Scheme of Study for

Associate Degree/BS Zoology Program

Department of Zoology

University of Lakki Marwat (ULM)



(As Per New Policy 2020)

Duration:

04 Years

08

Total Semester:

Eligibility Criteria: Intermediate FSc (Pre-Medical) with at least 45% marks.

Head of Department intment of Zoology ki Marwa Head of Departmenner sistly of UTI

Director Academics

University of Lakki Marwat (ULM) Khyber Pakhtunkhwa, 28420, Pakistan

Scanned with CamScanner

1 st Semester					
S. No	Course Category	Course Code	Course Title	Credits	
1	Gen. Ed.	AH-111	Islamic History	3 (3+0)	
2	Gen. Ed.	SS-112	Sociology	3 (3+0)	
3	Gen. Ed.	NS -113	Everyday Science	3 (3+0)	
4	Gen. Ed.	EW-114	English-I	3 (3+0)	
5	Gen. Ed.	QR-115	Introduction to Statistics	3 (3+0)	
	Gen. Ed.	QR-116	ICT	3 (3+0)	1 st Year
			Total Credits	18 (18+0)	
			2 nd Semester		
S. No	Course Category	Course Code	Course Title	Credits	
1	Gen. Ed.	AH-121	History of Pakistan	3 (3+0)	
2	Gen. Ed.	SS -122	Human Psychology	3 (3+0)	
3	Gen. Ed.	NS-123	An introduction to Zoology	3 (3+0)	
4	Gen. Ed.	EW-124	English-II	3 (3+0)	
5	Gen. Ed.	QR-125	Basic Mathematics	3 (3+0)	
6	Gen. Ed.	CIV-126	Islamic studies	3 (3+0)	
			Total Credits	18 (18+0)	
			3 rd Semester		
S.No	Course	Course Code	Course Title	Credits	
	Category				
1	Major	ZOO-231	Animal diversity-I (Invertebrates)	4 (3+1)	
2	Major	ZOO-232	Animals Form and Function-I	4 (3+1)	
3	Major	ZOO-233	Cell Biology	3 (2+1)	
4	Gen. Ed.	EW -234	English-III	3 (3+0)	
5	Gen. Ed.	CIV-235	Pak Studies	3 (3+0)	_
Total C	Credits			17 (14+3)	2 nd Year
			4 ^m Semester		
S. No	Course Category	Course Code	Course Title	Credits	
1	Major	ZOO-241	Animal Diversity-II (Chordates)	4 (3+1)	
2	Major	ZOO-242	Animal Form and Function-II	4 (3+1)	
3	Major	ZOO-243	General Biochemistry	4 (3+1)	
4	Major	ZOO-244	Economic Zoology	3 (2+1)	
5	Major	ZOO-245	Animals Behaviour	3 (3+0)	
Total C	credits			18 (15+3)	
5 th Semester					
S. No	Course Category	Course Code	Course Title	Credits	
1	Major	ZOO-351	Animals Physiology	4 (3+1)	
2	Major	ZOO-352	Environmental Biology	4 (3+1)	
3	Major	ZOO-353	Molecular Biology	3 (2+1)	

Total Credits 18 (12+6)					
5		200-485	/Research/Thesis	3 (2+1)	
4			Aguagultura and Eicharias/	4(3+1)	
3		200-403	Deresiteleav II	4(3+1)	
2	Major	200-482		4 (3+1)	
2	Major	700 402	Conoral Microbiology	$\frac{J(1+2)}{J(2+1)}$	
1	Major	700-481	Bioinformatics	3 (1+2)	
S.No	Course	Course Code	Course Title	Credits	
	1 -	1	8 [™] Semester		
Total C	redits		<u> </u>	16 (12+4)	
5	Elective II	ZOO-475	Entomology/Research/Thesis	3 (2+1)	4 Year
4	Elective I	Z00-474	Parasitology-l	4 (3+1)	ath se
3	Major	200-473	Research methodology	2 (2+0)	
2	Major	200-472	Endocrinology	3 (2+1)	
1	Major	200-471	Biotechnology	4 (3+1)	
	Category	700.474		4 (0 - 4)	
S.No	Course	Course Code	Course Title	Credits	
			7 th Semester	1	
Total C	redits			16 (11+5)	
5	Major	ZOO-365	Wild Life	2 (2+0)	
4	Major	ZOO-364	Evolution and Principal of Systematics	3 (2+1)	
3	Major	ZOO-363	Biological Techniques	3 (1+2)	
2	Major	ZOO-362	Genetics	4 (3+1)	
1	Major	ZOO-361	Developmental Biology	4 (3+1)	
S.No	Course Category	Course Code	Course Title	Credits	
	1 -		6 th Semester		
Total C	Total Credits		17 (14+3)	3 rd Year	
5	Major	ZOO-355	Zoogeography and Palaeontology	3 (2+1)	
4	Major	ZOO-354	Conservation Biology	3 (2+1)	
	T				

HOD

University of Lakki Marwat Khyber Pakhtunkhwa

University of Lakki Marwat Khyber Pakhtunkhwa 28420, Pakistan



Course outline Department of Zoology Program BS 1st Semester

S. No	Course Category	Course Code	Course Title	Credits
1	Gen. Ed.	AH-111	Islamic History	3 (3+0)
2	Gen. Ed.	SS-112	Sociology	3 (3+0)
3	Gen. Ed.	NS -113	Everyday Science	3 (3+0)
4	Gen. Ed.	EW-114	English-I	3 (3+0)
5	Gen. Ed.	QR-115	Probability and Statistics	3 (3+0)
6	Gen. Ed.	QR-116	ICT	3 (3+0)
Total Credits			18 (18+0)	

QR-116 Introduction to Information and Communication Technologies (ICT) 3 (3+0)

COURSE OBJECTIVES:

Students successfully completing this course should be able to:

- Develop a vocabulary of key terms related to the computer and to software programs.
- Identify the components of a personal computer system.
- Demonstrate mouse and keyboard functions.
- Demonstrate window and menu commands and how they are used.
- Demonstrate how to organize files and documents on a USB/hard drive.
- Send email messages and navigate and search through the internet.

SYLLABUS:

Week	Topics
1.	Data and Information, Information Processing Cycle
2.	Introduction to Computer, Components of a Computer, Advantages and Disadvantages of Using Computers.
3.	Categories of Computers, Computer Applications in Society.
4.	Input Devices : Types of Input, Input for Smart Phones, Game Controllers, Digital Cameras, Voice Input, Video Input, Scanners and Reading Devices, Biometric Input,
5.	Output Devices: Terminals. Display Devices, LCD Monitors and LCD Screens, Plasma Monitors, CRT Monitors,
6.	Printers, Nonimpact Printers, Impact Printers, Speakers, Headphones, Data Projectors. Interactive Whiteboards
7.	Storage Devices: Hard disks, Flash Memory Storage, Solid State Drives, Memory Cards, USB Flash Drives, Cloud Storage, Optical Discs, Blue-Ray Discs, Magnetic Tapes, Magnetic Stripe Cards and Smart Cards, Microfilm and Microfiche, Enterprise Storage.
8.	Programming Languages
9.	Mid Term Exam

10.	CPU: Processor, Control Unit, Arithmetic Logic Unit, Machine Cycle.
11.	Memory: Data Representation, Memory Sizes, Types of Memory, RAM, Cache,
	ROM, Flash Memory, Primary and Secondary Memory
12.	Software: System Software, Operating Systems, Utility Programs. Application
	Software, Business Software, Graphics and Multimedia Software, Software for
	Home, Personal, and Educational Use, Web Applications
13.	Data Communication
14.	Internet, World Wide Web,
15.	Networks, Internet and Searching Techniques, E-Learning, Freelancing
16.	Enterprise Computing, Computer Security Risks, Viruses
17.	Introduction to MS Word, MS Excel, MS PowerPoint
18.	Terminal Examination

TEXT/REFERENCE BOOKS/WEBSITES LINKS:

Text Books:

1. Shelly, G. B., & Vermaat, M. E. (2012). *Discovering computers fundamentals: your interactive guide to the digital world (Latest ed.)*. Cengage Learning.

Reference Books:

- 1. Sawyer, S. C., & Williams, B. (2000). *Introduction to Using Information Technology* (*Latest ed.*). McGraw-Hill Higher Education
- Brookshear, G. G., & Brookshear, J. G. (2002). Computer science: an overview (Latest ed.). Addison-Wesley Longman Publishing Co., Inc.

Website Links:

- 1. <u>https://www.tutorialspoint.com/computer_fundamentals/index.htm</u>
- 2. https://codescracker.com/computer-fundamental/

EW-114 English Composition and Comprehension (English–I) 3 (3+0)

COURSE OBJECTIVES:

- This course introduces the students with the basic grammatical/ structural rules of English Language.
- Students will be familiarized with the technical methods of reading/comprehension and will be exposed to different reading materials, which will help them in improving their vocabulary, grammar and sentence structure etc.
- It will help them to communicate effectively in English language.

SYLLABUS:

Week	Topics
1.	Parts of speech, Sentence structure (working on subject, verb, object and predicate)
2.	Kinds and types of sentences (Simple, Compound, Complex and Compound-complex
	sentences, Declarative, imperative, interrogative and exclamatory sentences)
3.	Conditional sentences
4.	Tenses
5.	Active and passive voice
6.	Direct and indirect narrations
7.	Practice in unified sentence
8.	Analysis of phrase, clause (working on different types of phrases and clauses)
	Transitive and intransitive verbs, models
9.	Mid Term Examination
10.	Punctuation and spelling
11.	Comprehension
12.	Answers to questions on a given text
13.	Translation skills
	Urdu to English

14.	Paragraph writing
15.	Parts of a paragraph
16.	Cohesion and coherence in paragraph
17.	Practice in writing a good, unified and coherent paragraph
18.	Final Examination

TEXT/ REFERENCE BOOKS:

1. Practical English Grammar by A. J. Thomson and A. V. Martinet. Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492.

2. Practical English Grammar by A. J. Thomson and A. V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506.

3. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.

4. Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis. Oxford Supplementary kills. Third Impression 1992. ISBN 019 453402 2.

QR-115

Probability and Statistics

COURSE OBJECTIVES:

- The course will impart knowledge and understanding of Statistics.
- To provide knowledge about the importance and use of statistics in life sciences.
- To familiar students with the methods of data analysis pertaining to their research work and to assess the significance of their experimental designs.

SYLLABUS:

Week	Topics		
1	A) Basic of Statistics:		
	Introduction to Statistics		
	• Scope and importance of statistics		
	• Meaning of Statistics according to the subject.		
	Branches of Statistics		
2	Population and sample, Parameter and Statistic		
	Variable and Constant		
	• Discrete and continuous variable		
	• Data and its types (Qualitative and Quantitative)		
3	• Scales of measurements (Nominal, Ordinal, Interval and Ratio)		
	• Diagrams and graphs		
	• Simple and Multiple bar chart		
	Histogram, Pie chart		
4	B) Frequency distribution (FD)		
	• Definition of frequency distribution		
	• Steps in construction of frequency distribution		

5	C) Measures of Central Tendency	
	• Arithmetic mean	
	• Real life examples for group and ungroup data	
6	The Median	
	• Uses of Median	
	• Applications of Median for simple and frequency data	
7	• The Mode	
	• Uses of Mode	
	• Applications of Mode for simple and frequency data	
8	D) Measures of Dispersion	
	• Definition and types of dispersion	
	 Bernhubr and types of dispersion Range, grouped and ungrouped dataCoefficient of range 	
	 Standard deviation, variance and Co-efficient of variance 	
	······································	
9	Mid Term Examination	
10	E) Probability	
	• Definition of probability	
	• Objective and Subjective probability.	
	• Experiment and random experiment, sample space and sample point,	
11	• Event, simple and composite events.	
	• Mutually exclusive and independent events	
	Calculation of probability relative to dice, coins and balls.	
12	F) Sempling	
12	r / Sampung	
	• Sampling and sampling distribution	

13 G) Estimation		
13 G) Estimation		
G) Estimation		
• Definition of Estimation		
• Estimator and Estimate		
• Definition of Point and Interval Estimation		
14 H) Hypothesis Testing		
• Hypothesis , Statistical Hypothesis and Testing of Hypothesis		
• Simple and Composite hypothesis		
• Steps of hypothesis testing		
15 • Definition of Student t-test		
• Properties oft-test		
• Real life examples of t-test for single population mean		
16 I) Regression and Correlation		
• Definition of Regression		
• Estimated regression line		
• Solution of Real life Problems for simple regression		
17 Correlation		
Definition of Correlation		
Pearson correlation co-efficient		
• Solution of Real life Problems		
18 Final Examination		

TEXT/ REFERENCE BOOKS:

- 1. Statistical Theory Part-I and Part-II BySherMohummadChaudary, Carwan Publisher.
- 2. Statistics 4th Edition, "Schaum's Outline Series, McGRAW-HILL
- 3. Basic Concepts and Methodology for the Health SciencesByWayne W. Daniel
- 4. Wayne W. D., (2005). Biostatistics: A foundation for Analysis in the health sciences. Wiley series in Probability and Statistics
- 5. Earl K. Bowem& Martin starr: Basic Statistics for Business and Economics.

COURSE OBJECTIVES:

The basic objective of this course is to make students aware of society, social groups, culture and beliefs.

SYLLABUS:

Week	Topics
1.	Nature, Scope, and subject matter of Sociology
2.	Brief historical development of Sociology, Society and community, Relationship
	with other social sciences like Economic, Political Science,
3.	History, Psychology, and Anthropology. Social interaction processes (Cooperation,
	Competition, Conflict, Accommodation, Acculturation, and Assimilation)
4.	Social Groups
	Definition and Functions
5.	Types of Social Groups (In and out group, Primary and Secondary groups, Reference
	groups. Formal and informal Groups and Pressure groups)
6.	Social Institutions
	Definition, Structure and Function of the following Institutions
7.	Family, Religion, Education, Economics, Political Inter-relationship among various
	social institutions
8.	Cultural and Related Concepts
	Definition and aspects of culture
9.	Mid Term Examination
10.	Material and non-material culture, Ideal and real culture, Elements of culture,

	Beliefs, values, norms (folkways, mores, laws)
11.	Organization of culture, Traits, complexes, and patterns other related concepts,
	Cultural relativism, Sub-Culture and ethnocentrism
12	Socialization and Damonality
12.	Socialization and Personality
	Role and Status, Socialization, Culture and Personality
13.	Deviance and Social Control
	Definition and types of deviance
14.	Formal and informal methods of social control
15.	Social Stratification
	Determinants of Social Stratification (Caste, Class, Ethnicity, Power, Prestige and
	Authority), Social Mobility, Definition and types, Dynamics of social mobility
16	Social and Cultural Change
10.	Social and California Change
	Definition of social change
17	Dynamics of social change (Education Innovation Industrialization Urbanization
17.	Dynamics of social change (Education, Innovation, Industrialization, Orbanization
	and Diffusion), Resistance to change
18.	Final Examination

TEXT/ REFERENCE BOOKS:

- 1. Horton Paul B. and Hunt, Chester L (1990), Sociology Singapore: McGraw Hill Book Company.
- 2. Sociology 1 by Allama Iqbal Open University, Islamabad
- 3.. Sociology 2 by Allama Iqbal Open University, Islamabad

NS -113 Everyday Science 3 (3+0)

COURSE OBJECTIVES:

The basic objectives of this course are to make students aware of day-to-day science, nature, and universe and about the living creatures.

SYLLABUS:

Week	Topics		
1.	Science		
	Introduction, History of Science, Achievements of some giants of Science in		
	Chronological order, Islamic Science		
2.	Contribution of Muslim Scientists, Famous Muslim scientist, Nature of science,		
	Scientific method, impact of science on society		
3.	The Universe		
	Introduction, the origin, The Big Bang, the structure, the galaxies, solar system, the		
	sun, the moon, the earth, structure of the earth, earth atmospheres		
4.	The greenhouse effect, global warming, ozone depletion, acid rain, satellites,		
	earthquake		
5.	Eclipses, the mystery of Stonehenge, day-night and seasons, volcanoes, minerals,		
	glossary of cosmology		
6.	Energy		
	Introduction and sources of energy, Fossil Fuels, Major oil producing countries,		
	Global search of Crude oil, Petroleum products, natural gas, hydel power or hydro-		
	electric power		
7.	Solar energy, nuclear energy, the nuclear reactor, heavy water, nuclear safety,		
	nuclear fusion, energy conversion, radiation and living things		
8.	Products of science		

	Ceramics, Semi-conductors		
9.	Mid Term Examination		
10.	Communications systems, Laser, Telescope, Camera, Fertilizers, Nanotechnology,		
	Plastics, Computer		
11.	Living Creature		
	Brain, Heart, Tissues, Epithelial Cell, Origin of Modern Humans		
12.	Pest Control, Protein, Vertebrate, Invertebrate, Liver, Enzymes, Organisms		
	(Common to all living things)		
13.	Blood Group system. Plants, Seed, Flower, Gene, Evolution Laws, Nucleic Acid		
	(DNA and RNA)		
14.	Diseases and Threats to Living organism		
	Swine flow, Hepatitis, Dengue fever		
15.	Corona virus, SARS (Severe acute respiratory syndrome virus)		
16.	Plants and Crop Diseases (Rust, Smut, Late Blight, Canker)		
17.	Any other topic from the day-to-day science		
18.	Final Examination		

TEXT/ REFERENCE BOOKS:

- 1. Horton Paul B. and Hunt, Chester L (1990), Sociology Singapore: McGraw Hill Book Company.
- 2. Sociology 1 by Allama Iqbal Open University, Islamabad
- 3.. Sociology 2 by Allama Iqbal Open University, Islamabad

COURSE OBJECTIVES:

This course is aimed

to provide basic information about Islamic history, life of the Holy Prophet Hazrat Muhammad (S.A.W), the administrative system of Califat e Rashida period, Umayyad period and Abbasids period and Muslims in Spain.

SYLLABUS:

Week	Topics			
1.	Part. 1 Life of the Holy Prophet Hazrat Muhammad (S.A.W)			
	Land and Geography of Arabia			
	Conditions of Arabia at the advent of Islam			
	Makki Life of the Holy Prophet (S.A.W)			
	Parentage, Birth and Early Childhood			
	Harb ul Fujjar, Half fu Fazool, Nikah and Re-Construction of Kaba			
	Baasat e Nabvi, Preeching of Islam and Hostility of Quraish			
	Emigration to Abyssinia 1st and 2nd, Aam ul Huzn, Pledge of Aqba 1st and 2nd			
	Hijrat e Madina			
2.	Madni Life of the Holy Prophet (S.A.W)			
	Causes, Events and Importance of Hijrat e Madina			
3.	Charter of Madina			
	Gazwat e Nabvi, Treaty of Hudaibiya and Conquest of Makkah			
4.	Last Sermon of the Holy Prophet (S.A.W)			
	Seerat tu Nabi (S.A.W)			
5.	Part. 2 Rashidun' Period			

	Hazrat Abu Bakr Saddiq (R. A)				
	Hazrat Umar Farooq (R. A)				
	Hazrat Usman (R. A)				
6.	Hazrat Ali (R. A)				
	Administration system and main Features of Rashidun Period				
7.	Part. 3 Umayyads' Period				
	Hazrat Amir Mu'awiya (R. A)				
	Yazed and Karbala incident				
	Hazrat Abdullah bin Zubair (R. A)				
8.	Marwan and Abdul Malik bin Marwan				
	Walid bin Abdul Malik and Sulaiman bin Abdul Malik				
	Hazrat Umar bin Abdul Aziz (R. A)				
9.	Mid Term Examination				
10.	Later Rulers of Umayyad Dynasty				
	Administration under Umayyads and causes of their downfall				
11.	Part. 4 Abbasids' Period				
	As-Safah and Abu Jafr Al-Mansoor				
	Hadi, Mahdi, Haroon ur Rashid				
12.	Amin, Mamoon and Moatasim				
	Later Rulers of Abbasids' Dynasty				
13.	Administration under Abbasids and causes of their downfall				
14.	Crusades and Sultan Salah ud Din Ayubi				
15.	Muslims in Spain				
16.	Administration and Causes of the downfall of Muslims in Spain				

TEXT/ REFERENCE BOOKS:

1. Islamic History (P-I and P-II). Published by KP Textbook Board Peshawar.

2. Dr. Hameed du Din. "Tareekh e Islam".

3. Mazar ul Haq. "History of the Arabs".

4. Shah Moeen ud Din. "Tareek e Islam".

ذوال قدرعلامه) اردوت رجمه(الذلف ت5. سيوطى الدين جلالعلامه) اردوت رجمه(الذلف ت5. منگ 6. جنگ 7. ندوى على رياستمولانا اندلس تاريخ 8. آبادى نجيب خان شاهاک بر اسلام تاريخ . طبرى جريرابن) اردوت رجمه(والملوک الامم تاريخ

University of Lakki Marwat Khyber Pakhtunkhwa 28420, Pakistan



Course outline Department of Zoology Program BS 2nd Semester

S. No	Course Code	Course Title	Credits
1	AH-121	History of Pakistan	3 (3+0)
2	SS -122	Human Psychology	3 (3+0)
3	NS-123	An introduction to Zoology	3 (3+0)
4	EW-124	English-II	3 (3+0)
5	QR-125	Basic Mathematics	3 (3+0)
6	CIV-126	Islamic studies	3 (3+0)
Total Credits			

AH-121History of Pakistan3 (3+0)

Scheme of Study, Course:

No. of Weeks	1 st Class	2 nd Class	3 rd Class
1	Introductory Class	Definition of History	Scope and Importance of History of Pakistan
2	Consolidation of the state 1947-58	Search for constitution, 1947-58	Search for constitution, 1947-58
3	Early problems	Early problems	Quid-i-Azam
4	Liaquat Ali Khan	Objectives resolution	Accession of stated and tribal areas
5	1956 constitution	1956 constitution	Ayub Khan Era 1958-1969 Martial Law
6	Ayub Khan Era 1958-1969	B.D system	Muslim Family Law ordinance 1959
7	Indo-Pak War 1965,	Land Reforms	Yaha Khan Regime, 1969-71
8	Legal Framwork Order	Elections of 1970	Separation of East Pakistan
9	Separation of East Pakistan	Z Bhutto Era (1971-77)	Z Bhutto Era (1971-77)
10	Economic Reforms	1973 Constitution	Policy of Nationalism
11	Zia Era 1977-88:	Islamization	Afghan Jihad and Its Implications
12	Benazir 1 st Regime	Benazir 1 st Regimes	Nawaz Sharif 1 st Regime
13	Nawaz Sharif 1 st Regime	Benazir 2 nd Regimes	Benazir 2 nd Regimes
14	Nawaz Sharif 2 nd Regime	Nawaz Sharif 2 nd Regime	Pervez Musharaf Era:
15	Pervez Musharaf Era	Local self-government,	Enlightened Moderation
16	Economic reforms	Economic reforms	Current political situation in Pakistan

SS -122 Human Psychology 3 (3+0)

Course Title: Human Psychology

Course Objectives

• The main aim is to familiarize students with history, main concepts, methods, and theoretical frameworks in psychology.

• The course will help students appreciate the human nature and its related concepts,

thereby will gain insight into human behavior and human relationships.

Course Outcome

After successful completion of this course the students will be able to:

• Have a grasp over basic concepts and theoretical perspectives explaining human behavior. They will be able to appreciate the complexity of human behavior and relationships.

• They will be able to understand Psychology as science and empirical methods used for understanding different aspects of human behavior.

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

Recommended Books

Atkinson R. C., & Smith, E. E. (2000). *Introduction to psychology* (13th ed.). NY: Harcourt Brace College Publishers.

Coon, D., & Mutterer, J. (2008). Introduction to psychology: Gateways to mind and behavior

(12th ed.). USA: Wadsworth Cengage Learning.

Fernald, L. D., & Fernald, P.S (2005). *Introduction* to psychology.USA; WMC Brown Publishers.

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.

Kalat, J. W. (2010). Introduction to psychology.USA: Cengage Learning, Inc.

Lahey, B. B. (2004). *Psychology: An introduction* (8th ed.). UK: McGraw-Hill Companies, Inc.

Leahey,T. H. (1992). A history of psychology: Main currents in psychological thought. New

Jersey: Prentice-Hall International, Inc.

Myers, D. G. (2011). Psychology (10th ed.). USA: Wadsworth Publishers.

NS-123 An introduction to Zoology

COURSE OBJECTIVES

The course has three basic aims:

To learn and appreciate the importance animals

To acquire a basic understanding of the structure and function of different systems of animals

3 (3+0)

To learn and appreciate the extraordinary diversity of organisms within the animal kingdom.

STUDENTS LEARNING OUTCOMES (SLOs)

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

- Understand the main ideas and concept of zoology
- Understand the concepts of ecosystem with emphasis on interaction and homeostasis
- Understand about the wild life in Pakistan
- Learn the basics about reproduction system.

Course Contents:

Introduction and branches of Zoology, The concept and scope of Zoology in life sciences, taxonomy and classification, Binomial nomenclature, evolution and Zoology, Multicellular and Tissue Levels of Organization, An overview of concepts of ecosystem with emphasis on interaction and homeostasis. zoogeography, Wildlife of Pakistan, conservation and management of fishes, reptiles, birds and mammals of major importance in Pakistan, Animal distribution, Basis of structure and functions of animal nutrition, digestion, homeostasis and temperature regulation. Basic concepts in reproduction and development in animal kingdom. Asexual reproduction in invertebrates; advantages and disadvantages of asexual reproduction; sexual reproduction in vertebrates. Embryonic development. Introduction to ethology, Perception, Taxes, Reflexes, integration and storage of information. The structure and functions of cell organelles, DNA structure and functions, Brief introduction to cell cycles. Multiple alleles, genetics of blood groups, the endocrine system; Type of hormones; Endocrine and nervous system relationship.

REFERENCE BOOKS:

• Hickman, C.P., Roberts, L.S. and Larson, A. INTEGRATED PRINCIPLES OF ZOOLOGY, 11th Edition (International), 2004. Singapore: McGraw Hill.

• Miller, S.A. and Harley, J.B. ZOOLOGY, 5th Edition (International), 2002. Singapore: McGraw Hill.

• Pechenik, J.A. BIOLOGY OF INVERTEBRATES, 4th Edition (International), 2000. Singapore: McGraw Hill.

• Kent, G.C. and Miller, S. COMPARATIVE ANATOMY OF VERTEBRATES. 2001. New York: McGraw Hill.

• Campbell, N.A. BIOLOGY, 6th Edition. 2002. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.

• Lewin, B. GENE-VIII. 2000. Oxford University Press. UK.

• Tamarin, R.H. PRINCIPLES OF GENETICS. 7th Edition, 2001. WCB publishers USA.

• Gardener, E.J., Simmons, M.J. and Snustad, D.P. PRINCIPLES OF GENETICS. 1991. John Wiley and Sons Ins. New York, USA.

• Strickberger, M.W. GENETICS. 1985.McMillan, New York. USA.

• Ali, S.S. PALAEONTOLOGY, ZOOGEOGRAPHY AND WILDLIFE MANAGEMENT. 1999. Nasim Book Depot, Hyderabad, India.

English-II

EW-124

Course Description:

The course focuses on the basic strategies of composition and writing skills. Good writing skills not only help students obtain good grades but also optimize their chances to excel in professional life. The course includes modes of collecting information and arranging it in appropriate manner such as chronological order, cause and effect, compares and contrast, general to specific etc. It enables the students to write, edit, rewrite, redraft and proofread their own document for writing effective compositions. Because of the use of a significant amount of written communication on daily basis, sharp writing skills have always been valued highly in academic as well as professional spheres.

Course Contents:

- 1. Writing Process
 - Invention
 - ✓ Generating Ideas (collecting information in various forms such as mind maps, tables, lists, charts etc)
 - ✓ Identifying Audience, Purpose, and Message
 - Ordering Information
 - ✓ Chronology for a narrative
 - ✓ Stages of a process
 - \checkmark From general to specific and vice versa
 - \checkmark From most important to least important
 - ✓ Advantages and disadvantages
 - ✓ Comparison and contrast
 - ✓ Problem solution pattern
 - Drafting
 - ✓ Free Writing
 - ✓ Revising
 - ✓ Editing
- 2. Paraphrasing
- 3. Cohesion and Coherence
 - Cohesive Devices
 - Paragraph unity
- 4. Summary and Precis Writing
- 5. Creative Writing
- 6. Essay Writing
 - developing a thesis
 - organizing an essay
 - writing effective introduction and conclusion
 - different types of essays
 - use of various rhetorical modes including exposition, argumentation and analysis

Recommended Books:

- Goatly, A. (2000). *Critical Reading and Writing: An Introductory Course*. London: Taylor & Francis
- Hacker, D. (1992). A Writer's Reference. 2nd ed. Boston: St. Martin's
- Hamp-Lyons, L. & Heasley, B. (1987). *Study writing: A course in written English for academic and professional purposes.* Cambridge: Cambridge University Press.
- Howe, D. H, Kirkpatrick, T. A., & Kirkpatrick, D. L. (2004). *Oxford English for Undergraduates.* Karachi: Oxford University Press.

QR-125 Basic Mathematics 3 (3+0)

1. Numbers systems 1.1.Real Numbers 1.2.Complex numbers

- The integers
- Rules for addition
- Rules for multiplication
- Even and odd integers; divisibility.
- Rational numbers
- Multiplicative inverses
- Addition and multiplication.
- Real numbers: positivity.
- Powers and roots
- Inequalities
- The complex plane
- Polar form

2. Linear and Quadratic Equations

- Equations in two unknowns
- Equations in three unknowns
- Quadratic Equations

3. Functions

- Definition of a function
- Polynomial functions.
- Graphs of functions
- Exponential function.

4. Determinants Matrices

- Determinants of order
- Properties of 2 X 2 determinants
- Determinants of order 3
- Properties of 3 X 3 determinants

5. Differentiation—Fundamentals

- Derivatives by Definitions
- Power Rule
- Properties of Derivatives
- Product and Division Rules

6. Integration—Fundamentals

- Basic Integrations
- Product Rule

7. GEOMETRY

- Distance and Angles
- The Pythagoras theorem.

7.1. Area and Applications

- Area of a disc of radius r
- Circumference of a circle of radius r

7.2. Coordinates and Geometry

- Coordinate systems
- Distance between points.
- Equation of a circle

7.3. Segments, Rays, and Lines

- Segments
- Rays
- Lines
- Ordinary equation for a line

8. Trigonometry

- Radian measure
- Sine and cosine.
- The graphs.
- The tangent

CIV-126 Islamic Studies (Compulsory) 3 (3+0)

Objectives:

This course is aimed at:

- ✤ To provide basic information about fundamental beliefs and Pillars of Islam
- To enhance understanding of the students regarding Quran and Sunnah
- ✤ To inform the students about the practical life of Prophet Muhammad (SAW)
- To provide the students with the sufficient knowledge about economic, social and cultural systems of Islam
- To boost up the balanced, enlightened and broad minded information of Islam in students
- ✤ To enable the students for adopting Islamic ethics and moral values
- ✤ To enable the students to live peacefully in a pluralistic and diversified society
- To promote the feelings of human sympathy in students without the condition of race or religion

Course Contents

1. Study of Fundamental Religious Beliefs & Practices

1.1 Islamic Beliefs:

- i. Importance of Beliefs in personality building (general discussion)
- Study of the Islamic Beliefs: (Beliefs in Almighty Allah, Angles, Revealed Books, Prophet hood as well as Finality of Prophet hood, Destiny, Day of Judgment (Resurrection), desired effects of Islamic beliefs on Individual and Society

1.2 Practices (Ibadaat) of Islam

- i. Philosophical Study of *Ibadaat*:
- ii. Definition and Scope of *Ibadah*
- iii. Physical Submissions i.e. prayer and fasting : its rationale and its desired effects on Individual and society
- iv. Financial Submissions i.e. Zakat and alms giving: its rationale and its desired effects on Individual and society
- v. Collective Submissions [Physical cum Financial] i.e. performing Hajj and Umarh: its rationale and its desired effects on Individual and society
- vi. Scope of chain of various Ibadah

2. <u>Study of Basic Sources of Religion</u>

- 2.1 Study of Quran:
 - i. Sources of Knowledge
 - ii. Need for Revelation
- iii. Division of Surahs in Makki and Madani Titles

- iv. Brief introduction of various kinds of Ayaa (verses) i.e. Ayaat ul Ahkaam, Ayaat Anfusi, Ayaat Kawnia.
- v. Special focus on the behavior of Qura'n with other divine books and prophets in the lights of Qura'nic texts
- vi. Textual & Thematic Study of Holy Quran:
 - a. Surah Hujarat (Complete) with special focus on ethics and morality
 - b. Surah Israa verses 23-40 with special focus on ethics and morality

2.2 Study of Sunnah:

- i. Meaning of Hadith & Sunnah and its kinds (Qawli, Feli, Taqreeri)
- ii. Need, Importance of Hadith and its authority
 - iii. Important Books of Hadith (Sihah Sitta and Kutub-e-Arbah)
 - iv. Textual & Thematic Study of Hadith: Study of 20 Selected Hadiths (attached as Annex-1)

3. Brief Study of Biography of Prophet Muhammad (SAW)

- 3.1 Year wise Summary of Prophet's Life
- 3.2 Lessons learnt from life at Makkah
- 3.3 Lessons learnt from His life at Madinah with special reference to pact of Madina and Hudaibiyyah
- 3.4 *Hijrat* (Migration): its philosophy in general, causes and results
- 3.5 Jihad: Definition, Philosophy, justification (with special reference to *Badr*, *Uhad* and *Khandaq*)

4. <u>Study of Islam in Multi-dimensional Aspects</u>

4.1 Cultural and Social System of Islam: Introduction of Society and Culture, Salient features of Islamic culture and Society

4.2 Economic System of Islam: Basic concepts of Islamic economic system, Means of distribution of wealth in Islam

4.3 Political System of Islam: Basic concepts of Islamic political system, Qualities of Islamic political System

5. <u>Pluralism, Diversity and Islam</u>

- 5.1 Introduction of Pluralism and diversity, with special reference to diversity in Universe
- 5.2 Diversity in humans (personalities, gender, interests, hobbies, languages etc.)
- 5.3 Religious diversity, with special focus on various religions and sects

6. <u>Human Rights and Islam</u>

- 6.1 Concept and significance
- 6.2 Human Rights in Islam
- 6.3 Human Rights in the constitution of Pakistan
- 6.4 Human Rights in UNO Charter

7. <u>Peace Education and Conflict Resolution</u>

7.1 Peace: Concept, its significance in personal, domestic, social, national and International level

- 7.2 Religious instructions regarding peace in various dimensions of life
- 7.3 Conflict: Reasons and Stages of conflict, Reconciliation
- 7.4 Role of Communication in Peace building: Concept of Communication, Effective Communication, Rehabilitation of peace through communication
- 7.5 The role of inter and intra faith dialogue in maintaining peace as well as religious Harmony on national and international level

Recommended Books

- 1. Hamidullah, Dr. (2000), Introduction to Islam, Dawah Academy, Islamabad
- 2. Khan, Rafique Ali(2001), Freedom of Thought in Islam, Royal Book Company, Karachi
- 3. Ali, Syed Amir (2009), The Spirit of Islam, Islamic Book Service, Lahore
- 4. Hamidullah, Dr. (2005), *Muhammad Rasulullah: A concise survey of the life and work of the founder of Islam*, Dawah Academy, Islamabad
- 5. Hamidullah, Dr. (2000), Islamic Notion of conflict of Laws, Dawah Academy, Islamabad
- 6. UNO Charter of International Human Rights of 1948

مودودی، سید ابو الاعلیٰ(2002)، انسان کے بنیادی حقوق، اسلامک پبلی کیشنز ، لاہور
 قطب، سید محدرزمان(2001)، اسلام اور جدید ذہن کے شبہات، ہولی قرآن پبلی کیشنگ ہاؤس، کراچی
 صدیقی، حیدرزمان(2006)، اسلامی نظریہ اجتماع، یونیورسل بکس، لاہور
 صدیقی، صدرالدین(2011) اسلام اور اجتماعیت، اسلامک پبلی کیشنڈ ہاؤس، کراچی
 اصلاحی، صدرالدین(2011) اسلام اور اجتماعیت، اسلامک پبلی کیشنز، لاہور
 اصلاحی، صدرالدین(2011) اسلام اور اجتماعیت، اسلامک پبلی کیشنز، الاہور
 ادریان، عبدالکریم(2002)، اسلام میں ریاست اور فرد کا مقام، ادارہ ترجمان القرآن، لاہور
 یونیورسل بکس، دارہ ترجمان القرآن، الاہور
 دیندان کیشنز، لاہور
 دیندان عبدالکریم(2002)، اسلام میں ریاست اور فرد کا مقام، ادارہ ترجمان القرآن، الاہور
 دیشن برائے انسانی حقوق (2012)، پاکستان میں انسانی حقوق کی صورت حال، میڈیا سیل پاکستان کیشن برائے انسانی حقوق، لاہور
 دیمیشن برائے انسانی حقوق، الاہور
 دیمیشن برائے انسانی حقوق، لاہور
 دیمیش برائے انسانی حقوق، لاہور

University of Lakki Marwat Khyber Pakhtunkhwa 28420, Pakistan



Course outline Department of Zoology Program BS 3rd Semester

S.No	Course Category	Course Code	Course Title	Credits
1	Major	ZOO-231	Animal diversity-I (Invertebrates)	4 (3+1)
2	Major	ZOO-232	Animals Form and Function-I	4 (3+1)
3	Major	ZOO-233	Cell Biology	3 (2+1)
4	Gen. Ed.	EW -234	Technical Report Writing (English-III)	3 (3+0)
5	Gen. Ed.	CIV-235	Pak Studies	3 (3+0)
Total Credits				18 (18+0)

ZOO-231 Animal diversity I (Invertebrates) 4 (3+1)

Course Objectives:

1. To provide the knowledge of evolutionary/phylogenetic relationship (from simple to the complex organisms).

2. To impart the basic taxonomic characteristics and classification of all the invertebrate phyla.

3. To provide understanding of body organization, Feeding and Digestive system; Other Organ System;

4. To provide the description of mode of Reproduction and Development

5. To provide the information of their economic and ecological importance

Course Learning Outcomes:

This course will be based on following outcomes:

1. Acquire the basic concepts of invertebrates with explanation of evolutionary origin and diversification.

2. Understand invertebrate organismal concepts in laboratory and field.

3. Demonstrate major evolutionary innovations for invertebrates with functional importance.

4. Understand how reproduction and development occured and able to breed animal in the laboratory/feild

5. Analyze economic and ecological importance of invertebrates.

1. INTRODUCTION

a. Classification of Organisms:

b. Evolutionary Relationships and Tree Diagrams: Patterns of organization.

2. ANIMAL-LIKE PROTISTS: THE PROTOZOA

a. Evolutionary perspective; Life within a single plasma Membrane;

b. Symbiotic Life-styles.

c. Protozoon Taxonomy; (up to Phyla, subphyla and super Classes, wherever applicable).

- d. Pseudopodia and Amoeboid Locomotion; Cilia and other pellicular structure;
- e. Nutrition; Genetic Control and Reproduction; Symbiotic ciliates;

f. Further Phylogenetic Consideration.

3. MULTICELLULAR AND TISSUE LEVELS OF ORGANIZATION

a. Evolutionary Prespective:

b. Origins of Multicellularity; Animal Origins.

Phylum Porifera

a. Characteristics and classification. Cell Types, Body Wall, and Skeletons;

b. Water Current and Body Forms;

c. Maintenance Functions, Reproduction.

Phylum Cnidaria (Coelenterate)

a. Characteristics and classification. The body Wall and Nematocysts: Alteration of Generations;

- b. Maintenance Functions; Reproduction and
- c. Classification up to Class.

Phylum Ctenophore;

a. Characteristics, body organization

4. THE TRIPLOBLASTIC AND WITH ACOELOMATE BODY PLAN PHYLUM PLATYHELMINTHES

a. Evolutionary Perspective; Classification up to class;

b. The Free-Living Flatworms and the Tapeworms, adaptive modification for parasitic life style

Phylum Numerate; Characteristics, body organization

Phylum Gastrotrich; Characteristics, body organization

5. PSEUDOCOELOMATE BODY PLAN

PHYLUM ASCHELMINTHS

a. Evolutionary perspective; General Characteristics; Classification up to order with External Features;

b. Feeding and Digestive system; Other Organ System; Reproduction and Development including Phylum **Rotifera**, Phylum **Nematoda** and Phylum **Kinorhyncha**.

c. Some Important Nematode Parasites of Humans;

6. PHYLUM MOLLUSCA

a. Evolutionary perspective; Relationship to other animals; Origin of the Coelom;

b. Molluscan Characteristics, Classification up to class. The Characteristics of Shell and Associated Structures,

c. Feeding, Digestion, Gas Exchange, Locomotion,

d. Reproduction and Development, Other maintenance Functions and Diversity in Gastropods, Bivalves and Cephalopods:

7. PHYLUM ANNELIDA

a. The Metameric Body Form; Evolutionary perspective; Relationship to other animals,

b. Metamerism and Tag-matization, Classification up to Class. External Structure and Locomotion,

- c. Feeding and the Digestive system, Gas Exchange and Circulation,
- d. Nervous and Sensory Functions, Excretion,

e. Regeneration, Reproduction and Development, in Polychaeta, Oligochaeta and Hirudinea, Further Phylogenetic Consideration.

8. PHYLUM ARTHROPODA:

a. Evolutionary Perspective: Classification and Relationship to other Animals;

b. Metamerism and Tagmatization;

c. The Exoskeleton; Metamorphosis;

d. Classification up to Class; Further Phylogenetic Consideration.

The Hexapods and Myriapods:

a. Evolutionary Perspective: Classification up to class. External Structure and Locomotion,

b. Nutrition and the Digestive system, Gas Exchange, Circulation and Temperature Regulation,

c. Nervous and Sensory Functions, Excretion, Chemical Regulation,

d. Reproduction and Development in Hexapoda,

e. Insects Behavior, Insect and Human;

10. PHYLUMECHINODERMS

a. Evolutionary Perspective: Relationship to other Animals; Echinoderm Characteristics; Classification up to class.

b. Maintenance Functions, Regeneration,

c. Reproduction, and Development in Asteroida, Ophiuroidea, Echinoidea, Holothuridea and Crinoidea;

SOME LESSER-KNOWN INVERTEBRATES;

a. The Lophophorates, Entoprocts, Cycliophores, and Cheatognaths.

Practical:

1. Study of Euglena, Amoeba, Endameba, Plasmodium, Trypanosome, Paramecium as representative of animal like Protists.

2. Study of prepared slides of sponges, spicules of songes, and their various body forms. Study of representatives of classes of Phylum Porifera.

3. Study of principal representatives of classes of Phylum Coelenterate.

- 4. Study of principal representatives of classes of Phylum Platyhelminthes.
- 5. Study of representatives of phylum Rotifer, Phylum Nematode.
- 6. Study of principal representatives of classes of Phylum Mollusca.
- 7. Study of principal representatives of classes of Phylum Annelida.
- 8. Study of principal representatives of classes of groups of Phylum Arthropoda
- 9. Study of representatives of classes of phylum Echinodermta.

10. Preparation of permanent mount of Leucosolenia, Obelia, Hydra, Proglottid of Tapeworm, Parapodia of Nereis and Daphnia. Drawing and labeling.

11. Preparation of permanent slide of mouthpart of insects (after dissection). Drawing and labeling.

12. How to make grade-wise series for preparation of temporary and permanent slides.
Recommended Principal Reference Book:

1. Miller, A.S. and Harley, J.B. ; 1999 , 2002., 2007, 2009, 2012 & 2016 Zoology, 4th , 5th, 6th, 7th, 8th , 9th& 10th Edition (International), Singapore : McGraw Hill.

2. Hickman, C.P., Roberts, L.C/, AND Larson, A., 2018. INTEGRATED PRINCIPLES OF ZOOLOGY, 15th Edition (International), Singapore: McGRAW-Hill.

3. Hickman, C.P., Roberts, L.C/, AND Larson, A., 2007. INTEGRATED PRINCIPLES OF ZOOLOGy, 12th& 13th Edition (International). Singapore: McGraw-Hill.

4. Pechenik, J.A., 2015. BIOLOGY OF INVERTEBRATES, 7th Edition, (International), Singapore: McGraw-Hill.

5. Kent, G. C. and Miller, S., 2001. COMPARATIVE ANATOMY OF VERTEBRATES New York: McGraw-Hill.

6. Campbell, N.A., 2002; BIOLOGY 6th Edition, Menlo Park, California; Benjamin Cummings Publishing Company, Inc.

BOOKS FOR PRACTICAL

7. Miller, S.A., 2002. GENERAL ZOOLOGY LABORATORY MANUAL. 5th Edition (International), Singapore : McGraw-Hill.

8. Hickman, C.P. and Kats, H.L., 2000. Laboratory Studies in integrated principal of zoology. Singapore : McGraw-Hill.

ZOO-232 Animals Form and Function I 4 (3+1)

Course Objectives:

The Objectives of the courses are:

1. 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.

2. To impart understanding of diverse strategic structural adaptations in each of the functions of integumentary, skeletal, muscular, nervous and sensory, endocrine, circulatory and respiratorysystemsfor effective survival in their specific conditions.

3. 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.

4. To embrace the phenomena in basic structure of each system that determines its particular function.

Course Learning Outcomes:

1. **Acquire**the concept that for the performance of a function for example exchange of respiratory gases the different forms are adapted in t environments e.g. gills in aquatic and lungs in terrestrial environment.

2. **Understand**that diverse forms adapted to perform the same functions are because of the different past and present conditions.

3. **Solve**of emergence of diversity of forms for the performance of similar function.

4. **Analyze**the requirements of diverse forms for the performance of similar function in their past and present needs.

5. **Evaluate**the adaptations in forms for its efficiency in managing the function in differing situations in the past and present times.

6. **Demonstrate**that a form is successfully adapted to perform a function adequately and successfully.

Course Outline:

1. Protection, Support, and Movement:

a. Protection: the integumentary system of invertebrates and vertebrates;

b. Movement and support: the skeletal system of invertebrates and vertebrates;

c. Movement: non-muscular movement; an introduction to animal muscles; the muscular system of invertebrates and vertebrates

2. Communication I:

a. Nerves: Neurons: structure and function.

3. Communication II:

a. Senses: Sensory reception: baroreceptors,chemoreceptors, georeceptors, hygroreceptors, phonoreceptors, photoreceptors, proprioceptors, tactile receptors, and thermoreceptors of invertebrates

b. 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.

4. Communication III:

a. 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

5. Circulation and Immunity:

a. Internal transport and circulatory systems in invertebrates

b. 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

Practicals:

1. Study of insect chitin, fish scale, amphibian skin, reptilian scales, feathers and mammalian skin.

2. Study and notes of skeleton of Labeo (*Labeo rohita*), Frog (*Hoplobatrachus tigerinus*), Varanus (*Varanus bengalensis*), fowl(*Gallus gallus domesticus*) and rabbit (*Oryctolagus cuniculus*).

3. Earthworm or leech; cockroach, freshwater mussel, Channa or Catlacatla or Labeo or any other local fish, frog, pigeon and rat or mouse and rabbits dissections as per availability.

4. Study of heart, principal arteries and veins in a representative vertebrate (dissection of representative fish/mammals).

Books Recommended:

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 Principlesof 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. NewYork: McGraw-Hill.

6. Hickman, C.P., Kats, H.L. 2000. Laboratory Studies in IntegratedPrinciples of Zoology. Singapore: McGraw-Hill.

ZOO-233 Cell Biology 3 (2+1)

Course Objectives:

The objectives of the course are:-

1. To explain the basic concepts of cell biology.

2. To understand cellular structure, composition of the organelles, cell growth and cellular division.

3. To explain how macromolecules and organelles govern the dynamic organization, function of living cells.

Course Learning Outcomes:

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

1. **ACQUIRE** the basic concepts of cell biology.

2. **UNDERSTAND** the metabolic processes of cells in terms of cellular organelles, membranes, and biological molecules.

3. ABILITY to understand the role of macromolecules regulating cellular processes.

4. FORMULATE the critical thinking skills and knowledge on cell.

Course Outline:

1. Introduction cell structure and function

- a. Cell theory
- b. Comparison of plant and animal cells
- c. Comparison of prokaryotic and eukaryotic cells
- 2. Cell membranes
- a. Structural models
- b. Chemical composition and function
- 3. Cell Organelles (structure and function)
- a. Endoplasmic reticulum
- b. Golgi Bodies
- c. Mitochondria
- d. Lysosomes
- e. Peroxysomes
- f. Ribosome
- 4. Nucleus
- a. Structure and function
- b. Nuclear membrane
- c. Chromatin
- 5. Cytoskeleton
- a. Structure and types
- b. Function of cytoskeleton
- 6. Cellular transport
- a. Diffusion and osmosis
- b. Facilitated and active transport

c. Endocytosis and exocytosis

7. Cellular reproduction

- a. Cell cycle
- b. Mitosis
- c. Meiosis

Practical:

- 1. Microscopy
- 2. staining techniques (Gram staining)
- 3. Identification of cell organelles (prepared slides)
- 4. Preparation of temporary whole mount.
- 5. Preparation of permanent whole mount.
- 6. Squash preparation of onion root tip for mitotic stages.
- 7. Study of mitotic and meiotic stages (prepared slides)

Books Recommended:

1. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K., Watson, J.D. 2017. Molecular Biology of the Cell. 6th Edition. Garland Publishing Inc., New York.

2. Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Anthony Bretscher, Hidde Ploegh, Angelika Amon, Kelsey C. Martin. 2016. Molecular Cell Biology. W. H. Freeman Publishers, Scientific American Inc.

3. Geoffrey M.C., Robert E.H. 2007. The cell: A Molecular Approach, Sinauer Associates, INC.

4. Karp, J. 2005. Cell and Molecular Biology, Concepts and Experiments, Jhon Wiley and Sons, INC.

5. De Robertis, E. D. P. 2017. Cell and Molecular Biology,8th edition, Lea & Febiger, New York.

EW -234 Technical Report Writing (English-III) 3 (3+0)

COURSE OBJECTIVES:

- This course will introduce students to the basic principles of effective / skillful writing and will develop the understanding of the students on academic and technical writing skills.
- Students will understand and know how to follow the stages of writing process and will apply these to technical and workplace writing tasks.
- Students will learn how to incorporate clarity and utility in their writing, learn stylistic methods for effective writing and to be aware of ethical issues in technical writing. Also, Students will read, analyze, and interpret material from technical fields, and will practice research and writing skills appropriate for technical topics.

STUDENTS LEARNING OUTCOMES (SLOs)

The students will:

- 1. Describe the basic principles of effective/skillful writing for academic and technical contexts
- 2. Identify various forms of technical and academic writings i.e. proposal and technical report writing
- 3. Demonstrate the skills of clarity and utility in various forms of writing
- 4. Identify the stylistic features and stages in the development of technical writing
- 5. Develop a technical report and proposal

COURSE OUTLINES:

Technical Writing

Introduction to technical writing

Process of technical writing (pre-writing, while-writing and post-writing)

Essay writing

Parts of an essay

Making an outline for essay

Descriptive, narrative, discursive, argumentative

Academic writing

How to write a proposal for research paper/term paper

How to write a research paper/term paper (emphasis on style, content,

language, form, clarity, consistency)

Technical Report writing

Formal and informal reports

Progress report writing

Feasibility reports

Note: Extensive reading is required for vocabulary building

REFERENCE BOOKS:

- Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression 1992. SBN 0 19 4354073
- 2. College Writing Skills by John Langan. McGraw-Hill Higher Education. 2004.
- **3.** Patterns of College Writing (4th edition) by Laurie G. Kirszner and Stephen R. Mandell. St. Martin's Press.

CIV-235 Pak Studies 3 (3+0)

COURSE OBJECTIVES:

- Develop the familiarity with historical perspectives, on Pakistan and with its government and politics.
- > To Study the natural environment
- To Study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

STUDENTS LEARNING OUTCOMES (SLOs)

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

- 1. Understand the main idea about Indus civilization
- 2. Learn the basic idea of Landforms, climate, water Resources
- 3. To Know about the futuristic outlook of Pakistan
- 4. Learn the basics of Government and Politics in Pakistan

COURSE OUTLINES:

1. Historical Perspective

- a. Indus Civilization
- b. Evolution and growth of Muslim society in the Subcontinent

c. Ideological rationale with special reference to Sir Syed Ahmad

Khan, Allama Muhammad Iqbal and Quaid-e-Azam Muhammad Ali Jinnah.

d. Factors leading to Muslim nationalism in the Subcontinent

2. Natural Environment

a. Landforms, climate, water Resources

3. Government and Politics in Pakistan

- a. Constitutional and Political developments in Pakistan 1947-1973
- b. Salient features of the Constitutions 1956, 1962 and 1973 and Amendments
- c. Political development in Pakistan: 1973 to date

4. Contemporary Pakistan (issues and prospects)

- a. Economic potential and its utilization
- b. Social issues, their gravity and resolution
- c. Youth role in the development of Pakistan
- d. World Affairs: challenges and contributions
- e. Environmental issues and potential
- f. Human Rights in Pakistan
- g. Futuristic outlook of Pakistan

REFERENCE BOOKS:

- **1.** Burki, Shahid Javed. State and Society in Pakistan, the MacMillan Press Ltd, 1980.
- **2.** Akbar, S. Zaidi. Issues in Pakistan's Economy. Karachi: Oxford University Press, 2000.
- **3.** S. M. Burke and Lawrence Ziring. Pakistan's Foreign Policy: A Historical analysis. Karachi: Oxford University Press, 1993.
- 4. Mehmood, Safdar. Pakistan: Political Roots & Development. Lahore, 1994.

- **5.** Wilcox, Wayne. The Emergence of Bangladesh., Washington: AmericanEnterprise, Institute of Public Policy Research, 1972.
- **6.** Mehmood, Safdar. Pakistan Kayyun Toota, Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.
- **7.** Amin, Tahir. Ethno National Movement in Pakistan, Islamabad: Institute of Policy Studies, Islamabad.
- **8.** Ziring, Lawrence. Enigma of Political Development. Kent England: WmDawson & Sons Ltd, 1980.
- 9. Zahid, Ansar. History & Culture of Sindh. Karachi: Royal Book Company, 1980.
- 10. Afzal, M. Rafique. Political Parties in Pakistan, Vol. I, II & III. Islamabad:
- **11.**National Institute of Historical and cultural Research, 1998.
- **12.**Sayeed, Khalid Bin. The Political System of Pakistan. Boston: HoughtonMifflin, 1967.
- **13.** Aziz, K. K. Party Politics in Pakistan, Islamabad: National Commission on Historical and Cultural Research, 1976.
- 14. Muhammad Waseem, Pakistan Under Martial Law, Lahore: Vanguard, 1987.
- 15. Haq, Noor ul. Making of Pakistan: The Military Perspective. Islamabad:
- **16.** National Commission on Historical and Cultural Research, 1993.
- **17.** Ziring, Pakistan in 20th Century.
- 18. Ian Talbot, Pakistan: A Country

University of Lakki Marwat Khyber Pakhtunkhwa 28420, Pakistan



Course outline Department of Zoology Program BS 4th Semester

S.No	Course	Course Title	Credits	
	Code			
1	ZOO-241	Animal Diversity-II (Chordates)	4 (3+1)	
2	ZOO-242	Animals Form and Function II	4 (3+1)	
3	ZOO-243	General Biochemistry	4 (3+1)	
4	ZOO-244	Economic Zoology	3 (2+1)	
5	ZOO-245	Animals Behaviour	3 (3+0)	
Total C	18 (14+4)			

ZOO-241Animal Diversity-II (Chordates)4 (3+1)

Course Objectives

The objectives of the course are:-

• To enable them to understand the Taxonomic characteristics of protochordates and chordates.

• To impart knowledge about the phylogenetic relationships of protochodates and various classes of chordates.

• To develop critical thinking about phylogeny of chordates with respect to their physiological adaptations, behavior and ecology.

Course Learning Outcomes:

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

1. ACQUIRE the basic knowledge of Taxonomic characteristics of chordates.

2. **UNDERSTAND** the phylogenetic relations and diversity of Pisces, amphibians, reptiles and mammals.

3. **ANALYZE** the process of micro evolution within chordates.

4. **DEMONSTRATE** individually phylogenetic relationships of chordates and their diversity.

Course Outline:

1. Protochordates

a. Classification of protochordates.

b. Structure, anatomy and organ systems of Acorn worms, Urochordates and Cephalochordates.

c. Reproduction; life histories and metamorphosis of protochodates.

d. Phylogenetic relationships.

2. Fishes:

a. Vertebrate Success in Water.

b. Phylogenetic relationships of Pisces.

c. Classification of Chondrichthyes, Osteichthyes, Dipnoi and Holocephalli

d. Locomotory adaptations, nutrition and the digestive system, circulation, gas exchange, nervous and sensory functions, excretion and osmoregulation, reproduction and development of Chondrichthyes (Scoliodon) and Osteichthyes (*Cyprinus carpio* and *Wallago attu*).

3. Amphibians:

a. The first terrestrial vertebrates. Characteristics of amphibians

b. Phylogenetic relationships.

c. Classification of amphibians and characteristics of order Caudata, Gymnophiona, and Anura.

d. Structure and locomotory adaptations, nutrition and the digestive system, circulation, gas exchange, temperature regulation, nervous and sensory functions, excretion and

e. Osmoregulation, reproduction, development, and metamorphosis of caudate, anura and Gymnophiona.

4. Reptiles:

a. The First Amniotes and cladistic interpretation of the amniotic lineage. General characteristics of reptiles.

b. Characteristics of OrderTestudines or Chelonia, Rhynchocephalia, Squamata, and Crocodilia.

c. Adaptations in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, and temperature regulation, nervous andsensory functions, excretion and osmoregulation, reproduction and development of helonia, squamata, Rhynchocephalia and crocodilian.

d. Further phylogenetic considerations.

5. Birds:

a. Classification, Feathers, flight and endothermy.

b. Phylogenetic relationships; ancientbirds and the evolution of flight.

c. Diversity of modern birds.

d. Adaptation in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, and regulation, nervous and sensory systems, excretion and osmoregulation, reproduction and development.

e. Migration and navigation.

6. Mammals:

a. Classification, Specialized teeth, endothermy, hair and viviparity.

b. Diversity of mammals.

c. Adaptations in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, and temperature regulation, nervous and sensory functions, excretion and osmoregulation, behaviour, reproduction and development.

Practicals:

- **1.** Classification and study of lab specimens of hemichordates, fishes, amphibians, reptiles, birds and mammals.
- **2.** Visit to PMNH for the study of diversity of chordates.

Books Recommended:

- 1. Campbell, N.A. Biology. 9th Ed. 2011. Menlo Park, California Benjamin/Cummings Publishing Company, Inc.
- 2. Miller, S.A. and Harley, J.B. 2010. Zoology, 8th Edition (International) Singapore: McGraw Hill.
- 3. Miller, S.A. 2002. General Zoology Laboratory Manual. 5th Ed. (International), Singapore: McGraw Hill.
- 4. Hickman, C.P., Roberts, L.S. and Larson, A. Integrated Principles of Zoology, 14th Edition (International), 2009. Singapore: McGraw-Hill.

ZOO-242Animals Form and Function II4 (3+1)(A Comparative Perspective)

Course Objectives:

The Objectives of the courses 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 functional systems of nutrition, excretion, osmoregulation and reproduction and development 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 Outcomes:

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

Course Outline:

1. Nutrition and Digestion:

- a. Evolution of nutrition; the metabolic fates of nutrients in heterotrophs; digestion
- b. Animal strategies for getting and using food, diversity in digestive structures of invertebrates.
- c. The mammalian digestive system: gastrointestinal motility and its control
- d. 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.
- 2. Temperature and Body Fluid Regulation:
- a. 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
- b. Control of Water and Solutes (Osmoregulation and Excretion); Invertebrate and Vertebrate.

c. Excretory Systems; How Vertebrates Achieve Osmoregulation; Vertebrate Kidney Variations; Mechanism in Metanephric Kidney Functions. Reproduction and Development

3. Reproduction:

- a. Asexual reproduction in invertebrates; advantages and disadvantages of asexual reproduction;
- b. Sexual reproduction in invertebrates; advantages and disadvantages of sexual reproduction; sexual reproduction in vertebrates; reproductive strategies; examples of reproduction among various vertebrate classes;
- c. The human male reproductive system: spermatogenesis, transport and hormonal control, reproductive function;
- d. 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.

Practicals:

- **1.** Study of excretory system in an invertebrate and a vertebrate representative (Model).
- **2.** Study of dissection system in invertebrate and a vertebrate representative (Dissection).
- **3.** Dissection and study of male and female reproductive system in vertebraes and invertebrates.

Note: Prepared slides and preserved specimen and/or projection slides and/or CD ROM computer projections may be used.

Books Recommended

- 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., 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 Company, Inc.
- **5.** Kent, G.C., Miller, S. 2001. Comparative Anatomy of Vertebrates. New York: McGraw-Hill.

ZOO-243 General Biochemistry 4 (3+1)

Course Objectives

The course aims to

- Provide in-depth knowledge about the polymerized organic compounds of life.
- Develop an understanding about the dynamism life as it proceeds with interconversion of the chemicals from feeding to the liberation of energy for work.
- Understand that inter-conversion is performed by various tools called as enzymes.

• Enable students to know how organisms harvest of energy for growth, duplication etc.

Course Contents

Amino acids, peptides and proteins: standard amino acids, their structure and classification; acid/base properties of amino acids and their titration curves; peptides, their ionic behavior and amino acid composition, cytochrome c; Proteins: level of structural organization, example of structural and functional proteins.

Enzymes: Introduction; important characteristics of enzymes; immobilized enzymes; how enzymes work; example of enzymatic reaction; enzyme kinetics, enzyme rate of reaction and substrate concentration, how pH and temperature effect on enzyme activity.

Carbohydrates: Classification, types, important characteristics and structure of carbohydrates; cyclic structure of monosaccharides; cyanohydrins formation; disaccharides their types structure and function; polysaccharides, storage and structural types; structure and major functions of polysaccharides.

Lipids: fatty acids, their types and major characteristics; storage lipids, acylglycerols; waxes; structural lipids in membranes; major functions of lipids; lipoproteins, their types and major functions.

Vitamins and cofactors: occurrence, structure and biochemical function of vitamins B complex group.

Metabolism: detailed description of glycolysis and catabolism of other hexoses; regulation and bioenergetics of glycolysis. Anabolic role of glycolysis; fate of pyruvate under aerobic and anaerobic conditions, lactate, acetyl CoA and ethanol formation; alcoholic fermentation; gluconeogenesis, its regulation and significance in the tissues; feeder pathways in glycolysis; utilization of other carbohydrates in glycolysis phosphorolysis and starch; regulation of glycogen metabolism.

Citric acid (TCA) cycle: conversion of pyruvate to acetyl CoA, pyruvate dehydrogenase, a multi-enzyme complex; detailed description of citric acid cycle; bioenergetics and conservation of energy produced in the cycle. Anabolic or biosynthetic role of citric acid cycle intermediates; replenishing or anaplerotic reactions and their role; regulation of citric acid cycle; Electron transport and its components, oxidative phosphorylation, chemiosmotic theory, ATP synthesis, uncouple electron transport and heat generation.

Lipid metabolism: oxidation of fatty acids; digestion, mobilization and transport of fats; biosynthesis of triacylglycerol; utilization of triacylglycerol; activation of fatty acids and their transportation to mitochondria; beta oxidation; bioenergetics of beta-oxidation; oxidation of unsaturated and odd

chain fatty acids; omega oxidation pathway; biosynthesis of saturated fatty acid, supply of raw material for palmitic acid synthesis; fatty acid synthetase (FAS) multi enzyme complex; Ketone bodies their biosynthesis, utilization and role in the tissues; cholesterol metabolism: Steroid hormones.

Nitrogen metabolism: metabolic fate of amino acids; catabolism of amino acids; deamination and transamination; nitrogen excretion and urea cycle; regulation of urea cycle.

Practicals

- 1. Preparation of standard curve for glucose by ortho-Toluidine method.
- 2. Tests for detection of carbohydrates in alkaline and acidic medium.
- 3. Tests for detection of Disaccharides.
- 4. Detection of Non-Reducing sugars in the presence of reducing sugars.
- 5. Demonstration of Acid Hydrolysis of Polysaccharide.
- 6. Separation and identification of various types of sugars, fatty acid and amino acid Thin Layer Chromatography (TLC).
- 7. Determination of pKa values of an amino acid by preparation of titration curves.
- 8. Biochemical tests for detection of different amino acids.
- 9. Separation of various protein fractions by precipitation method.
- 10. Demonstration of differential solubility of lipids in various solvents.
- 11. Quantitative analysis of phospholipids by estimation of inorganic phosphorous.
- 12. Quantitative analysis of Amylase activity from blood serum or liver.
- 13. Study on the effect of temperature on the enzymatic rate of reaction

Books Recommended

- 1. Nelson, D. L., Cox, M. M. 2012. Lehninger Principles of Biochemistry. McMillan worth Publishers, New York.
- 2. Berg, J. M., Tymoczko, J. L., Lubert Stryer. 2010. Biochemistry. 7TH Ed.
- Lodish, H., Berk, A., Zipursky, S. L., Paul. M., Baltimore D., Darnell, J. 2012. Molecular Cell Biology.
- 4. McKee, T., McKee, J.R. 2003.Biochemistry: The Molecular Basis of Life. 3rd Edition, McGraw Hill.
- 5. Wilson, K., Walker, J. 1994.Practical Biochemistry: Principles and Techniques, 4th Ed., Cambridge University Press.

Economic Zoology

Course Objectives:

The objectives of the course are:-

ZOO-244

• 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 Outcomes:

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

1. ACQUIRE basic knowledge of Commerce and Economics in relation to Zoology

2. UNDERSTAND the Economic relationship of Animals with Humans

3. **SOLVE** problems related to animal husbandry and pest management by applying theoretical knowledge with practical efficacy

4. **ANALYZE** and enhance Animal husbandry techniques by using different Entrepreneurship skills

5. EVALUATE problems using practical knowledge in Zoology

6. **DEMONSTRATE** the Economy based interactions of Man and Animals

Course Outline:

- 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.

Practicals:

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

Books Recommended:

- 1. *Economic Zoology*. Ravindranathan, K. R. 2003. 1st ed. Dominent Publishers and Distributers. 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.
- 9. Anon, 1999. FAO Bulletins on Sericulture Nos. 1 & 2. FAO Office, Rome, Italy.

ZOO-245 Animals Behavior

Course Objectives:

The objectives of the course are:

- 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 neuro-physiology in behavioural development.

Course Learning Outcomes:

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

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

Course Outline

1. Introduction

• Behaviour and its types.

•Proximate and ultimate causes of behavior.

• Development of behavior and impact of neural and physiological mechanisms; role of external and internal stimuli and animal responses. Physiology of behavior in changed environments.

• Hormones and behavior in animals.

• Innate behavior and innate releasing mechanisms; built in programmed performance by offspring to that of parents. Innate behavior of three spined stickle back fish.

• Learned behavior and its mechanisms; quick learners' vs slow learners. Concept of animal cognition; key to understand and develop multiple behavioural choices. Ecological and genetics to maintain animal behavior. Concept of territoriality and defense in animals.

• Circadian rhythms and concept of bio-rhythmicity in animals. 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. Altruism and parental sacrifice to nurture the young.

• Competition for resources; survival of the most suitable individuals; evolutionary arms races in behavior.

• Social organization in animals and concept of group living; benefits and losses. Aggression, appeasement and selfish individuals. Social organization in insects and mammals.

• Communication in animals: Visual, Bioacoustic, electrical, chemical and tactile.

• Various types of chemical signals in animals' behavior and their importance in ecosystems.

Books Recommended:

- 1. Dngatkin, L. A. 2012. Principles of Animal Behavior.W.W. Nortan and Co.New York.
- 2. Alcock, J. 2010. Animal behavior, an evolutionary approach. 9th Edition. Sinauer Publishers.
- 3. Scott, G. 2009. Essential Animal Behavior. Wiley publishers.
- 4. Scott, G. 2005. Essential Animal Behavior. Blackwell Pub. New York.
- 5. Goodenough, J., McGuire, B., Wallace, R.A. 2001.Perspective on Animal Behavior. John Wiley & Sons, New York.

University of Lakki Marwat Khyber Pakhtunkhwa 28420, Pakistan



Course outline Department of Zoology Program BS 5th Semester

S. No	Course Category	Course Code	Course Title	Credits
1	Major	ZOO-351	Animals Physiology	4 (3+1)
2	Major	ZOO-352	Environmental Biology	4 (3+1)
3	Major	ZOO-353	Molecular Biology	3 (2+1)
4	Major	ZOO-354	Conservation Biology	3 (2+1)
5	Major	ZOO-355	Zoogeography and Palaeontology	3 (2+1)
Total Credits				

ZOO-351 Animals Physiology 4 (3+1)

Objectives

The course aims to

- Provide information about the physiological mechanisms underlying animal functions.
- Enable students to understand neuro-endocrine coordination, physiology of heart, hemodynamics and kidney function.
- > Impart information on respiratory function and gut physiology.
- Give understanding about the mechanism of homeostasis, physiological regulation of temperature and its maintenance

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.

Receptors Physiology: Receptor types: Mechanoreceptors, Olfactory and taste receptors, Photoreceptors, Photochemistry and Phototransduction; acoustico-lateralis system, Cutaneous receptors, electro-receptors. Sensory transduction, coding and adaptations. Range fractionation. **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: Autorythmicity, 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.

Temperature Regulation: Temperature classification of animals; Temperature relation of ectotherms in freezing and cold and warm and hot environment; Costs and benefits of ectothermy; Temperature relations of heterotherms and endotherms; Dormancy: Sleep, Torpor, Hibernation and Estivation.

Practicals

- Determination of haemoglobin content, haematocrit and cell counting. Preparation of blood smears.
- Nerve muscle preparation, Muscle twitch, Comparison of muscle and nerve irritability, effect of stimulus strength, effect of stimulus frequency (tetany), effect of load or stretch, effect of prolonged activity (fatigue), neuromuscular fatigue, stimulation of motor points in human.

- Recording of action potential by oscilloscope and demonstration of its various features. Experiments to demonstrate characteristic of reflex arc. Experiment in human (students themselves) to demonstrate some aspect of sensory physiology.
- 4. Normal cardiac activity, effect of temperature, effect of drug, heart block, tetanization of heart. Measurement of blood pressure.
- 5. Oxygen consumption in fish and effect of temperature (by dissolved oxygen meter) and terrestrial animal (mouse). Oxygen consumption (by respirometer), heart rate, blood pressure glycemia altered by exercise.
- 6. Effect of insulin on glycemia, study of stages in estrous cycle.

Books Recommended

- Guyton, A.C., Hall, J.E. 2013. Textbook of Medical Physiology, 10th Ed. W.B. Saunders Company, Philadelphia.Sherwood 2013.
- Tharp, G., Woodman, D. 2010. Experiments in Physiology, 10th Ed. Bejamin 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
- 5. Physiology: Mechanisms and Adaptations, 5th Ed. W.H. Freeman and Company, New York
- Bullock, J., Boyle, J., Wang, M.B. Physiology, 4th Ed. 2001. Lippincott, Williams and Wilkins, Philadelphia.
- Berne, R.M., Levy, M.N. 2000.Principles of Physiology, 3rd Ed. St. Lious, Mosby.
- 8. Withers, P.C. 1992. Comparative Animal Physiology. Saunders College Publishing, Philadelphia.
- Schmidt-Nelsen, K. 1997. Animal Physiology, Adaptation and Environment, 5th Edition. Cambridge University Press, Cambridge.

ZOO-352 Environmental Biology 4 (3+1)

Objectives

The main goal of this course is to:

- Enable students to develop strong expertise in contemporaneous themes in ecological research
- Develop critical thinking and to discuss about advanced topics in population, community and ecosystem ecology as well as in biodiversity research.
- Develop expertise to update their knowledge continuously, and to design their own research in ecology.

Course Contents:

Energy: laws of thermodynamics, primary and secondary productions, trophic levels and energy variation with increasing trophic levels, energy flow, food chains and food webs. Biogeochemical cycle: nitrogen,

phosphorus, sulpher, water, carbon, nutrient. Limiting factors: basic concepts, temperature, soil, water and humidity, light, fire.

Ecosystems: (atmosphere, hydrosphere, lithosphere, ecosphere). An overview of ecosystem with special reference to ecological niche: basic concepts and types. Major ecosystem of world: Marine, Estuarine,

Freshwater, Wetlands, Tundra, Forest, Grassland, Desert and Agricultural ecosystems.

Population ecology: basic population characters, growth and growth curves, population dynamics and regulations. Community ecology: basic concepts, community analysis, ecotones, inter-population interactions.

Applied Ecology: resources and their ecological management (mineral, agricultural desalination and weather modification, forest and range management, landscape and land use);

Pollution: (definition, types, cost, origin and management); water (sources, domestic and industrial pollution, heavy metals); air (sulpher dioxide, nitrogen oxide, carbon monoxide, ozone, smog and PAN, MTBE & CFCs); land pollution (pesticides, bacterial toxins, synthetic hormones); noise pollution.

Radiation ecology: global environmental changes (ozone depletion, acid rain, greenhouse effect and global warming, Koyota protocol, desertification, deforestation, exotic and invasive species, radioactivity leakage, environmental laws).

_ . .

Practicals

1. Measurement of environmental factors on land, water and air.

2. Study of different ecosystems: pond, agricultural or grassland, forest.

3. Community analysis through different sampling techniques (quadrat, Transect),

4. Population studies mark and recapture method, statistical analysis of field data.

5. Adaptive features of animals in relation to food and environment.

6. Food chain studies through analysis of gut contents.

7. Analysis of polluted and fresh water for biotic and abiotic variations.

8. Field visits for study of selected terrestrial habitat and writing notes.

9. Experimental design and approaches in ecological research; writing a research project

10. Development of an ecological management plan of some selected area.

Books Recommended

1. Molles, M.C. 2005. Ecology: Concepts and Applications. 6th Ed., McGraw Hill, New York, USA.

2. Cox, C.B., Morre, D. 2000. Biogeography: An Ecological and Evolutionary Approach, 6th Ed., Life Sciences King's College, London, UK.

ZOO-353 Molecular Biology 3 (2+1)

Course Objectives:

- To impart knowledge about chemical, physical and biological properties of nucleic acids.
- To understand different molecular mechanisms and their regulation in prokaryotes and eukaryotes.

Course Learning Outcomes:

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

1. **EXPLAIN** how the structure and chemistry of nucleic acids relate to their functions, relative stability and interactions with proteins.

2. UNDERSTAND the regulation of proteins and nucleic acids interaction

3. **COMPARE & CONTRAST** mechanisms of DNA replication, transcription, translation, repair, recombination, gene regulation, RNA processing in prokaryotes and eukaryotes.

4. **APPLY** molecular knowledge to identify human genetic disorders and to understand underlying molecular mechanism

Course Outline:

1. Introduction

- a. Introduction to nucleic acids
- b. Chromosome structure, Chromatin,
- c. DNA forms, structures and packaging
- d. RNA types and structures

2. Replication

- a. DNA replication in prokaryotes
- b. DNA replication in eukaryotes
- c. Enzymology of replication
- d. DNA damage and repair
- 3. Transcription

a. Types of RNA polymerases in prokaryotes and eukaryotes

b. Synthesis of mRNA, rRNA and tRNA with special reference to enzymes involved

- c. RNA processing
- d. Split genes, concept of ribozymes
- c. Genetic Code

4. Translation

- a. Role of Ribosomes
- b. Mechanism of translation in prokaryotes and eukaryotes
- c. Various factors, and posttranslational processing

5. Mutation

- a. Types of Mutations
- b. Base-Analogue Mutagens
- c. Chemical Mutagens

6. Gene expression and control

- a. Control of gene expression in Prokaryotes.
- b. Inducible and repressible operons.
- c. Control of gene expression in eukaryotes.

Practicals:

1. Preparation of different stock solutions used in molecular biology (solution used in PCR, electrophoresis, DNA isolation, RNA isolation and Protein isolation.

- 2. Isolation of DNA from human blood.
- 3. Quantification of DNA and RNA through spectrophotometer.
- 4. DNA amplification through polymerase chain reaction.
- 5. Separation of different sized DNA fragments on agarose gel.

Text and Reference books:

- Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K., Watson, J.D. 2017. Molecular Biology of the Cell. 6th Edition. Garland Publishing Inc., New York.
- Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Anthony Bretscher, Hidde Ploegh, Angelika Amon, Kelsey C. Martin. 2016. Molecular Cell Biology. W. H. Freeman Publishers, Scientific American Inc.
- **3.** Geoffrey M.C., Robert E.H. 2007. The cell: A Molecular Approach, Sinauer Associates, INC.
- Karp, J. 2005. Cell and Molecular Biology, Concepts and Experiments, Jhon Wiley and Sons, INC.
- De Robertis, E. D. P. 2017. Cell and Molecular Biology, 8th edition, Lea & Febiger, New York.

ZOO-354 Conservation Biology 3 (2+1)

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. DEMONSTRATEsound 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. AnOverview 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. ProtectedAreas and theirEstablishment 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 SustainableDevelopment

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.

Text and Reference Books:

1. Richard B. Primack, 2012. A Primer of Conservation Biology; 5th Edition: Sinauer Associates, Inc. Publishers Sunderland, MA U.S.A.

2. Groom, M.J., G.K. Meffe and C.R. Carroll, 2006, Principles of Conservation Biology, 3rd edition, Sinauer Associates, Sunderland, MA.

3. Malcolm L. Hunter, Jr. 2001. Fundamentals of Conservation Biology, 2nd Edition. Blackwell Science Inc.

4. Mills, L.S. 2007. Conservation of Wildlife Populations: Demography, Genetics and Management. Blackwell Publishing, USA.

ZOO-355 Zoogeography and Paleontology 3 (2+1)

Objectives:

The course aims to

- 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 provide 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.

Zoogeography of Pakistan:

(ii). Paleontology

The Planet Earth: History, age, shells of earth; atmosphere, hydrosphere, biosphere and lithosphere.

Rocks: types; lgneous 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.

Practicals

- 1. Study of fauna of various zoogeographical regions.
- 2. Study of mould, cast, pseudomorph, coprolite, petrified fossils of plants and animals.
- **3.** Study of invertebrate fossils of coelenterates, trilobites, ammonite, brachiopods, molluscs and echinoderms.
- 4. Study of vertebrate fossils e.g. horse/elephant/camel/bovids.
- 5. Study and identification of Igneous, Sedimentary and Metamorphic rocks.
- 6. Map work for identification of various zoogeographical regions of the World.

Books Recommended

Zoogeography:

- 1. Beddard, F. E. 2008. A text book of zoogeography. Bibliobazar, LLC.
- 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.
- 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.

University of Lakki Marwat Khyber Pakhtunkhwa 28420, Pakistan



Course outline Department of Zoology Program BS 6th Semester

S.No	Course Category	Course Code	Course Title	Credits
1	Major	ZOO-361	Developmental Biology	4 (3+1)
2	Major	ZOO-362	Genetics	4 (3+1)
3	Major	ZOO-363	Biological Techniques	3 (1+2)
4	Major	ZOO-364	Evolution and Principal of Systematics	3 (2+1)
5	Major	ZOO-365	Wild Life	2 (2+0)
Total Credits				16 (11+5)

Developmental Biology

Course Objectives:

ZOO-361

The course aims to:

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

Course Learning Outcomes:

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

- 1. 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.
- 2. Apprehend the contributions of the sperm and the egg to form zygote.
- 3. Elucidate the problems associated with cell differentiation through fate mapping.
- 4. Arrange and investigate the classical and modern experiments into "find it", "block it", and "move it" categories.
- 5. Assess the set of experiments that will establish whether a planned aspect is both necessary and ample to cause a developmental episode.
- 6. **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 Outline:

Introduction: Principal features of development, origin of sexual reproduction, developmental patterns; Spermatogenesis; Oogenesis.

Fertilization: Recognition of sperm and egg, fusion of gametes, activation of egg metabolism, rearrangement of egg cytoplasm.

Cleavage: Patterns of embryonic cleavage, mechanism of cleavage.

Gastrulation: Fate maps, gastrulation in sea urchin, amphibians, birds and mammals.

Early Vertebrate Development: Neurulation, ectoderm, mesoderm and endoderm.

Cellular Basis of Morphogenesis: Differential cell affinity, cell adhesion molecules.

Mechanism of Cellular Differentiation: RNA processing, translational regulation of developmental process, cell-fate by progressive determinants, autonomous cell specification by cytoplasmic determinants, establishment of body axes and mechanism of teratogenesis; Secondary Induction.

Organogenesis: A brief account; Origin and migration of germ cells in vertebrates. Factors controlling growth and oncogenesis. Post embryonic Development and metamorphosis
Hormones as mediators of Aging, development; Regeneration in vertebrates.

Practicals

- 1. Study of the structure of gametes in some representative cases, i.e. frog, fish, fowl and a mammal.
- 2. Study of cleavage and subsequent development from prepared slides and/or whole mounts in various animals i.e., frog, chick etc.
- 3. Study of fertilization, early development of frog/fish through induced spawning under laboratory conditions.
- 4. Preparation and study of serial sections of frog or chick embryos.
- 5. Application of microsurgical techniques on chick embryos Invitro.
- 6. Preparation and staining of histological slides.

Books Recommended

- 1. Gilbert, S. F. 2012. Developmental Biology, Sinauer Associates, Sunderland, MA.
- 2. Klaus, K. 2001. Biological Development. 2nd Ed., McGraw Hill.
- 3. Balinsky, B. I. 1985. An Introduction to Embryology, Saunders.
- 4. Oppenheimer, S.S. 1984. Introduction to Embryonic Development, Allen and Bacon.
- 5. Saunders, J. W. 1982. Developmental Biology, McMillan and company.
- 6. Ham, R. G., Veomett, M. J. 1980. Mechanism of Development. C. V. Mosby Co.

Genetics

ZOO-362

Course Objectives:

- 1. To understand the terms and basic concepts of genetics, providing a conceptual framework for future reference.
- 2. To 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.
- 3. To 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.
- 4. To understand how traits are inherited and to use this understanding in analyses (to solve problems and complete pedigrees).
- 5. To understand probability concepts and use these concepts to solve problems (including basic statistical problems).
- 6. To understand how genetic problems may lead to disease or lethality.
- 7. To understand the molecular basis of genetics (including such topics as replication, transcription, translation, and mutation).
- 8. To understand mechanism of repair and molecular genetic analysis.
- 9. To understand the workings and importance of major genetics techniques such as PCR.
- 10. To understand current issues regarding genetics (e.g., cloning, use of transgenic organisms).
- 11. To understand Mendelian and non-Mendelian pattern of inheritance in human.
- 12. To understand the workings and uses of population genetics technique.

Course Learning Outcome

- 1. Able to define terms of genetics and apply concepts of modern transmission
- 2. Identify and describe the process and purposes of the cell cycle, meiosis, and mitosis, as well as predict the outcomes of these processes.
- 3. Solve transmission genetics problems, make accurate predictions about inheritance of genetic traits, and map the locations of genes.
- 4. Identify the parts, structure, and dimensions of DNA molecules, RNA molecules, and chromosomes, and be able to categorize DNA as well as describe how DNA is stored.
- 5. Able to accurately draw the diagram and describe the processes of replication, transcription, translation, as well as predict the outcomes of these processes.
- 6. Describe what causes and consequences of DNA sequence changes and how cells prevent these changes, as well as make predictions about the causes and effects of changes in DNA.
- 7. Describe the processes of gene regulation and predict how a gene will be expressed under specific circumstances.

- 8. Learn and practice common genetics laboratory techniques.
- 9. Describe applications and techniques of modern genetic technology, as well as select the correct techniques to solve practical genetic problems.
- 10. Carry out genetics laboratory and research techniques.
- 11. Identify the human traits and genetic diseases.
- 12. Describe experimental results in written format both informally and in formal manuscript format
- 13. Able to solve problem related to population genetics.

Course Contents:

1. Introduction

a. Classical, molecular and population Genetics: Scope and importance of genetics, Forward and reverse genetics. The basic principles of Inheritance (Mendelism): Monohybrid and Dihybrid crosses (Definition - characteristics criss-cross inheritance).

b. Multiple Alleles: blood groups and coat color in rabbits.

c. Genetics of Rh factor and Erythroblastosis Foetalis.

2. Chromosomal Basis of Inheritance:

- a. Chromosomal theory of inheritance
- b. Interaction of genes, Epistasis, Lethality and Pleiotropism.

3. Chromosomal Aberrations

a. Changes in chromosomal number, Euploidy, aneuploidy (Klinefelters syndrome, and Turners syndrome, Down syndrome and Edwards syndrome).

b. Structural changes, insertion, deletion (Cri du chat syndrome), duplication,

c. Inversion and translocation

4. Pedigree Analysis:

- a. Normal human chromosome complement; Karyotyping.
- b. Sex-determination and Sex-linkage:
- c. Sex determination in animals and humans,

d. Sex linked (Hemophilia, muscular dystrophy, color blindness), sex influenced and sex limited traits,

e. Prenatal Diagnosis: Amniocentesis and choriovillus sampling - Ultrasound scanning and Fetoscopy. Genetic counselling, Eugenics and Euthenics

5. Chromosome mapping

- a. Linkage, recombination (crossing over) and
- b. Chromosome mapping in eukaryotes.

6. Molecular Genetics:

- a. Gene Concept (classical and modern),
- b. Genetics of Viruses and Bacteria,
- c. Transposons,

d. Mutation and DNA repair

- e. Molecular Genetic Analysis,
- f. Regulation of Gene Expression in Prokaryotes,
- g. Gene Regulation in Eukaryotes,
- h. Genetic basis of diseases, like cancer,
- i. Genetic control of animal development.
- j. The genetic control of the Vertebrate Immune System,

7. Recombinant Technology

a. The Techniques of Molecular Genetics (elements of genetic engineering),

b. PCR

8. Human Genetics;

a. Single and Multifactorial Disorders:

b. Autosomal anomalies, Pseudoautosomal genes,

c. Single gene disorders: Gene mutation and disorders; autosomal single gene disorders (Sickle cell anemia, brachydactyly; inborn errors of metabolism such as Phenylketonuria, alkaptonuria).

d. Complex Inheritance Patterns, Polygenic traits- Cleft lip and cleft palate,

9. Population Genetics:

- a. Hardy-Wienberg equilibrium,
- b. Systematic and Dispersive pressures, Inbreeding and heterosis

Practical:

- 1. Drosophila culture techniques: preparation and maintenance of culture
- 2. Identification of male and female fruit fly and isolation of virgin females
- 3. Study of polytene chromosomes from the salivary glands of Drosophila melanogaster
- 4. Mutation induction in Drosophila
- 5. Human karyotyping from photographs prepared slides: paper cut out method
- 6. Preparation of human metaphase chromosomes from blood lymphocytes
- 7. Study of mitosis in plants by using onion root tip cells
- 8. Study of meiosis in the testes of male grasshopper
- 9. Extraction of genomic DNA from whole blood (lymphocytes)
- 10. Separation of heterogeneous population of bio-molecules through electrophoresis
- 11. Study of blood group polymorphisms in local population
- 12. Study of qualitative traits in humans: a survey of common physical heritable (monogenic) polymorphisms
- 13. Human Pedigree analysis problems (Determination of inheritance pattern of different human characters (Widows Peak, ear loop, etc), risk estimation and genetic counselling
- 14. Study of quantitative traits in humans: finger prints as model of polygenic traits

- 15. Study of Barr bodies in human cell nucleus
- 16. Dermatoglyphics in normal and mentally retarded subjects
- 17. Probability problems. Tossing of coins. X2 test
- 18. Study of transformed bacteria on the basis of antibiotic resistance

19. PCR

Books Recommended:

- 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. 2013. 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.
- Strickberger, M.W. 2015. Genetics. McMillan, New York. USA.(9780024181206) PRINCIPALS OF GENETICS Gardner E.J., Simmons M.J. and Snistad A.P. (Latest available Addition)
- 6. Concepts of Genetics By Klug, W.S and Cummings M.R.
- 7. Willium S. Klug, 2014. Concept of Genetics, ISBN-11: 978-0321948915
- Lewin's Gene XI BY Jocelyn E.Krebs et al. 2013, isbn-13:978-1449659851,ISBN-10:1449659853.
- 9. Gene- XI by Lewin's,2013,ISBN:978-1449659851.
- 10. Concepts of genetics 11th edition, William S.Klug, 2014, ISBN-13:978-0321948915.

ZOO-365 Wild Life 2 (2+0)

Course Objectives:

The objective of this course is

- 1. To enable the student to understand philosophy and significance of wildlife conservation
- 2. To understand the wildlife management rules and regulations in Pakistan
- 3. To understand how National and International agencies are involved in conservation and management of wildlife

Course Learning Outcomes:

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

- 1. **ACQUIRE** theoretical knowledge about the identification, distribution, status, conservation and management of amphibians, reptiles, birds and mammals of major importance in Pakistan
- 2. **UNDERSTAND** the protected area system (Game Reserves, Wildlife Sanctuaries and National Parks)
- 3. **SOLVE** the threats to wildlife by applying the scientific principles and modern technologies (Sustainable development through local community participation).
- 4. **ANALYSE**, interpret and synthesize data and other information about the population of wildlife
- 5. **EVALUATE** the conservation management by government department, National and International organizations.
- 6. **DEMONSTRATE** the ecological assessment and importance of wildlife to certain area.

Objectives

The students will learn:

- About wildlife, distribution pattern world over
- Regarding wildlife of Pakistan, threatened, endangered species
- Modern techniques used in animal tracking, data collection

• How to protect, maintain, control and preserve the health and environment of wildlife.

Course Contents

Wildlife: Animal occurrence, protection, needs of animals, maintenance, and the habitat.

Techniques: Ground and aerial tracking, GPS, radiotelemetry, maps etc.

Wildlife Conservation: Philosophy and significance, Biodiversity and sustainability of wildlife.

Wildlife Agencies: National and International agencies involved in conservation and management of wildlife. International conventions, agreements.

Wildlife of Pakistan: identification, distribution, status, conservation and management (population estimate technology) of fishes, reptiles, birds and mammals of major importance in Pakistan.

Wildlife rules and regulations in Pakistan: Sanctuaries, Game Reserves and National Parks in Pakistan. Endangered species of Pakistan.

Books Recommended

- **1.** Ali, S.S. 1999. Paleontology, Zoogeography& Wildlife Management. Nasim Book Depot. Hyderabad, India.
- 2. Roberts, T. J. 1998. The Birds of Pakistan, (Vol. II), Oxford University Press.
- 3. Roberts, T. J. 1992. The Birds of Pakistan, (Vol.I). Oxford University Press.
- 4. Magon, C.F. 1988. *Biology of Freshwater Ponds*. Longman and Scientific Publication.
- 5. Bailey, J.A. 1986. Principles of Wild life Management. John Wiley and Sons.
- 6. Robinson, W.L., Bolen, E.G. 1984. *Wildlife Ecology and Management*. McMillan, Cambridge.
- 7. Roberts, T.J. 1977. Mammals of Pakistan. Ernest Benon Ltd, London.
- 8. Ali S., Ripley S. D. 1973. *A Handbook of Birds of India & Pakistan*, Oxford University Press, London.
- 9. Elirza Z.B, the Birds of Pakistan.

ZOO-363 Biological Techniques 3 (1+2)

Course Objectives:

1. To course aim to demonstrate the knowledge of skills

2. To familiarize with the basic tools and techniques of scientific study with emphasis on biological sciences

3. To develop basic understanding of the equipments handling/usage

4. To develop scientific technical expertise, culture and work habits.

5. To know how to collect and preserved animals

Course Learning Outcome:

After successfully completion of this course,

- 1. Students must be able to identify the instrument
- 2. Able to use instrument for identification, measurement, fixing and cutting of tissue
- 3. Able to apply a practical and research skill
- 4. Able to operate use the lab equipment efficiently.
- 5. Able to collect and preserved the specimen in dry and wet form.

6. Developed expertise in Preservation techniques – Taxidermy - Rearing techniques, Laboratory and field

Course Contents:

1. Microscopy:

a. Principles of light microscopy. Magnification, Resolution,

- b. Types of microscopy (Bright field, Dark field, Phase Contrast)
- c. Confocal Microscopy

d. Electron microscope: Scanning electron microscope and Transmission electron microscope (SEM and TEM).

2. Standard unit system for weight, length, volume and Micrometery:

a. Different Measurement systems (length; surface; weight, volume, temperature),

Calculations and related conversions

- b. Concentrations- percent volume; ppt; ppm molarity, normality, molality
- c. Preparation of stock solutions of various strengths
- d. Use of stage and ocular micrometers

e. Calibration of ocular micrometer and measurement of size animal and plant cell and nuclei

3. Specimen preparation for optical microscopy:

a. Introduction to Microtomy and its types

b. Tissue Fixation, dehydration, clearing, embedding, Section cutting (transverse,

longitudinal section)

- c. Tissue mounting (dry mount, wet mount)
- d. Staining: Hematoxylin and Eosin staining
- 4. Separation and purification techniques:

- a. Cell fractionation
- b. Centrifugation and its types
- c. Filtration and its types,

5. Chromatography:

- a. Chromatography: Principle, applications, types,
- b. Paper chromatography and thin layer chromatography
- c. Column chromatography
- d. High pressure liquid chromatography.
- e. Electrophoresis: Principle, applications and types (Agarose and PAGE).

6. Spectrophotometry:

- a. Principle, applications, types
- b. Visible/UV spectrophotometry

7. Basic principles of Sampling and Preservation:

- a. Sampling from soil, water, air, plants and animals
- b. Preservation of dry and wet specimens.
- c. Preservation techniques. lyophilization, preservation in ethanol, formalin etc.

8. DNA sequencing

- a. Polymerase chain reaction (PCR), principle and application
- b. DNA sequencing (Sanger and Maxam Gilbert).

Practicals:

- 1. Preparation of slides (dry mount and wet mount)
- 2. Observation of wet mounts of human cheek cells employing bright and dark field microscopy
- 3. Measurement of cell size: bacterial and eukaryotic Cell
- 4. Recording of microscopic observations with the help of camera lucida
- 5. Liquid handling: proper use of pipettes and micropittes
- 6. Hematoxylin and eosin staining
- 7. Gram's staining,
- 8. Handling of centrifuge machines
- 9. Paper Chromatography
- 10. Thin layer chromatography of amino acids
- 11. Spectrophotometric estimation of glucose
- 12. Collection and Preservation of representative animals of various phyla

Books Recommended:

- 1. Dean, J. R. 1999. Extraction Methods for Environmental Analysis. John Wiley and Sons Ltd. UK.
- 2. Cheesbrough, M. 1998. District Laboratory Practice in TropicalCountries. Part I. Cambridge University Press, UK.
- 3. Cheesbrough, M. 1998. District Laboratory Practice in TropicalCountries. Part II. Cambridge University Press, UK.

- 4. Curos, M. 1997.Environmental Sampling and Analysis: Lab Manual. CRC Press LLC. USA.
- 5. Curos, M. 1997.Environmental Sampling and Analysis: ForTechnician. CRC Press LLC. USA.
- 6. Slingsby, D., Cock, C.1986. Practical Ecology. McMillan Education Ltd. London.
- 7. Rob Reed/ David HOLMES, Jonathan Weyers/ Allan Jones Pearson, Practical skill in bio-molecular sciences.
- 8. Gallagher, S.R. and Wiley E.A. 2008. Current protocols essential laboratory Techniques. John Wiley & Sons Inc, USA.
- 9. Jones, A. Reed, R and Weyers, J. 1994. Practical skills in Biology. Longman Singapore Publishers (Pte) Ltd.

ZOO-364 Evolution and Principal of Systematics 3 (2+1)

Objectives

The course aims to:

- Provide in-depth knowledge of origin of life
- Develop concepts about forces responsible for evolutionary changes

• Study the importance and history of systematics with basic rules and regulations about the identification and naming of organisms

Course Contents

(i). Evolution

The nature and origin to life: Evidences of evolution (molecular, embryological & paleontological).

Theories of Evolution: Theories to explain the diversity of life – Modern synthetic theory, factors initiating elementary evolutionary changes (micro-evolution) by changing gene frequencies, mutation pressure, selection pressure, immigration and crossbreeding, genetic drift.

Role of isolation in evolution: Factors of large evolutionary changes (macro/mega evolution) - allometry, orthogenesis, adaptive radiation.

Modern concept of Natural Selection: Levels of selection, selection patterns, laboratory and field example regarding action of Natural Selection. Action of Natural Selection leading to convergence, radiation, regression and extinction, Batesian mimicry, Mullerian mimicry, Sexual selection: Darwin's concept, Fisher's view, Zahavi's handicap theory, Recapitulation theory, Trend and rates in evolution.

(ii). Systematic Zoology

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

History of taxonomy: systematics, basic terminology of systematics, theories of biological classifications.

Taxonomic characters: Kinds and weightage, microtaxonomy, taxonomic categories: specific category, infraspecific category, higher categories;

Species concept.

Typological species concept: Nominalistic species concept, biological species concept, Evolutionary species concept. Kinds of different species, Speciation, Taxonomic procedures, taxonomic collection; their preservation and duration, Taxonomic keys, different kinds of keys and their merits and demerits.

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.

Practicals

- 1. Study of preserved invertebrate species and their classification up to 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.

Books Recommended Evolution

- 1. Strickberger. M.W. 2012. Evolution. Jones & Barrett Publishers.
- 2. Ridley, M. 1993. Evolution. Blackwell Scientific Publications.
- **3.** Moody, P.A. 1989. *Introduction to Evolution*, Harper and Row Publishers, New York.
- **4.** Dobzhansky, T., Ayala, F.J., Stebbins, G.L., Valentine, J.W. 1973. Evolution. W.H. Freeman and Company.
- 5. Mayr, E. 1965. *Populations, Species and Evolution*, Harvard University Press.
- **6.** Dobzhansky, T. 1951. *Genetics and the origin of species*. Columbia University Press, New York.

Systematic Zoology

- 1. Wiley, E. O. and Lieberman, B. S. 2011. Phylogenetics: Theory and practice of phylogenetic systematics. 2nd Ed. Wiley-Blackwell.
- 2. Mayer, E. Principles of Systematic Zoology. 1994. McGraw 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

7.

University of Lakki Marwat Khyber Pakhtunkhwa 28420, Pakistan



Course outline Department of Zoology Program BS 7th Semester

S.No	Course Category	Course Code	Course Title	Credits	
1	Major	ZOO-471	Biotechnology	4 (3+1)	
2	Major	ZOO-472	Endocrinology	3 (2+1)	
3	Major	ZOO-473	Research methodology	2 (2+0)	
4	Elective I	ZOO-474	Parasitology-I	4 (3+1)	
5	Elective II	ZOO-475	Entomology/Research/Thesis	3 (2+1)	
Total Credits					

ZOO-471

Biotechnology

Course Objectives:

To acquaint students of zoology with the basic concepts and significance of biotechnology.

Course outcomes:

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

1. **COMPREHEND**about the introduction and history of biotechnology

 UNDERSTANDING of core molecular genetics concepts including molecular biology, genetics, cell biology, physiology, and evolution
 KNOW about basic of rDNA technology, concept and principle and application of genetic engineering, transgenic animals, cryopreservation, apoptosis, and animal cloning.

Course Content:

1. Introduction:

a. Definitions, classes, types of modern biotechnology

b. Historical perspective, timeline of important events in the field of biotechnology

2. Genetics and Biotechnology:

a. Genome, human genome, types and size of human genome, diversity of human genome

b. Short Tandem Repeats, nomenclature, uses of STRs, inheritance of STRs, allele, locus, genotype, phenotype

c. Polymerase Chain Reaction, principle, requirements, procedures and applications, Gel electrophoresis, definition, principle, steps/methods involved, DNA ladder, allelic ladder

3. Biotechnology and Justice:

a. Sources of DNA, Forensic DNA testing,

b. Principles, techniques, types and applications

4. Genetic Engineering

a. Introduction, Steps, Vectors and its types, characteristics of vectors

b. Plasmids and its types, pBR322, pUC19, Ti-Plasmid

c. Restriction Enzymes, Screening, Blue White Screen, Negative and Positive Control, Competent Cells, Insulin as an example, genetically modified organisms

d. Cloning, its types of cloning, cell cloning, molecular cloning, organism cloning, applications and uses

5. Animal and Insect Biotechnology:

a. Introduction, reasons for producing GM animals,

b. Genetic manipulation, mammalian cloning, somatic cell nuclear transfer, procedure and uses, GM hormones and vaccines, GM insects

6. Bioprocess Technology:

a. Introduction, requirements of bioreactors, types of bioreactors

b. Bacterial and mammalian cell culturing, production of novel antibiotics, steps for production of antibiotics, production of industrially important chemicals

7. Biotechnology and Medicine:

a. Applications, monoclonal antibodies, importance, steps for production of monoclonal antibodies.

8. Stem Cell Biotechnology:

a. Introduction, sources – embryonicstem cells, adult stem cells

b. Types of stem cells based on potency, applications of stem cells.

9. Public Perception of Biotechnology:

a. Current issues in bioethics (Autopsy, GMOs, Stem Cells, Euthanasia, Organ Transplant, Human Cloning, IVF, Surrogacy and sperm donor, etc) 10. Bioethics and Islamic Bioethics:

10. Bioethics and Islamic Bioethics:

a. Introduction and principles of bioethics,

b. Concept of bioethics in different religions, principles of Islamic bioethics **Practicals:**

1. DNA Extraction from different sources

2. Quantification of DNA using gel electrophoresis and spectrophotometer

- 3. Amplification of DNA using PCR
- 4. PCR product measurement using gel electrophoresis
- 5. Gender typing of human and animal samples using PCR
- 6. Restriction fragment length polymorphism of samples
- 7. Species identification of different animal samples using PCR and RFLP

Text and Reference Books:

1. Clark, D.B., Pazdernik, N.J. (2015) Biotechnology. 2nd Edition. Academic Cell

2. Glick, B., Pasternak, J.J., Patten, C.L. (2009) Molecular Biotechnology: Principles and Applications of Recombinant DNA. 4th Edition. ASM Press.

3. Freeman, S., Quillin, K., Allison, L. (2013) Biological Science. 5th Edition. Pearson.

4. Schmid, R.D., Schmidt-Dannert, C., Hammelehle, R. (2016) Biotechnology: An Illustrated Primer. Willey-Blackwell.

5. Dehlinger, C.A. (2014) Molecular Biotechnology. Jones & Bartlett Learning 6. Brown, T.A. (2016) Gene Cloning and DNA Analysis: An Introduction. 7th Edition. Willey-Blackwell.

7. Butler, J.M. (2009) Fundamentals of Forensic DNA Typing. Academic Press.

8. Setlow J. K. (2000). Genetic Engineering: Principles and Methods. Kluwer Academic Publishers

9. Krishna.V.S. (2007) Bioethics and Biosafety in Biotechnology. New Age International

10. Furr, A.K. (2008) CRC Handbook of Laboratory Safety. 5th Edition. Boca Raton, FL, CRC Press

ZOO-472 Endocrinology 3 (2+1)

Course Objectives:

1. To discuss the definition of hormone in terms of its general properties.

2. To differentiate among endocrine, paracrine and autocrine system.

3. To describe different classes and chemical structure of hormone.

4. To explain the roles of the endocrine system in maintain homeostasis, integrating growth and development, responding to environmental insult and

promote successful reproduction.

5. To identify the glands, organs, tissues and cell that synthesize and secrete hormones, hormone precursors and associated compounds.

6. To describe synthesis and mode of secretion of hormone, regulation of hormone secretion of hormone, including the principles of negative and positive feedback mechanism.

7. To explain the importance of patterns of hormone secretion such as pulsatile, diurnal,cyclicle and how hormones are transported in the blood and consequences of reversible binding of many hormones by plasma proteins

8. To explain the basis of hormone assays and assessment of biological activity

9. To discuss the metabolism, clearance and excretion of hormones and their metabolic derivatives

10. To define and discuss the physiological actions of hormone relating them whenever possible to human disorders

11. To explain the consequences of under and overproduction of hormones to determine the pathophysiological basis and consequences of specific endocrine disorders.

12. 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 Outcome:

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 cyclicle.

9. Explain how hormone 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 hormone 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.

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;

d. Evolution of endocrine system. RIA, RIMA, ELISA, bioassay and receptor assay

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 pro-

opiomelanocortin 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, Functionof thyroid hormone,

b. Mechanism of action; regulation and factors affecting thyroid function.

c. Causes and effect of Hypothyroidism and hyperthyroidism

4. Calciotrophic 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 Heart, Kidney,

- b. Immune system:
- c. Growth and pineal gland.

15. Functional diversity of vertebrate hormo nes

a. Functional diversity of hormones in different vertebrates

16. Overview of Endocrine Mechanisms in Invertebrates

a. Hormones of invertebrates

17. Geriatric Endocrinology

a. Endocrine and Associated Metabolism in aging: Specifically thyroid, glucose and calcium homeostasis

Practical:

1. Demonstration of endocrine glands and associated structures in dissections, transparencies, computer projections etc;

2. Histological and ultrastructure features of endocrine glands;

3. Experiments to demonstrate physiological roles of hormones of different endocrine glands;

4. Experiments to demonstrate regulation of hormones' releases.

5. Experiments to demonstrate functional diversity of hormones in different vertebrates.

6. Experiments on endocrine mechanism in vertebrates.

7. Experiment on recognition and response of receptors

8. Studies of disorders of pituitary by observing anatomical and histological features

9. Studies of thyroid status in deficient and excess hormone functions

10. Studies of type 1 and type 2 diabetes mellitus: Epidemiology of the types in population, studies of management of the type 2;

11. Model studies of Ovarian and Testicular disorders;

12. Model studies of obesity and aneroxia;

13. Studies of hormonal status in puberty and aging.

Text Books:

1. Greenspan, F.S. and Strewler, 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. Wiley-Blackwell (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.

ZOO-4<u>77</u>

Parasitology-I

Objectives

This course will

•Introduction to general Parasitology

•provide knowledge regarding different modes of transmission of parasites of medical and veterinary importance

•knowledge about their pathology, host parasite relationship and control measures

Course Contents

Introduction to parasitology. Relationship to other sciences, parasitology and human welfare. Parasites of domestic and wild animals. Camers in parasitology. Some basic definitions. Basic principles and concepts.

Parasite ecology and evolution. Basic principles and concepts. Immunology and pathology. Susceptibility and resistance, innate defence mechanisms.

Acquired immune response in vertebrates. Immunity in invertebrates.

Immunodiagnosis, pathogenesis of parasitic infections. Accommodation and tolerance in the host-parasite relationship.

Parasitic form. function classification: protozoa, and Kinetoplasta, trypanosomes and their kin, forms of trypanosomatidae. Other flagellated protozoa, order Retortamonadita, order Diplomonadida, order Trichomonadida, order Opalinida. The Amoebas. Order Amoebida, order Schizopyrenida. Phylum Apicomplexa, Gregarines, Coccidia and related organisms. The apical complex, class Gregarinea, class Coccidea. Phylum Apicomplexa, Malana, organisms, and pyroplasms, order Haemospondea, order Pyroplasmida. Phylum ciliophora, ciliated protistan parasites, class Spirotoichea, class Litostomitea, class Oligohymenophorea. Phyla Microspora and Myxozoa. Parasites with polar filaments. Phylum Microspora, Phylum Myxozoa. The Mesozoa, pioneers or Degenerates.

Practicals

- **1.** Preparation of temporary and permanent slides and identification of parasitic protozoan and local helminthes of medical and veterinary importance.
- 2. Section cutting of the infected tissues and the study of their pathology.
- 3. Methods of collection, preservation and transportation of parasitic material.
- 4. Qualitative and quantitative faecal examination for helminth ova.
- **5.** Collection, preservation and preparation of slides of local helminthes and their identification.
- 6. Identification of insects of medical and veterinary importance.

Books Recommended

- 1. Roberts, L.S. and Janovy, J. Jr. 2005. Foundations of Parasitology. 7th Edition. W.M. Brown Publishers, Chicago, London, Tokyo, Toronto.
- Urquhart, G.M., Hucan, J.L., Dunn, A.M. and Jennings, F.W. 2000. Veterinary Parasitology. Longman Scientific and Technical publications, Longman Group, UK.
- Roberts, L.S. and Janovy, J. 2000. Foundation of Parasitology, 6th Edition. McGraw Hill Book Co.
- Hausman, K. and Hulsmann, N. T. 1996. Protozoology, 2nd Edition. Medical Publishers, Inc. New York.
- 5. Smyth, J.D. Introduction to Animal Parasitology. 1994. Cambridge University Press.
- Cheesbrough, M. 1987. Medical Laboratory Manual for Tropical Medicine. Vol.I. University Press Cambridge.
- 7. Noble, E.R. and Noble, G.A. Parasitology. 1982. The Biology of Animal Parasites. 5th Edition. Lea and Febiger Publisher.
- Beck, J.W. and Davies, J.E. 1981. Medical Parasitology. 3rd Edition. C.V. Mosby Company, Toronto, London.

ZOO-479 Synopsis and Research Methodology 2 (2+0)

Objectives

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
- > Enable students to write a research proposal.

Course Contents

Course Contents:

1. Introduction:

a. Objectives of Research, Motivations

2. 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

3. Topic Selection:

a. Problem identification for research, criteria and evaluation

4. Literature review:

- a. Importance and sources
- b. Referencing and citation and Bibliography
- c. plagiarism

5. Research Design:

a. Parts, important features, important concepts in research design

6. Aims and objectives:

a. Research objectives, qualities of research objectives

7. Material and methods:

a. Bioethics, sampling, data collection and data analysis, sampling requirements, scales of measurement, error of measurement and its sources

8. Data Analysis:

a. Processing, statistics in research, hypothesis testing, t-tests and ANOVA

9. Scientific Writing:

- a. Difference between thesis/report/synopsis/research proposal
- b. Parts of synopsis/project proposal, parts of thesis/report
- 9. **Budgeting:** Cost estimates for a research project, funding sources e.g. USAID, HEC, DoST, HED, PMRC, WWF, PSF etc.

Text and Reference Books:

- Paul Leedy, 2004, Practical Research: Planning and Design (8th Edition), Jeanne Ellis Ormrod.
- Creswell, J. W. (2013). Research Design Quantitative Qualitative and Mixed Methods Approaches. Sage.
- Hess-Biber, S. N. and P. Leavy. (2004). Approaches to Qualitative Research, A Reader on Theory and Practice. New York, Oxford University Press.
- 4. Khan, J.A. (2008). Research Methodology. New Delhi: APH Publishing.
- Kothari, C.R., & Gaurav, G. (2014). Research Methodology: Methods and Techniques. New Delhi: New Age International.
- Kumar, R. (2011). Research Methodology: A Step By Step Guide for Beginners. Cornwall: SAGE Publications, Inc.
- Laurel, B. (2003). Design Research, Methods and Perspectives. London England, The MIT Press.

ZOO-480 Entomology/Research/Thesis 3 (2+1)/3 (3+0)

Course Contents

Introduction to Entomology, Position of insect in animal kingdom, general characteristics of insects.

Hard Parts: General segmentation, tagmatosis and organization.

Cuticle: Detailed structure along with its biochemistry. Epidermal layer; its structure and function. Basement membrane. Colours of insects. Cuticular outgrowths and appendages sclerotization.

Head: cephalization, sclerites, modifications.

Antennae: Different types of antenna and their structure.

Thorax: Sclerites: legs, their different modifications and functions.

Wings: Origin; Different regions. Development and basal attachments, main veins and their branches (generalized insects), wing coupling.

Abdomen: General segments of abdomen of Insect. Flight; types of flight. Aerodynamics, fuels, endoskeleton; head, thorax and abdomen.

Soft Parts: General account of Insects Muscular system. Basic structure of Insects muscle, types of muscles. Muscle contraction and its energetics,

Digestive system: Comparative structure of the digestive system and their physiology.

Respiratory System: Comparative structure of the respiratory System and their physiology.

Nervous system: Incubatory, and nervous system and their physiology.

Excretory System: Comparative structure of the excretory system and their physiology.

Reproduction: Reproductive organs and different types of reproduction in insects. Egg fertilization and maturation.

Development: Embryology up to dorsal closure,

Sense organs: sound producing organ and types. light producing organ.

Endocrine system: Exocrine and endocrine glands of insects. Pheromones and their functions.

Metamorphosis: Different types of metamorphosis.

Insects defence: Insect defences and adaptations. Prey-predation and competition in Insect.

Ecology: Carrying capacity 'r' and k selection, Food chains, predation and competition, insect defenses and adaptations, diapause insect population and community studies, insect communication.

Practical:

- 1. Preparation of permanent slides. All the hard parts (antennae, mouth parts, wings, legs, terminal segments and genitalia).
- 2. Different systems, especially digestive, reproductive of the following insects. American cockroach, Gryllus, grasshopper, housefly, butterfly, mosquito, any common beetle. Red cotton bug. Wasp and honey bee.
- 3. Sympathetic nervous system of cockroach and gryllus. Salivary glands of cockroach, red cotton bug and honey bee.

Books Recommended

- 1. Chapman, R.F. The insects: structure and function. 2000. Blackwell Science Inc., London.
- Krebs, C. J. Ecology: the experimental analysis abundance. 5th Edition.
 2000. Benjamin-Cummings Publishing Company.
- 3. Price, W. Insect ecology. 1997. John Wiley & Sons.
- 4. RICHARDS, O. W. and DAVIES, R. G. IMM'S General Textbook of Entomology. Vol.1, 10th Edition. 1977. Chapman & Hall, London.
- 5. Robert L. Patton. W. B. Insect Physiology. 1963. Saunders Co., Philadelphia.
- 6. Southhood, T.R.E. Ecological Methods. 1978. Chapman and Hall, London.
- 7. Tembhare, Db. Modern Entomology. 2002. Himalaya Publishing House. India.
- 8. Wigglesworth, V. B. Insect Physiology 8th Edition. 1984. Springer Publisher.
- Yazdani, S.S., and Agarwal, M.L. 1997. Elements of insect ecology. Narosa Publishing House. India. 10. Sakis Drosopoulos, Michael F. Claridge, 2005,

Insect Sounds and Communication: Physiology, Behaviour, Ecology, and Evolution Contemporary Topics in Entomology, Illustrated edition. Publisher CRC Press.

10.Gordon Gordh, Contributor David Headrick, 2011, A Dictionary of Entomology. Publisher CABI.

University of Lakki Marwat Khyber Pakhtunkhwa 28420, Pakistan



Course outline Department of Zoology

Program BS 8th Semester

S. No	Course Category	Course Code	Course Title	Credits
1	Major	ZOO-481	Bioinformatics	3 (1+2)
2	Major	ZOO-482	General Microbiology	4 (3+1)
3	Major	ZOO-483	Immunology	4 (3+1)
4	Elective I	ZOO-484	Parasitology II	4 (3+1)
5	Elective II	ZOO-485	Aquaculture and Fisheries Thesis/Research	3 (2+1)
Total Cr	18 (12+6)			

ZOO-481 Bioinformatics 3 (1+2)

Course Objectives

The course will provide:

- 1. An introduction to bioinformatics.
- 2. To develop awareness about fundamental bioinformatics databases.
- 3. Information on the tools used to compute solutions to those problems, and the theory upon which those tools are based.

Course Outcomes:

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

- 1. GAIN an understanding of the basic concepts of Bioinformatics.
- 2. **EXPLAIN** the basics of bioinformatics and computational biology.
- 3. To **USE** bioinformatics search tools on the internet for mining data, pairwise and multiple sequence alignments and predict protein structures.

Course Contents:

1. Introduction:

- a. Introduction to Bioinformatics, Scope of bioinformatics, useful websites.
- b. Aims of bioinformatics, disciplines related to bioinformatics, major tasks involved in bioinformatics analysis, bioinformatics tools
- c. Short introduction to proteomics and genomics, and the role of bioinformatics in the pharmaceutical industry.
- d. Human genome project
- 2. Biological databases
- a. Data and types of data, data acquisition
- b. Major DNA databases around the world, NCBI, BOLD, DDBJ and EMBL
- **c.** Major protein databases in the world, protein sequence databases, protein structure databases
- d. Specialized databases, genome and organism databases
- e. Non sequence databases, pubmed, pubmed health, OMIM
- **3.** Short introduction to DNA/RNA: structure, genetic code; analyzing the DNA/RNA sequence by the use of BI tools.
- 4. Enzyme classification: retrieval databases
- 5. Genome mapping
- **a.** Genetic and linkage mapping, physical mapping

6. Gene family:

- **a.** Introduction, types, protein family, Globin family as an example, globin genes and chains, evolution of globin proteins in human, combination and types of globin proteins in human.
- 7. Data Retrieval:
- a. Searching sequence databases

- **b.** FASTA format
- **c.** Retrieval of nucleotide sequence data, retrieval of protein sequence and structure data, retrieval of literature and map data

8. Primer Designing:

- a. Primer and probe, qualities of primer, general rules for primer designing.
- **b.** Websites used for primer designing (PRIMER3+, PRIMER-BLAST, OLIGO-CALC etc.)

9. Sequence Alignment:

- a. Importance and significance of alignment, methods for sequence alignment
- b. Local and global alignment, pair-wise local alignment
- 10. BLAST: Introduction, types, uses, algorithm, BLAST Scores

11. Multiple Sequence Alignment:

a. Introduction, tools for MSA, uses and importance

12. Phylogenetic analysis:

- a. Introduction, interpretation, rooted and unrooted tree,
- **b.** phylogenetic methods, tree terminology, comparison of methods, software

Practicals/Tutorials:

- 1. Introduction to NCBI
- 2. Retrieving Literature from NCBI
- 3. Classification of an organism using NCBI
- 4. Retrieving FASTA sequence for nucleotide and protein
- 5. Retrieving disease gene information
- 6. Searching gene families
- 7. Primer Designing
- 8. BLASTing a nucleotide / amino acid sequence
- 9. Multiple Sequence Alignment using different amino acids / nucleotide sequences
- 10. Phylogenetic Analysis of different nucleotide / amino acid sequences
- 11. Microarrays data retrieval from the web

Text and Reference Books:

- 1. Baxevanis, A.D., Ouellette, B.F.F. (2011) Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. John Wiley & sons, Inc.
- **2.** Rastogi, S.C., Mendiratta, N., Rastogi, P. (2011) Bioinformatics Methods and Applications: Genomics, Proteomics and Drug Discovery. PHI publishing.
- **3.** Pevsner, J. (2015) Bioinformatics and Functional Genomics. 3rd Edition. Willey-Blackwell
- **4.** Lesk, A. (2014) Introduction to Bioinformatics. 4th Edition. Oxford University Press
- **5.** Selzer, P., Marhofer, R. and Rohwer, A. (2008) Applied Bioinformatics: An Introduction. Springer publishing, Germany.

- 6. Primerose, S.B. (2004) Genomics: Applications in Human Biology. Willey-Blackwell
- 7. Westhead, D.R., Parish, J.H., Twyman, R.M. (2003) Instant Notes on Bioinformatics. Viva Books Private Limited.
- **8.** Krane, D.E. and Raymer, M.L. (2002) Fundamental Concepts of Bioinformatics. Benjamin Cummings.
- **9.** Gibas, C. and Jambeck, P. (2001) Developing Bioinformatics Computer Skills. O'Reilly publishers.

ZOO-482 General Microbiology

Objectives

The course aims to:

- \Box Enable the students to work with microorganisms.
- □ Understand the basic techniques of sterilization, culturing, isolation
- □ Determine different characteristics of the microorganisms

Course Contents

The beginnings of Microbiology: Discovery of the microbial world; Discovery of the role of microorganisms in transformation of organic matter, in the causation of diseases, development of pure culture methods. The scope of microbiology. Microbial evolution, systematics and taxonomy; Characterization and identification of microorganisms. Nomenclature and Bergey's manual.

Viruses: Bacteriophages and phages of other protests. Replication of bacteriophages. Viruses of animals and plants; History, structure and composition; classification and cultivation of animal viruses.Effects of virus infection on cells. Cancer and viruses.

Morphology and fine structure of bacteria: Size, shape and arrangement of bacterial cells, Flagella and motility, Pili, Capsules, sheaths, Prosthecae and stalks, structure and chemical composition of cell wall, cytoplasmic membrane, protoplasts, spheroplasts, the cytoplasm, nuclear material.

The Cultivation of Bacteria: Nutritional requirements, nutritional types of bacteria, bacteriological media, physical conditions required for growth, choice of media, conditions of incubation.

Reproduction and growth of bacteria: Modes of cell division, New cell formation, Normal growth cycle of bacteria, synchronous growth, continuous culture, quantitative measurement of bacterial growth; Direct microscopic count, Electronic enumeration of cell numbers, the plate count method, Membrane-filter count, Turbidimetric method, Determination of nitrogen content, Determination of the dry weight of cells, The selection of a procedure to measure growth, Importance of measurement of growth.

Pure cultures and cultural characteristics: Natural microbial populations selective methods; Chemical methods, Physical methods, Biological methods, Selection in

nature, Pure cultures; Methods of isolating pure cultures, Maintenance and preservation of pure cultures, Culture collections, Cultural characteristics; Colony characteristics, Characteristics of broth cultures.

Eukaryotic Microorganisms: Algae: Biological and economic importance of algae; Characteristics of algae; Lichens. Fungi: Importance of fungi; Morphology; Physiology and reproduction, Cultivation of fungi. Economic importance of protozoa.

Prokaryotic diversity Bacteria: Purple and green bacteria; cyanobacteria, prochlorophytes, chemolithotrophs, methanotrophs and methylotrophs, sulfate and sulfur-reducing bacteria, homoacetogenic bacteria, Budding and appendaged bacteria, spirilla, spirochetes, Gliding bacteria, Sheathed bacteria, Pseudomonads, Free living aerobic nitrogen fixing bacteria, Acetic acid bacteria, Zymomonous and chromobacterium, Vibrio, Facultatively aerobic Gram-negative rods, Neisseria and other Gram-negative cocci, Rickettsias, Chlamydias, Gram-positive cocci, Lactic acid bacteria, Acetic acid bacteria, Zymomonous and chromobacterium, Vibrio, Facultatively aerobic nitrogen fixing bacteria, Acetic acid bacteria, Pseudomonads, Free living aerobic nitrogen fixing bacteria, Acetic acid bacteria, Pseudomonaus, Acetic and other Gram-negative cocci, Lactic acid bacteria, Coryneform bacteria, and other Gram-negative bacteria; Actinomycetes, Coryneform bacteria, propionic acid bacteria, Mycobacterium, Filamentous Actinomycetes.

Prokaryotic Diversity: Archaea: Extremely Halophilic archaea, Methane producing archaea: Methanogens, Hyperthermophilic archaea, Thermoplasma.

Practicals

- 1. Preparation of culture media
- 2. Pure culturing and cultivation of bacteria

3. Simple, Gram, endospore, capsular, flagellar and acid fast stainings

of different genera of bacteria\Vital staning and microscopic

observations of protozoa

- 4. Cultivation methods of fungi
- 5. Isolation of bacteriophages

Books Recommended

1. Eugene W. N., Denise, G., Anderson, M. T., Nester, C., Roberts, E. Nancy, N. 2001. Microbiology: A Hhuman Perspective, McGraw Hill Higher Education.

2. Jacquelyn, G.G. 2001. Microbiology: Principles and Explorations, John Wiley & Sons Inc.

3. Madigan, M.T., Martinko, J.M. and Parker, J. 1997. Brock Biology of Microrganisms, Prentice-Hall, London.

4. Benson, H.J. 1994. MICROBIAL APPLICATIONS: LABORATORY MANUAL IN GENERAL MICROBIOLOGY, WMC Brown Publishers, England.

ZOO-483 Immunology

4 (3+1)

Course Objectives:

The objectives of the course are:-

1. To be able to clearly state the role of the immune system and a foundation in immunological processes

2. To provide students with knowledge on how the immune system works building on their previous knowledge from biochemistry, genetics, cell biology and microbiology

3. The students will be able to describe immunological response and how it is triggered and regulated.

Course Learning Outcomes:

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

1. Explore the basic knowledge of immune system

2. Describe the concepts of how the immune system works.

3. Interpret the problems using immunological techniques for diagnosis of immune disorders.

4. Identify the problems using immunological diagnostic tools.

5. Detect the problems using the same techniques for other disorders.

6. **DEMONSTRATE** individually the ELISA and other Assays/Tests.

Course Outline:

1. Introduction

a. Introduction to immunity.

- b. Immune response
- c. Infectious agents

2. Innate Immunity and Inflammation

- a. Sentinel cells and circulating leukocytes
- b. Inflammatory events and signalling
- c. The formation of pus

3. Microbial Recognition and Responses in Innate Immunity

- a. Pattern recognition receptors
- b. Innate immune signalling
- c. The complement system

4. Antibodies

- a. B lymphocytes
- b. Antibody structure and function

5. Lymphocyte Development and Diversity

- a. Lymphocyte development
- b. Clonal selection and expansion
- c. Differences between B and T lymphocytes
- d. The generation of lymphocyte receptor diversity

6. T Cell Activation by Antigens

- a. The role of dendritic cells
- b. The lymphatic system and delivery of antigen to lymph nodes
- c. Adaptive immune activation in secondary lymphoid tissues
- d. Antigen presentation

7. T Cell-Dependent B Cell Responses

- a. T Cell activation of B cells
- b. Isotype switching and affinity maturation

8. Helper T Cells

- a. Helper T cell functions
- b. The role of helper T cells in disease

9. Cytotoxic T Cells

- a. Cytotoxic T cell functions
- b. Selection and expansion of cytotoxic T cells
- c. Therapies that target cytotoxic T cell functions

10.Failures of the Immune System

- a. Immunodeficiencies
- b. Autoimmune diseases
- c. Allergic diseases

11. Immunology-Based Therapy of Diseases

a. Transplantation and transfusion

Practical:

- 1. Antibody Purification and Conjugation
- 2. Immunofluorescence
- 3. Gel Techniques
- 4. ELISA
- 5. SDS PAGE/Western blots.

Text and Reference Books:

- 1. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Molecular Biology of the Cell (5th ed. 2008, Garland)
- Thomas J Kindt, Richard A Goldsby, Barbara A Osborne, Janis Kuby: Immunology (2003, Freeman).
 Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt Roitt: Roitt's Essential Immunology (12th ed. 2012, Blackwell)
- 3. Abul Abbas , Andrew H. Lichtman, Shiv Pillai. Cellular and Molecular Immunology, 9th edition, 2017. Elsevier Pub Co.
- 4. Gerd R. Burmester, Antonio Pezzutto Color Atlas of Immunology, 2006. Thieme Stuttgart, New York.
ZOO-484 Parasitology- II 4 (3+1)

Theory:

Systematics, biology, pathology, host parasite relationships and control of parasitic Helminths with particular reference to Helminths of Medical and Veterinary importance. Systematics, morphology and biology of Arthropods causing disease or those responsible for transmission of disease. Chemical and non-chemical control of Arthropods of Medical and Veterinary importance.

Helminthology

- a. Helminth parasites of man and other animals
- b. General account, classification, biology, life cycle, pathology and symptology and immunology of Platyhelmenthes: e.g. Trematodes (Fisccciola and Schistosoma) Cestodes: Taenia. Nematodes: Trichuris, Strongyloides, Toxocara and Filaria worms.

Medical and Veterinary Entomology

- a. Biology and classification of arthropods of veterinary and medical importance.
- b. Biology and life cycles e.g. lice, Ticks, mites, mosquitoes, fleas, flies, bugs etc.
- c. Arthropods as disease transmitters/vectors.

Practical

- 1. Methods of collection, preservation and transportation of parasitic material.
- 2. Qualitative and quantitative faecal examination for helminthic ova.
- 3. Collection, preservation and preparation of slides of local helminthes and their identification.
- 4. Identification of insects of medical and veterinary importance.

Books Recommended:

- 1. Noble and Noble, 1982. Parasitology. The Biology of animal parasites. 5th Ed.. Lea and Febiger.
- 2. Beck, J.W. and Davies, J.E., 1981. Medical parasitology. 3'd Ed.. The C.V. Mosby Company, Toronto, London. Cheesbrough, M., 1987.
- 3. Medical Laboratory Manual for Tropical Medicine. Vol.I. University Press Cambridge. Smyth, J.D., 1994.
- 4. Introduction to Animal Parasitology. Cambridge University Press.

ZOO-485 Aquaculture and Fisheries

3(2+1)

Course Objectives:

The course aims to-

1. Impart knowledge about history, needs and importance of fisheries and Aquaculture.

- 2. Describe the cultureable fish species and their biology.
- 3. Elaborate the basics of fish culture and aquaculture facilities.
- 4. Provide knowledge about fishing gears and post-harvest techniques.

Course Learning Outcomes:

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

- 1. Acquire knowledge about history, needs and importance of fisheries and aquaculture.
- 2. Discuss various fish species characteristics and understand their culture requirements.
- 3. Understand basics of pond fish culture and other advanced culture practices.
- 4. Define various types of fishing gears, capturing methods and post-harvest technology.

Course Outlines:

- a. Introduction to fisheries and aquaculture, national and international trends. Fish morphology and diversity in size and shape. Distribution of fishes in Pakistan, commercial fishes, marine and freshwater.
- b. Types of ponds, planning construction and pond preparation. Pond fertilization, dosage and methods of application.
- **c.** Food and feeding habits of fishes, feed types, artificial and natural fish feeds, feeding strategies of artificial fish feeds.
- d. Aquatic habitats, ecology and extant of distribution, Water quality parameters (abiotic: temperature, light, salinity, pH, turbidity etc.) and their effects on fish health and production.
- e. Biotic parameters (plankton, insects, aquatic vegetation etc.) of ponds, lakes, rivers, and impacts on fish growth.
- f. Induced breeding techniques.
- g. Fish diseases and their control.
- h. Fishing gears, fishing techniques, fishing communities.
- i. Fisheries co-management.
- j. Fish preservation, processing, transportation and marketing.

Practical:

Morphological characters of a typical fish

- 1. Identification of commercially important fish species, meristic counts, fin formula, scale formula etc.
- 2. Dissection of common fish to study its various systems.
- 3. Practical demonstration of induced fish breeding.
- 4. Introduction to artificial feed ingredients.
- 5. Fish disease diagnosis and identification.
- 6. Demonstration of fishing gears and methods of fish capture.

Books Recommended:

- 1. Fitzsimmons, K., R.S.N. Janjua and M. Ashraf, 2015. Aquaculture Handbook— Fish Farming and Nutrition in Pakistan.
- 2. Sharma, O. P. 2009. Handbook of Fisheries and Aquaculture. Agrotech Publishing Academy, Udaipur, New Delhi, India.
- 3. Stickney, R. R. 2009. Aquaculture: An Introductory Text. CABI Publishing, London, UK.
- 4. Pillay, T.V.R. and M.N. Kutty 2005. Aquaculture: Principles and Practices. Blackwell Science Limited. New York.
- 5. Ali, S.S. 1999. An Introduction to Freshwater Fishery Biology. University Grants Commission, H-9 Islamabad.