.B. 2011 Biodiversity of Pakistan.