SHAHEED BENAZIR BHUTTO WOMEN UNIVERSITY
PESHAWAR

CURRICULUM BS ZOOLOGY(4YEARS)

SESSION: 2012-2016
2013-2017
2014 -2018
2015-2019

EX POST FECTO APPROVAL

Submitted By
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SHAHEED BENAZIR BHUTTO WOMEN UNIVERSITY PESHAWAR

TITLE:

"CURRICULUM ZOOLOGY – BS 4-YEAR PROGRAM"

COMPILED BY:

Academics Section.
Shaheed Benazir Bhutto Women University, Peshawar.

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SHAHEED BENAZIR BHUTTO WOMEN UNIVERSITY PESHAWAR

CURRICULUM OF ZOOLOGY

SCHEME OF STUDIES OF BS-ZOOLOGY (SESSION: 2012-2016, 2013-2017, 2014-2018 AND 2015-2019)

S. NO	SEMESTER	COURSE TITLE	COURSE CODE	theory	practical	CREDIT HOURS
1.	1st	English-I	ZG-311	3	0	3
2.		Pakistan Studies	ZG -312	2	0	2
3.		Mathematics-I	ZG -313	3	0	3
4.		Functional Biology-I	ZG -314	3	0	3
5.		Organic Chemistry	ZG -315	3	1	3
6.		Principles of Animal Life-I	ZG -316	3	1	4
				Total Credit Hours		**18**
S.NO	**SEMESTER**	**COURSE TITLE**	**COURSE CODE**	**Theory**	**Practical**	**CREDIT HOURS**
7.	2nd	English-II	ZG -321	3	0	3
8.		Islamic Studies/Ethics	ZG -322	2	0	2
9.		Biostatistics	ZG -323	2	1	3
10.		Functional Biology-II	ZG -324	3	0	3
11.		Inorganic Chemistry	ZG -325	2	1	3
12.		Principles of Animal Life-II	ZG -326	3	1	4
				Total Credit Hours		**18**
S.NO	**SEMESTER**	**COURSE TITLE**	**COURSE CODE**	**Theory**	**Practical**	**CREDIT HOURS**
13.	3rd	English-III	ZG -431	3	0	3
14.		Introduction to Computer	ZG -432	2	1	3
15.		Plant Systematic, Anatomy & Development	ZG -433	2	1	3
16.		Environmental Chemistry	ZG -434	3	0	3
17.		Animal Diversity-I	ZG -435	3	1	4
				Total Credit Hours		**16**
S.NO	**SEMESTER**	**COURSE TITLE**	**COURSE CODE**	**Theory**	**Practical**	**CREDIT HOURS**
18.	4th	Introduction to Statistics	ZG -441	3	0	3
19.		Biodiversity and Conservation	ZG -442	2	1	3
20.		Animal Diversity-II	ZG -443	3	1	4
21.		Animal Form and Function-I	ZG -444	3	1	4
22.		Animal Form and Function-II	ZG -445	3	1	4
				Total Credit Hours		**18**

SHAHEED BENAZIR BHUTTO WOMEN UNIVERSITY PESHAWAR
CURRICULUM OF ZOOLOGY

SCHEME OF STUDIES OF BS-ZOOLOGY (SESSION: 2012-2016, 2013-2017, 2014-2018 AND 2015-2019)

S. NO	SEMESTER	COURSE TITLE	COURSE CODE	Theory	Practical	CREDIT HOURS
25.	5th	Introduction to Psychology	ZG -551	2	0	2
26.		Developmental Biology	ZG -552	3	1	4
27.		Cell and Molecular Biology	ZG -553	3	1	4
28.		Animal Behavior	ZG -554	2	0	2
29.		Physiology	ZG -555	3	1	4
					Total Credit Hours	**16**
S.NO	**SEMESTER**	**COURSE TITLE**	**COURSE CODE**	**Theory**	**Practical**	**CREDIT HOURS**
30.	6th	Biological Techniques	ZG -561	1	2	3
31.		Evolution and Principles of Systematics	ZG -562	4	0	4
32.		Biochemistry	ZG -563	3	0	3
33.		Ecology	ZG -564	3	0	3
34.		Wildlife	ZG -565	0	3	3
					Total Credit Hours	**16**
S.NO	**SEMESTER**	**COURSE TITLE**	**COURSE CODE**	**Theory**	**Practical**	**CREDIT HOURS**
36.	7th	Genetics	ZG – 671	3	0	3
37.		Bioinformatics	ZG – 672	3	0	3
38.		Zoogeography & Paleontology	ZG – 673	3	0	3
39.		Principles of Parasitology	ZG – 674	1	2	3
40.		Biotechnology	ZG – 675	3	0	3
					Total Credit Hours	**16**
S.NO	**SEMESTER**	**COURSE TITLE**	**COURSE CODE**	**Theory**	**Practical**	**CREDIT HOURS**
41.	8th	Physiology of Coordination	ZG – 681	2	1	3
42.		Cancer Biology	ZG – 682	3	0	3
43.		Clinical Biochemistry	ZG – 683	2	1	3
44.		Environmental Pollution	ZG – 684	3	0	3
45.		Research Project/Two Optional Courses	ZG – 689	6/ 3+3	6/0	6/ 3+3
46.						
					Total Credit Hours	**18**

SHAHEED BENAZIR BHUTTO WOMEN UNIVERSITY PESHAWAR
ZOOLOGY CURRICULUM

SCHEME OF STUDIES OF BS ZOOLOGY (SESSION: 2012-2016, 2013-2017, 2014-2018 AND 2015-2019)

LIST OF OPTIONAL COURSES

S.NO	COURSE TITLE	COURSE CODE	CREDIT HOURS
1.	Agricultural Biotechnology	ZG -685-1	3
2.	Analysis of Development	ZG -685-2	3
3.	Animal Adaptations	ZG -685-3	3
4.	Animal Behaviour	ZG -685-4	3
5.	Animal Communication	ZG -685-5	3
6.	Animal Pests and Disease Producing Organisms	ZG -685-6	3
7.	Applied Microbiology	ZG -685-7	3
8.	Aquaculture and Fisheries	ZG -685-8	3
9.	Arachnology	ZG -685-9	3
10.	Behavioural Ecology	ZG -686-1	3
11.	Biochemistry of Drugs Action	ZG -686-2	3
12.	Biology and Control of Vertebrate Pests	ZG -686-3	3
13.	Biomedical Technology	ZG -686-4	3
14.	Biotechnology in Aquaculture	ZG -686-5	3
15.	Ecological Genetics	ZG -687-1	3
16.	Elements of Stratigraphy and Structural Geology	ZG -687-2	3
17.	Endocrinology	ZG -687-3	3
18.	Environmental Physiology	ZG -687-4	3
19.	Fish Bioenergetics	ZG -688-1	3
20.	Fish Culture	ZG -688-2	3
21.	Fish Ecology	ZG -688-3	3
22.	Fish Endocrinology	ZG -688-4	3
23.	Fish health Management	ZG -688-5	3
24.	Fish Feeding Management	ZG -688-6	3
25.	Hematology	ZG -689-1	3
26.	Herpetology	ZG -689-2	3
27.	Histology	ZG -689-3	3
28.	Human Genetics	ZG -689-4	3
29.	Ichthyology	ZG -690-1	3
30.	Immunology	ZG -690-2	3
31.	Insect Bioacoustics	ZG -690-3	3

32.	Insect Biochemistry and Physiology	ZG -690-4	3
33.	Insect Pathology	ZG -690-5	3
34.	Insects of Veterinary and Medical Importance	ZG -690-6	3
35.	Invertebrata	ZG -690-7	3
36.	Invertebrate Palaeontology	ZG -690-8	3
37.	Limnology	ZG -691-1	3
38.	Mammalogy	ZG -692-1	3
39.	Microbiology	ZG -692-2	3
40.	Medical Biotechnology	ZG -692-3	3
41.	Medical Microbiology	ZG -692-4	3
42.	Molecular Biology	ZG -692-5	3
43.	Microbiology of Extreme Environment	ZG -692-6	3
44.	Neurobiology	ZG -693-1	3
45.	Ornithology	ZG -694-1	3
46.	Pharmacological and Pathological Endocrinology	ZG -695-1	3
47.	Physiology of Functional Systems	ZG -695-2	3
48.	Population Biology	ZG -695-3	3
49.	Principles of Genetics	ZG -695-4	3
50.	Quantitative Zoology	ZG -696-1	3
51.	Radiation Biology	ZG -697-1	3
52.	Reproductive Biology	ZG -697-2	3
53.	Teratology	ZG -698-1	3
54.	Techniques in Fisheries Research	ZG -698-2	3
55.	Vector Biology	ZG -699-1	3
56.	Vertebrate Palaeontology	ZG -699-2	3
57.	Veterinary and Wildlife Parasitology	ZG -699-3	3
58.	Wildlife Management and conservation	ZG -699-4	3
59.	Zoological Microtechniques	ZG -699-5	3

Enlightenment Through Knowledge

SHAHEED BENAZIR BHUTTO WOMEN UNIVERSITY
PESHAWAR
DEPARTMENT OF ZOOLOGY

DETAILED COURSE OUTLINE OF ZOOLOGY
BS (4-YEARS PROGRAM)

SEMESTER-I

COURSE NAME: English – I	**COURSE CODE:** ZG-311
COURSE STRUCTURE: Lectures: 3, Labs: 0	**CREDIT HOURS:** 3
PREREQUISITES: None	

Course Objectives
Enhance language skills and develop critical thinking.

Course Outline
Basics of Grammar, Parts of speech and use of articles, Sentence structure, active and passive voice, Practice in unified sentence, Analysis of phrase, clause and sentence structure, Transitive and intransitive verbs, Punctuation and spelling

Comprehension: Answers to questions on a given text

Discussion: General topics and every-day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students)

Listening: To be improved by showing documentaries/films carefully selected by subject teachers

Translation skills: Urdu to English

Paragraph writing: Topics to be chosen at the discretion of the teacher

Presentation skills: Introduction

Recommended Books

Functional English

a) Grammar
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

b) Writing
1. 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.

c) Reading/Comprehension
1. Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.

d) Speaking

COURSE NAME: Pakistan Studies	**COURSE CODE:** ZG – 312
COURSE STRUCTURE: Lectures: 2, Labs: 0	**CREDIT HOURS:** 2
PREREQUISITES: None	

Course Objectives

- Develop vision of historical perspective, government, politics, contemporary Pakistan, ideological background of Pakistan.
- Study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

Course Outline

1. **Historical Perspective**

a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah.
b. Factors leading to Muslim separatism
c. People and Land
i. Indus Civilization
ii. Muslim advent
iii. Location and geo-physical features.

2. **Government and Politics in Pakistan**

Political and Constitutional phases:
a. 1947-58
b. 1958-71
c. 1971-77
d. 1977-88
e. 1988-99
f. 1999 onward

3. **Contemporary Pakistan**

a. Economic institutions and issues
b. Society and social structure
c. Ethnicity
d. Foreign policy of Pakistan and challenges
e. Futuristic outlook of Pakistan

Recommended Books

1. Burki, Shahid Javed. *State & Society in Pakistan,* The Macmillan Press Ltd 1980.
2. Akbar, S. Zaidi. *Issue in Pakistan's Economy.* Karachi: Oxford University Press, 2000.
3. S.M. Burke and Lawrence Ziring. Pakistan's Foreign policy: An Historical analysis. Karachi: Oxford University Press, 1993.
4. Mehmood, Safdar. *Pakistan Political Roots & Development.* Lahore, 1994.
5. Wilcox, Wayne.*The Emergence of Banglades.,* Washington: American Enterprise, 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: National Institute of Historical and cultural Research, 1998.
11. Sayeed, Khalid Bin. *The Political System of Pakistan.* Boston: Houghton Mifflin, 1967.
12. Aziz, K.K. *Party, Politics in Pakistan,* Islamabad: National Commission on Historical and Cultural Research, 1976.
13. Muhammad Waseem, Pakistan Under Martial Law, Lahore: Vanguard, 1987.
14. Haq, Noor ul. *Making of Pakistan: The Military Perspective.* Islamabad: National Commission on Historical and Cultural Research, 1993.

COURSE NAME: Mathematics-I	**COURSE CODE:** ZG – 313
COURSE STRUCTURE: Lectures: 3, Lab: 0	**CREDIT HOURS:** 3
PREREQUISITES: None	

Course Objectives

This is a deficiency course for students who have not studied mathematics at the intermediate level. The basic concepts of trigonometry, linear algebra and vectors are introduced in this c ourse.

Course Outline

Preliminaries: Real-number system, complex numbers, introduction to sets, set operations, functions, types of functions.

Matrices: Introduction to matrices, types, matrix inverse, determinants, system of linear equations, Cramer's rule.

Quadratic Equations: Solution of quadratic equations, qualitative analysis of roots of a quadratic equations, equations reducible to quadratic equations, cube roots of unity, relation between roots and coefficients of quadratic equations.

Sequences and Series: Arithmetic progression, geometric progression, harmonic progression.

Binomial Theorem: Introduction to mathematical induction, binomial theorem with

rational and irrational indices.

Trigonometry: Fundamentals of trigonometry, trigonometric identities.

Recommended Books

1. Dolciani MP, Wooton W, Beckenback EF, Sharron S, Algebra 2 and Trigonometry, 1978, Houghton & Mifflin,Boston (suggested text)
2. Kaufmann JE, College Algebra and Trigonometry, 1987, PWS-Kent Company, Boston
3. Swokowski EW, Fundamentals of Algebra and Trigonometry (6th edition), 1986, PWS-Kent Company, Boston

COURSE NAME: Functional Biology – I	**COURSE CODE:** ZG – 314
COURSE STRUCTURE: Lectures: 3, Labs: 0	**CREDIT HOURS:** 3
PREREQUISITES: None	

Course Objectives

To provide students with a biological foundation on which they can build a graduate degree in natural and physical science.

Course Outline

Biological Methods

Principles of Cellular Life

- Chemical Basis
- Structure and Function
- Principles of Metabolism
- Energy Acquisition

Principles of Inheritance

- Mitosis and Meiosis
- Chromosomes
- Observable Inheritance Patterns
- DNA Structure and Function
- RNA and Proteins
- Genes
- Genetic Engineering and Biotechnology

Biodiversity

- Fundamental Concept of Biodiversity
- One or two examples of each of the following from commonly found organism
- Prions
- Viruses
- Bacteria
- Protistans
- Algae
- Fungi

- Plants
- Crops
- Animals
- Invertebrates
- Vertebrates

Recommended Books

1. Roberts, M.M., Reiss and G.Monger. 2000. Advanced Biology, Nelson.
2. Starr, C, and R, Taggart, 2001. Biology: The Unity and Diversity of Life Brooks and Cole.
3. Campbell, N.A., J.B, Reece, L.G. Mitchell, M.R, Taylor. 2001. Biology: Concepts and Connections. Prentice-Hall.

COURSE NAME: Organic Chemistry	**COURSE CODE:** ZG – 315
COURSE STRUCTURE: Lectures: 2, Labs: 1	**CREDIT HOURS:** 3
PREREQUISITES: None	

Course Objectives

Familiarize students with basic principles, concepts and theories in organic chemistry.

Course Outline

Introduction to Organic Chemistry

Organic chemistry-the chemistry of carbon compounds; the nature of organic chemistry-a historical perspective.

Chemical Bonding and Properties of Organic Molecules

Localized and delocalized chemical bonding; concept of hybridization leading to bond angles, bond lengths, bond energies and shape of organic molecules; dipole moment; inductive and field effects; resonance; aromaticity; tautomerism; hyperconjugation; hydrogen bonding; acids and bases; factors affecting the strengths of acids and bases.

Classes and Nomenclature of Organic Compounds

Classification of organic compounds; development of systematic nomenclature of organic compounds; IUPAC nomenclature of hydrocarbons and heteroatom functional groups.

Functional Group Chemistry

A brief introduction to the chemistry of hydrocarbons, alkyl halides, alcohols, phenols, ethers, aldehydes, ketones, amines, and carboxylic acids and their derivatives.

Recommended Books

(Latest available editions of the following books)

1. Clayden, J., Greeves, N., Warren, S. and Wothers, P., “Organic Chemistry”, Oxford University Press, New York.
2. Loudon, G. M., “Organic Chemistry”, Oxford University Press, New York
3. Sorrell, T. N., “Organic Chemistry”, Viva Books Private Ltd., New Delhi.
4. Finar, I. L., “Organic Chemistry”, Vol. 1, Pearson Education, Delhi.
5. Carey, F. A., “Organic Chemistry”, McGraw-Hill, New York.
6. Ahluwalia, V. K. and Goyal, M., “A Text Book of Organic Chemistry”, Narosa Publishing House, New Delhi

7. March, J., "Advanced Organic Chemistry", John Wiley & Sons, New York.
8. Bansal, R. K., "Organic Reaction Mechanisms", Tata McGraw-Hill Publishing Company Ltd., New Delhi.
9. Pine, S. H., "Organic Chemistry", National Book Foundation, Islamabad.
10. Bailey Jr., P. S. and Bailey, C. A., "Organic Chemistry-A Brief Survey of Concepts and Applications", Prentice-Hall, New Jersey.

Supplementary Literature

(Latest available editions of the following books)

11. Morrison, R. T. and Boyd, R. N., "Organic Chemistry", Prentice-Hall of India, New Delhi.
12. Carey, F. A. and Sundberg, R. J., "Advanced Organic Chemistry Part A: Structure and Mechanisms", Kluwer Academic /Plenum Publishers, New York.
13. Sykes, P., "A Guide Book to Mechanism in Organic Chemistry", Longman, London.
14. Hand, C. W. and Blewitt, H. L., "Acid-Base Chemistry", Macmillan Publishing Company, New York.
15. McMurry, J., "Organic Chemistry", Brooks/Cole Publishing Company, California.
16. Solomons, T. W. G. and Fryhle, C. B., "Organic Chemistry", John Wiley & Sons, New York.
17. Panico, R., Powell, W. H. and Richer, J. C., "A Guide to IUPAC Nomenclature of Organic Compounds", Jain-Interscience Press, Delhi.
18. Streitwieser Jr., A. and Heathcock, C.H., "Introduction to Organic Chemistry", Macmillan Publishing Company, New York.
19. Fox, M. A. and Whitesell, J. K., "Organic Chemistry", Jones and Bartlett Publishers, London.

COURSE NAME: Principles of Animal Life - I	**COURSE CODE:** ZG – 316
COURSE STRUCTURE: Lectures: 3, Labs:1	**CREDIT HOURS:** 4
PREREQUISITES: None	

Course Objectives

The course aims to impart knowledge and understanding of:

a. The concept and status of Zoology in life sciences.
b. The common processes of life through its chemistry, biochemical and molecular processes.
c. The structure and function of cell organellae and how common animal cell diversified in various tissues, organs and organ systems.
d. Biochemical mechanisms eventually generating energy for animal work.
e. Animals and their relationship with their environment.

Course Contents

1. **Place of Zoology in Science**

- A one-world view: genetic unity, the fundamental unit of life, evolutionary oneness and the diversity of life, environment and world resources; what is zoology? The classification of animals; the scientific method.

2. **The Chemical Basis of Animal Life**

- Atoms and elements: building blocks of all matter; compounds and molecules: aggregates of atoms; acids, bases, and buffers; the molecules of animals: fractional account of carbohydrates, lipids, proteins, nucleotides and nucleic acids based on their structural aspects.

3. **Cells, Tissues, Organs, and Organ System of Animals**

- Structure and functions of cell membranes; various movements across membranes; cytoplasm, organelles, and cellular components: functional account of ribosomes, endoplasmic reticulum, golgi apparatus, lysosomes, mitochondria, cytoskeleton, cilia and flagella, centrioles and microtubules, and vacuoles based on their structural aspects. The nucleus: nuclear envelope, chromosomes and nucleolus. Tissues: diversity in epithelial tissue, connective tissue, muscle tissue and nervous tissue to perform various functions. Structural integrations for functions in organs and organ systems.

4. **Energy and Enzymes: Life's Driving and Controlling Forces**

- Energy and the laws of energy transformation; activation energy; enzymes: structure, function and factors affecting their activity; cofactors and coenzymes; ATP: how cells convert energy? An overview.

5. **How Animals Harvest Energy Stored in Nutrients**

- Glycolysis: the first phase of nutrient metabolism; fermentation: "life without oxygen"; aerobic respiration: the major source of ATP; metabolism of fats and proteins; control of metabolism; the metabolic pool.

6. **Ecology I: Individuals and Populations**

- Animals and their abiotic environment; populations; interspecific interactions.

7. **Ecology II: Communities and Ecosystems**

- Community structure and diversity; ecosystems; ecosystems of the earth; ecological problems; human population growth, pollution, resource depletion and biodiversity.

Laboratory Work Outline

Practicals

1. Tests for different carbohydrates, proteins and lipids.

Note: Emphasis on the concept that tests materials have been ultimately obtained from living organisms and constituted their body.

2. Study of the prepared slides of epithelial tissue (squamous, cuboidal, columnar), connective tissue (adipose, cartilage, bone, blood), nervous tissue and muscle tissue

(skeletal, smooth and cardiac).

Note: *Prepared microscopic and/or projection slides and/or CD ROM computer projections must be used.*

3. Plasmolysis and deplasmolysis in blood.
4. Protein digestion by pepsin.
5. Ecological notes on animals of a few model habitats.
6. Field observation and report writing on animals in their ecosystem (a terrestrial and an aquatic ecosystem study).

Recommended Books

1. Hickman, C.P., Roberts, L.S. and Larson, A. INTEGRATED PRINCIPLES OF ZOOLOGY, 12th Edition (International), 2004. Singapore: McGraw Hill.
2. Miller, S.A. and Harley, J.B. ZOOLOGY, 6th Edition (International), 2005. Singapore: McGraw Hill.
3. Pechenik, J.A. BIOLOGY OF INVERTEBRATES, 5th Edition (International), 2000. Singapore: McGraw Hill.
4. Kent, G.C. and Miller, S. COMPARATIVE ANATOMY OF VERTEBRATES, 2001. New York: McGraw Hill.
5. Campbell, N.A. BIOLOGY, 6th Edition. 2002. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.
6. Miller, S.A. GENERAL ZOOLOGY LABORATORY MANUAL. 5th Edition (International), 2002. Singapore: McGraw Hill.
7. Hickman, C.P. and Kats, H.L., LABORATORY STUDIES IN INTEGRATED PRINCIPLES OF ZOOLOGY. 2000. Singapore: McGraw Hill.
8. Molles, M.C. ECOLOGY: CONCEPTS AND APPLICATIONS. 6th Edition. 2005. McGraw Hill, New York, USA.
9. Odum, E. P. FUNDAMENTALS OF ECOLOGY. 3rd Edition. 1994. W.B. Saunders.Philadelphia.
10. Slingby, D. and Cook, C., PRACTICAL ECOLOGY. 1986. McMillan Education Ltd. UK.

SHAHEED BENAZIR BHUTTO WOMEN UNIVERSITY PESHAWAR
DEPARTMENT OF ZOOLOGY

DETAILED COURSE OUTLINE OF BS ZOOLOGY (SESSION: 2012-2016, 2013-2017, 2014-2018 AND 2015-2019)

SEMESTER-II

COURSE NAME: English – II	**COURSE CODE:** ZG-321
COURSE STRUCTURE: Lectures: 3, Labs: 0	**CREDIT HOURS:** 3
PREREQUISITES: None	

Course Objectives

Enable the students to meet their real life communication needs.

Course Contents

1. **Paragraph writing:** Practice in writing a good, unified and coherent paragraph
2. **Essay writing** : Introduction
3. **CV and job application:** Translation skills- Urdu to English
4. **Study skills:** Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension
5. **Academic skills:** Letter/memo writing, minutes of meetings, use of library and internet
6. **Presentation skills**
   Personality development (emphasis on content, style and pronunciation)
   Note: documentaries to be shown for discussion and review

Recommended Books

Communication Skills

a. Grammar
   1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press 1986. ISBN 0 19 431350 6.

b. Writing
   1. Writing. Intermediate by Marie-Chrisitine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 019 435405 7 Pages 45-53 (note taking).
   2. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).

c. Reading
1. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.
2. Reading and Study Skills by John

COURSE NAME: Islamic Studies	**COURSE CODE:** ZG – 322
COURSE STRUCTURE: Lectures: 2, Labs: 0	**CREDIT HOURS:** 2
PREREQUISITES: None	

Course Objectives

This course is aimed at:

- To provide Basic information about Islamic Studies
- To enhance understanding of the students regarding Islamic Civilization
- To improve Students skill to perform prayers and other worships
- To enhance the skill of the students for understanding of issues related to faith and religious life.

Course Contents

Introduction to Quranic Studies

1. Basic Concepts of Quran
2. History of Quran
3. Uloom-ul -Quran

Study of Selected Text of Holy Quran

1. Verses of Surah Al-Baqra Related to Faith(Verse No-284-286)
2. Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
3. Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
4. Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
5. Verses of Surah Al-Inam Related to Ihkam(Verse No-152-154)

Study of Selected Text of Holy Quran

1. Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6,21,40,56,57,58.)
2. Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
3. Verses of Surah Al-Saf Related to Tafakar,Tadabar (Verse No-1,14)

Seerat of Holy Prophet (S.A.W) I

1. Life of Muhammad Bin Abdullah (Before Prophet Hood)
2. Life of Holy Prophet (S.A.W) in Makkah
3. Important Lessons Derived from the life of Holy Prophet in Makkah

Seerat of Holy Prophet (S.A.W) II

1. Life of Holy Prophet (S.A.W) in Madina
2. Important Events of Life Holy Prophet in Madina

3. Important Lessons Derived from the life of Holy Prophet in Madina

Introduction To Sunnah

1. Basic Concepts of Hadith
2. History of Hadith
3. Kinds of Hadith
4. Uloom –ul-Hadith
5. Sunnah & Hadith
6. Legal Position of Sunnah

Selected Study from Text of Hadith

Introduction To Islamic Law & Jurisprudence

1. Basic Concepts of Islamic Law & Jurisprudence
2. History & Importance of Islamic Law & Jurisprudence
3. Sources of Islamic Law & Jurisprudence
4. Nature of Differences in Islamic Law
5. Islam and Sectarianism

Islamic Culture & Civilization

1. Basic Concepts of Islamic Culture & Civilization
2. Historical Development of Islamic Culture & Civilization
3. Characteristics of Islamic Culture & Civilization
4. Islamic Culture & Civilization and Contemporary Issues

Islam & Science

1. Basic Concepts of Islam & Science
2. Contributions of Muslims in the Development of Science
3. Quranic & Science

Islamic Economic System

1. Basic Concepts of Islamic Economic System
2. Means of Distribution of wealth in Islamic Economics
3. Islamic Concept of Riba
4. Islamic Ways of Trade & Commerce

Political System of Islam

1. Basic Concepts of Islamic Political System
2. Islamic Concept of Sovereignty
3. Basic Institutions of Govt. in Islam

Islamic History

1. Period of Khlaft-E-Rashida
2. Period of Ummayyads
3. Period of Abbasids

Social System of Islam

1. Basic Concepts Of Social System Of Islam
2. Elements Of Family
3. Ethical Values Of Islam

Recommended Books

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

COURSE NAME: Biostatistics	**COURSE CODE:** ZG – 323
COURSE STRUCTURE: Lectures: 2, Lab: 1	**CREDIT HOURS:** 3
PREREQUISITES: None	

Course Objectives

The course will provide knowledge about the importance and use of statistics in life sciences. It will help the students to understand the methods to analyze data pertaining to their research work and to assess the significance of their experimental designs.
After this course students will be able to apply basic statistical procedures for analysis of data for practical and research.

Course Outline

Introduction and scope, use of statistics in biology. Population and sample. Stages of research, types of data and methods of data collection. Data arrangement and presentation, formation of tables and charts. Measures of central tendency computation of mean, median and mode from grouped and ungrouped data. Measures of dispersion, computation of variance, standard deviation, standard error and their coefficients. Probability rules. Binomial, poissons and normal distributions. Hypothesis testing, Student 't' test, Chi square test, Analysis of variance and LSD. Correlation and regression. Experimental designing, planning of an experiment, replication and randomization.

Recommended Books

1. Geoffery, R. Norman, David L. Streiner BIOSTATISTICS: THE BARE ESSENTIALS. 2000. B.C. Decke Inc.
2. Gerry, P. Quinn, Michael J. Keough, EXPERIMENTAL DESIGN AND DATA ANALYSIS FOR BIOLOGISTS. 2002. Cambridge University Press.
3. Campbell, R. C. STATISTICS FOR BIOLOGISTS. 1989. Cambridge University Press.

COURSE NAME: Functional Biology – II	**COURSE CODE:** ZG – 324
COURSE STRUCTURE: Lectures: 3, Labs: 0	**CREDIT HOURS:** 3
PREREQUISITES: None	

Course Outline

Myths and Realities of Evolution

- Microevolution
- Speciation
- Macroevolution

Level of Organization

- **Plants**
  Tissues
  Nutrition and Transport
  Reproduction
  Growth and Development
- **Animals**
  Tissue, Organ System and Homeostasis
  Information Flow and Neuron
  Nervous System
  Circulation and Immunity
  Nutrition and Respiration
  Reproduction and Development
- **Ecology and Behavior**
  Ecosystems
  Biosphere
  Social Interactions
  Community Interactions
  Human Impact on Biosphere
  Environment Conservation

Recommended Books

1. Roberts, M.M., Reiss and G.Monger. 2000. Advanced Biology, Nelson.
2. Starr, C, and R, Taggart, 2001. Biology: The Unity and Diversity of Life Brooks and Cole.
3. Campbell, N.A., J.B, Reece, L.G. Mitchell, M.R, Taylor. 2001. Biology: Concepts and Connections. Prentice-Hall.

COURSE NAME: Inorganic Chemistry	**COURSE CODE:** ZG – 325
COURSE STRUCTURE: Lectures: 2, Labs: 1	**CREDIT HOURS:** 3
PREREQUISITES: None	

Course Outline

The program is aimed that the student should learn:

1. The Development of periodic law and properties of elements in a systematic way.
2. The principal of chemical bonding
3. Chemistry of acid and bases
4. Chemistry of p-block Elements

1. **The Periodic Law and Periodicity**
   Development of Periodic Table; Classification of elements based on s, p, d and f orbitals, group trends and periodic properties in s, p, d and f block elements, i.e., atomic radii, ionic radii, ionization potential, electron affinities, electronagetivities and redox potential.
2. **Principles of Chemical Bonding**
   Types of chemical bonding; ionic bonding; the localized bond approach: VB theory, hybridization and resonance; the delocalized approach to bonding: molecular orbital theory as applied to diatomic and polyatomic molecules, three center bonds, bonding theory of metals and intermetallic compounds; conductors, insulators and semiconductors; bonding in electron deficient compounds; hydrogen bonding.
3. **Acids and Bases**
   Concepts of acids and bases including SHAB concept, relative strength of acids and bases, significance of pH, pKa, pKb and buffer solutions. Theory of Indicators, solubility, solubility product, common ion effect and their industrial applications.
4. **Chemistry of p-block Elements**
   Chemistry and structure of *p*-block elements; main emphasis on the chemistry and structure of noble gases and their compounds, chemistry and structure of interhalogens, pseudohalogens and polyhalides. Prediction of shapes of molecules using VSEPR model and hybridization.

Practical Work

1. Laboratory Ethics and safety measures

Awareness about the toxic nature of chemicals and their handling, cleaning of glassware, safe laboratory operations

2. Qualitative analysis

Analysis of four ions (two anions and two cations) from mixture of salts

3. Quantitative analysis

Laboratory work illustrating topics covered in the lecture of BT – 325

Recommended Books

1. Huheey, J. E., Keiter, E. A. and Keiter, R. L., “Inorganic Chemistry: Principles of Structure and Reactivity”, 4th Ed., Harper and Row, New York, 2001
2. Cotton, F. A., Wilkinson, G. and Gaus, P. L., “Basic Inorganic Chemistry”, 3rd Ed., Wiley, New York, 1995.
3. Clyde Day, M. & Selbin, J., “Theoretical Inorganic Chemistry”, 2nd Ed., Van Nustrand Reinhold, 1969.
4. Lee, J.D., “Concise Inorganic Chemistry”, Chapman and Hall, 5th Edition,1996.
5. Shriver, D. F., Atkins, P. W. and Langford, C. H., “Inorganic Chemistry”, Oxford University Press, 2nd Edition, 1994.
6. Bassette, J., Denney, G. H. and Mendham, J., “Vogel’s Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis” English Language Book Society, 4th Edition, 1981.
7. Vogel, A. I., “A Textbook of Micro and Semi-micro Qualitative Inorganic Analysis” Longman Green & Co. 1995.

COURSE NAME: Principles of Animal Life -II	**COURSE CODE:** ZG – 326
COURSE STRUCTURE: Lectures: 3, Labs:1	**CREDIT HOURS:** 4
PREREQUISITES: None	

Course Objective

The course imparts knowledge and understanding of:

a. Cell division and its significance in cell cycle. Concepts and mechanisms of inheritance pattern, chromosome and gene linkage and molecular basics of genetics.
b. Animal behaviour and communication.
c. Theories of evolution, gene flow and mechanism of evolution with reference to animals and diversity.

Course Outline

1. Cell Division

Mitosis, cytokinesis, and the cell cycle: an overview; control of the cell cycle; meiosis: the basis of sexual reproduction; gamete formation.

2. Inheritance Patterns

The birth of modern genetics; Mendelian inheritance patterns; other inheritance patterns; environmental effects and gene expression.

3. Chromosomes and Gene Linkage

Eukaryotic chromosomes; linkage relationships; changes in chromosome number and structure.

4. Molecular Genetics: Ultimate Cellular Control

DNA: the genetic material; DNA replication in eukaryotes; genes in action; control of gene expression in eukaryotes; mutations; applications of genetic technologies; recombinant DNA.

5. Animal Behaviour

Four approaches to animal behaviour; proximate and ultimate causes; anthropomorphism; development of behavior; learning; control of behavior; communication; behavioral ecology; social behavior.

6. Evolution: A Historical Perspective

Pre-Darwinian theories of change; Lamarck: an early proponent of evolution; early development of Darwin's ideas of evolution and evidences; the theory of evolution by natural selection; evolutionary thought after Darwin; biogeography.

7. Evolution and Gene Frequencies

The modern synthesis: a closer look; the Hardy-Weinberg theorem; evolutionary mechanisms: population size, genetic drift, natural selection, gene flow, mutation, and balanced polymorphism; species and speciation; rates of evolution; molecular evolution; mosaic evolution.

Lab Outline

1. Study of mitosis in onion root tip.
2. Study of meiosis in grasshopper testis (students should prepare the slide).

Note for 1-2: Prepared microscopic and/or projection slides and/or CD ROM computer projections must be used).

3. Problem based study of Mendelian ratio in animals.
4. Multiple alleles study in blood groups.
5. Survey study of a genetic factor in population and its frequency.
6. Study of karyotypes of *Drosophila*, mosquito.
7. Study of cytochemical detection of DNA in protozoa and avian blood cell.
8. Study to demonstrate nervous or endocrine basis of behaviour (conditioned reflex or aggression or parental behavior).
9. Study to demonstrate social behaviour (documentary film be shown, honey bee, monkey group in a zoo).

Recommended Books
For Courses

1. Hickman, C.P., Roberts, L.S. and Larson, A. INTEGRATED PRINCIPLES OF ZOOLOGY, 11th Edition (International), 2004. Singapore: McGraw Hill.
2. Miller, S.A. and Harley, J.B. ZOOLOGY, 5th Edition (International), 2002. Singapore: McGraw Hill.
3. Pechenik, J.A. BIOLOGY OF INVERTEBRATES, 4th Edition (International), 2000. Singapore: McGraw Hill.
4. Kent, G.C. and Miller, S. COMPARATIVE ANATOMY OF VERTEBRATES. 2000. New York: McGraw Hill.
5. Campbell, N.A. BIOLOGY, 6th Edition. Menlo Park, California: 2002. Benjamin/Cummings Publishing Company, Inc.

For Lab
Recommended Books

1. Miller, S.A. GENERAL ZOOLOGY LABORATORY MANUAL. 5th Edition (International), 2002. Singapore: McGraw Hill.
2. Hickman, C.P. and Kats, H.L. LABORATORY STUDIES IN INTEGRATED PRINCIPLES OF ZOOLOGY. 2000. Singapore: McGraw Hill.

SHAHEED BENAZIR BHUTTO WOMEN UNIVERSITY PESHAWAR
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DETAILED COURSE OUTLINE OF BS ZOOLOGY (SESSION: 2012-2016, 2013-2017, 2014-2018 AND 2015-2019)

SEMESTER-III

COURSE NAME: English-III	**COURSE CODE:** ZG-431
COURSE STRUCTURE: Lectures: 3, Labs: 0	**CREDIT HOURS:** 3
PREREQUISITES: None	

Course Objectives

To enhance language skills and develop critical thinking

Course Contents

- **Presentation skills**
- **Essay writing**
  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**
- **Progress report writing**

Note: Extensive reading is required for vocabulary building 15

Recommended Books

Technical Writing and Presentation Skills

a) Essay Writing and Academic Writing

1. Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 435407 3 (particularly suitable for discursive, descriptive, argumentative and report writing).
2. College Writing Skills by John Langan. Mc=Graw-Hill Higher Education. 2004.
3. Patterns of College Writing (4th edition) by Laurie G. Kirszner and Stephen R. Mandell. St. Martin's Press.

b) Presentation Skills

c) Reading

The Mercury Reader. A Custom Publication. Compiled by norther Illinois University. General Editiors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharton. (A reader which will give

students exposure to the best of twentieth century literature, without taxing the taste of engineering students).

COURSE NAME: Introduction to Computer	**COURSE CODE:** ZG-432
COURSE STRUCTURE: Lectures: 1, Labs: 2	**CREDIT HOURS:** 3
PREREQUISITES: None	

Course Objectives

This course focuses on introducing computing environments, general application software, basic computing hardware, operating systems, desktop publishing, Internet, software applications and tools and computer usage concepts.

Course Outline

History, classification, computer and society, overview of numbering system with various Boolean functions, flow chart techniques, storage, programs & software, system software, application software, operating systems, office automation tools: word processing, graphics packages, databases and spreadsheets, various operating systems, current trends and research prospects. Legal and moral aspects of computing.

Lab Outline

Computation of Number system, Implementation of Boolean Functions, Basic machines organization including motherboard, memory, I/O cards, Networking devices, Use of flow charts, Introduction to office tools, overview of different browser including open source browsers, Introduction to various operating systems.

Recommended Books

1. "Introduction to Computer Science", P.K Sinha
2. "Computer Science- An Overview", Glenn Brooks.

COURSE NAME: Plant Systematic, Anatomy & Development	**COURSE CODE:** ZG-433
COURSE STRUCTURE: Lectures: 2, Labs: 1	**CREDIT HOURS:** 3
PREREQUISITES: None	

Course Objectives

To understand

1- Various systems of classification, identification and nomenclature of higher plants.
2- Structures and functions of tissues and organs at embryonic level.

Course outline:

a) Plant Systematics

1. Introduction to Plant Systematics: aims, objectives and importance.
2. Classification: brief history of various systems of classification with emphasis on Takhtajan.
3. Brief introduction to nomenclature, importance of Latin names and binomial system with an introduction to International Code of Botanical

Nomenclature (ICBN).Vienna code.

4. Morphology: a detailed account of various, orphological characters root, stem, leaf, inflorescence, flower, placentation and fruit types.

5. Diagnostic characters, economic importance and distribution pattern of the following families:

   i. Ranunculaceae

   ii. Brassicaceae (Cruciferae)

   iii. Fabaceae (Leguminosae)

   iv. Rosaceae

   v. Euphorbiaceae

   vii Cucurbitaceae

   vii. Solanaceae

   viii. Lamiaceae (Labiatae)

   ix. Apiaceae (Umbelliferae)

   x. Asteraceae (Compositae)

   xi. Liliaceae (Sen. Lato)

   xii. Poaceae (Gramineae)

b) Anatomy

1. Cell wall: structure and chemical composition
2. Concept, structure and function of various tissues like:
   i. Parenchyma
   ii. Collenchyma
   iii. Sclerenchyma
   iv. Epidermis (including stomata and trichomes)
   v. Xylem
   vi. Phloem
3. Meristem: types, stem and root apices
4. Vascular cambium
5. Structure and development of root, stem and leaf.

Primary and secondary growth of dicot stem, periderm

6. Characteristics of wood: diffuse porous and

ring –porous, sap and heart wood, soft and hard wood, annual rings.

c) Development / Embryology

Early development of plant body:

1. Capsella bursa-pastoris
2. Structure and development of Anther Microsporogenesis Microgametophyte
3. Structure of Ovule Megasporogenesis Megagametophyte
4. Endosperm formation
5. Parthenocarpy
6. Polyembryony

Lab Outline:

Anatomy

1. Study of stomata, epidermis,
2. Tissues of primary body of plant
3. Study of xylem 3-dimensional plane of wood.
4. T.S of angiosperm stem and leaf.

Taxonomy

1. Identification of families given in syllabus with the help of keys.
2. Technical description of common flowering plants belonging to
3. families mentioned in theory syllabus.
4. Field trips shall be undertaken to study and collect local plants.
5. Students shall submit 40 fully identified herbarium specimens.

Recommended Books

- Mauseth, J.D. 1998. An Introduction to Plant Biology: Multimedia Enhanced. Jones and Bartlett Pub. UK
- Moore, R.C., W.D. Clarke and Vodopich, D.S. 1998. Botany. McGraw Hill Company, U.S.A.
- Raven, P.H., Evert, R.E. and Eichhorn, S.E. 1999. Biology of Plants. W.H. Freeman and Company Worth Publishers.
- Stuessy, T.F. 1990. Plant Taxonomy. Columbia University Press, USA.
- Lawrence, G.H.M. 1951 Taxonomy of Vascular Plants. MacMillan & Co. New York.
- Panday, B.P. 2004. A textbook of Botany (Angiosperms). S. Chand and Co. New Delhi.
- Raymond E, S. E. Eichhorn. 2005. Esau's Plant Anatomy. Meristems cells and tissues of the plant body, 3rd ed. John Wiley & Sons. Inc.
- Fahn, A. 1990. Plant Anatomy. Pergamon Press, Oxford.
- Esau, K. 1960. Anatomy of Seed Plants. John Wiley, New York.
- Maheshwari, P.1971. Embryology of Angiosperms, McGraw Hill.New York.

- Eames A.J. and L.H Mac Daniels. 2002. An Introduction to Plant Anatomy. Tata-Mac Graw-Hill Publishing Company, Limited New Delhi.
- Pullaiah, T. 2007. Taxonomy of Angiosperms. 3rd Edition Regency Publications, New Delhi.
- Naik, V.N. 2005 Taxonomy of Angiosperms. 20th Reprint. Tata-Mac Graw-Hill Publishing Company, Limited New Delhi.

Journals / Periodicals: Pakistan Journal Of Botany, Taxon, Phyton.

COURSE NAME: Environmental Chemistry	**COURSE CODE:** ZG-434
COURSE STRUCTURE: Lectures: 2, Labs: 1	**CREDIT HOURS:** 3
PREREQUISITES: None	

Course Objectives

From this course, the students should be able to:

- Understand the fundamental principles of environmental chemistry.
- Apply these principles in pollution related subjects.
- Demonstrate the understanding of environmental chemistry principles via experimental exercises in the laboratory.

Course Outlines

Atmospheric Chemiser

The air around us, atmospheric temperature and pressure profile, Temperature inversion and photochemical smog, particulate matter in the atmosphere, Industrial pollutants, radioactivity, atmospheric aerosols, Acid rain –major sources, mechanism, control measures and effects on buildings and vegetation, Global warming – major green house gases, mechanism, control measures and global impact, The stratospheric ozone – the ozone hole, CFCs, ozone protection, biological consequences of ozone depletion.

Water Pollution and Water Treatment – sources of water pollution-industrial sources and agricultural sources, heavy metals contamination of water, Eutrophification, detergents and phosphates in water, water quality criteria, Water purification – primary, secondary and advanced treatment, Removal of nitrogen and phosphorous compounds from polluted water, organic matter in water and its decomposition.

Soil Pollution – soil and mineral resources, general principles of metal extraction, Heavy metals contamination of soil, toxicity of heavy metals, bio-accumulation of heavy metals, Organic matter in soil, Macro and micro-nutrients in soil, ion-exchange in soil, soil pH and nutrients availability.

Green Revolution – pest control, pesticides, toxicity of pesticides, integrated pests management.

Energy Production and Environment – liquid and gaseous fuel, hydrogen economy.

Renewable Energy – nuclear energy, solar energy, geothermal and tidal energy.

Recommended Books

Recommended Text Books

Latest editions of the following books:

1. Collin Baird, Environmental Chemistry, W. H. Freeman and company, New York,

1995.
2. John W. Moore and Elizabeth A. Moore, Environmental Chemistry, Academic Press Inc., New York, 1976.
3. Anil Kumar De, Environmental Chemistry, Wiley Eastern Ltd. New Delhi, 1989.
4. R. W. Raiswell, P. Brimblecombe, D. L. Dent and P. S. Liss, Edward Arnold Ltd., London, 1980.
5. Staneley E. Manahan, Environmental Chemistry, Brooks, California.

Recommended Reference Books

Latest editions of the following books:

1. Peter O. Neill, Environmental Chemistry, Chapman and Hall, London, 1993.
2. Derek M. Elsom, Atmospheric Pollution, Blackwell Publishers, Oxford, 1992.
3. Geoffrey Lean and Don Hinrichsen, Atlas of the Environment, Helicon Publishing Ltd., Oxford, 1992.

Recommended Journals/Periodicals Journals related to:

1. Atmospheric Chemistry.
2. Air Pollution.
3. Water Pollution.
4. Soil Pollution/Soil sciences.
5. Environmental Technology.

Recommended World Web:
Web Sites related to:

1. Global Warming/Green House Effect.
2. Ozone depletion.
3. Acid Rain
4. Environmental Pollution
5. Energy Conservation

COURSE NAME: Animal Diversity-I	**COURSE CODE:** ZG-435
COURSE STRUCTURE: Lectures: 3, Labs: 1	**CREDIT HOURS:** 4
PREREQUISITES: None	

Aims and Objectives:
The course is designed to provide students with:
a. concepts of evolutionary relationship of animal kingdom.
b. knowledge about animal kingdom, emphasizing their phylogenetic relationships and simple to complex mode of animal life.

Course Contents

1. Introduction

Classification of organisms; evolutionary relationships and tree diagrams; patterns of organization.

2. Animal-Like Protists: The Protozoa

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

3. Multicellular and Tissue Levels of Organization

Evolutionary perspective: origins of multicellularity; animal origins. Phylum porifera: cell types, body wall, and skeletons; water currents and body forms; maintenance functions; reproduction. Phylum cnidaria (coelenterata) the body wall and nematocysts; alternation of generations; maintenance functions; reproduction and classification up to class. Phylum ctenophora; further phylogenetic considerations.

4. Triploblastics and Acoelomate Body Plan

Evolutionary perspective; phylum platyhelminthes: classification up to class; the free-living flatworms and the tapeworms; phylum nemertea; phylum gastrotricha; further phylogenetic considerations.

5. Pseudocoelomate Body Plan: Aschelminths

Evolutionary perspective; general characteristics; classification up to phyla with external features; feeding and the digestive system; other organ systems; reproduction and development of phylum rotifera and phylum nematoda; phylum kinorhyncha. Some important nematode parasites of humans; further phylogenetic considerations.

6. Molluscan Success

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

7. Annelida: The Metameric Body Form

Evolutionary perspective: relationship to other animals, metamerism and tagmatization; classification up to class. External structure and locomotion, feeding and the digestive system, gas exchange and circulation, nervous and sensory functions, excretion, regeneration, reproduction and development, in polychaeta, oligochaeta and hirudinea; further phylogenetic considerations.

8. Arthropods: Blueprint for Success

Evolutionary perspective: classification and relationships to other animals; metamerism and tagmatization; the exoskeleton; metamorphosis; classification up to class; further phylogenetic considerations.

9. Hexapods and Myriapods: Terrestrial Triumphs

Evolutionary perspective; classification up to class. External structure and locomotion, nutrition and the digestive system, gas exchange, circulation and temperature regulation, nervous and sensory functions, excretion, chemical regulation, reproduction and development in hexapoda; insect behavior; insects and humans; further phylogenetic considerations.

Lab Outline

Practicals

1. Study of *Euglena, Amoeba, Entamoeba, Plasmodium, Trypanosoma, Paramecium* as representative of animal like protists. (Prepared slides).
2. Study of sponges and their various body forms.
3. Study of principal representative classes of phylum Coelenterata.
4. Study of principal representative classes of phylum Platyhelminthes.
5. Study of representative of phylum Rotifera, phylum Nematoda.
6. Study of principal representative classes of phylum Mollusca.
7. Study of principal representative classes of phylum Annelida.
8. Study of principal representative classes of groups of phylum Arthropoda.
9. Brief notes on medical/economic importance of the following: *Plasmodium, Entamoeba histolitica, Leishmania*, Liverfluke, Tapeworm, Earthworm, Silkworm, Citrus butterfly.
10. Preparation of permanent stained slides of the following: *Obelia, Daphnia*, Cestode, Parapodia of *Nereis.*

Books Recommended

1. Hickman, C.P., Roberts, L.S. and Larson, A. INTEGRATED PRINCIPLES OF ZOOLOGY, 11th Edition (International), 2004. Singapore: McGraw Hill.
2. Miller, S.A. and Harley, J.B. ZOOLOGY, 5th Edition (International), 2002. Singapore: McGraw Hill.
3. Pechenik, J.A. BIOLOGY OF INVERTEBRATES, 4th Edition (International), 2000. Singapore: McGraw Hill.
4. Kent, G.C. and Miller, S. COMPARATIVE ANATOMY OF VERTEBRATES. 2001. New York: McGraw Hill.
5. Campbell, N.A. BIOLOGY, 6th Edition. 2002. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.

Books Recommended (Practicals)

1. Hickman, C.P. and Kats, H.L. LABORATORY STUDIES IN INTEGRATED PRINCIPLES OF ZOOLOGY. 2000. Singapore: McGraw Hill.
2. Miller, S.A., GENERAL ZOOLOGY LABORATORY MANUAL. 5th Edition (International), 2002. Singapore: McGraw Hill.

SHAHEED BENAZIR BHUTTO WOMEN UNIVERSITY PESHAWAR
DEPARTMENT OF ZOOLOGY

DETAILED COURSE OUTLINE OF BS ZOOLOGY (SESSION: 2012-2016, 2013-2017, 2014-2018 AND 2015-2019)

SEMESTER-IV

Course Name: Introduction to Statistics	**Course Code:** ZG-441
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites: None	

Course Objectives

The course aims at enabling the students to understand the basic statistical tools for research and economic models development.

The course covers basic concepts, descriptive statistics, probability, random variables, probability distributions, parameter estimation, hypothesis testing, linear correlation, linear regression, contingency tables, and analysis of variance. Applications are made to business, social sciences, and natural/physical sciences

Intended Learning Outcomes

a. **Knowledge and understanding:**
   i. Learn about early development of statistics.
   ii. ii. Upgrade students' knowledge about hypothesis and the use of parametric and non parametric tests.
   iii. Explain the role and importance of statistics in psychology.

b. **Intellectual skills**
   i. Understand the basic qualities of central tendency, dispersion, hypotheses etc.

c. **Professional and practical skills**
   i. Use of Statistics in psychological researches.
   ii. Use of z test, t test, ANOVA etc.
   iii. Interpret test scores.

d. **General and transferable skills**
   i. Apply and interpret various statistical methods.

Course Outline

Unit I. What is Statistics?

Definition of Statistics, Population, sample Descriptive and inferential Statistics, Observations, Data, Discrete and continuous variables, Errors of measurement, Significant digits, Rounding of a Number, Collection of primary and secondary data, Sources, Editing of Data. Exercises.

Unit 2. Presentation of Data

Introduction, basic principles of classification and Tabulation, Constructing of a frequency distribution, Relative and Cumulative frequency distribution, Diagrams, Graphs and their Construction, Bar charts, Pie chart, Histogram, Frequency polygon and Frequency curve, Cumulative Frequency Polygon or Ogive, Historigram, Ogive for Discrete Variable. Types of frequency curves. Exercises.

Unit 3. Measures of Central Tendency

Introduction, Different types of Averages, Quantiles, The Mode, Empirical Relation between Mean, Median and mode, Relative Merits and Demerits of various Averages. properties of Good Average, Box and Whisker Plot, Stem and Leaf Display, definition of outliers and their detection. Exercises.

Unit 4. Measures of Dispersion

Introduction, Absolute and relative measures, Range, The semi-Inter-quartile Range, The Mean Deviation, The Variance and standard deviation, Change of origin and scale, Interpretation of the standard Deviation, Coefficient of variation, Properties of variance and standard Deviation, Standardized variables, Moments and Moments ratios. Exercises.

Unit 5. Probability and Probability Distributions.

Discrete and continuous distributions: Binomial, Poisson and Normal Distribution. Exercises

Unit 6. Sampling and Sampling Distributions.

Introduction, sample design and sampling frame, bias, sampling and non sampling errors, sampling with and without replacement, probability and non-probability sampling, Sampling distributions for single mean and proportion, Difference of means and proportions. Exercises.

Unit 7. Hypothesis Testing

Introduction, Statistical problem, null and alternative hypothesis, Type-I and Type-II errors, level of significance, Test statistics, acceptance and rejection regions, general procedure for testing of hypothesis. Exercises.

Unit 8. Testing of Hypothesis-Single Population

Introduction, Testing of hypothesis and confidence interval about the population mean and proportion for small and large samples, Exercises

Unit 9. Testing of Hypothesis-Two or more Populations

Introduction, Testing of hypothesis and confidence intervals about the difference of population means and proportions for small and large samples, Analysis of Variance and ANOVA Table. Exercises

Unit 10. Testing of Hypothesis-Independence of Attributes

Introduction, Contingency Tables, Testing of hypothesis about the Independence of attributes. Exercises.

Unit 11. Regression and Correlation

Introduction, cause and effect relationships, examples, simple linear regression, estimation of parameters and their interpretation. r and R^2. Correlation. Coefficient of linear correlation, its estimation and interpretation. Multiple regression and interpretation of its parameters. Examples

Recommended Books

1. Walpole, R. E. 1982. "Introduction to Statistics", 3rd Ed., Macmillan Publishing Co., Inc. New York.
2. Muhammad, F. 2005. "Statistical Methods and Data Analysis", Kitab Markaz, Bhawana Bazar Faisalabad.

COURSE NAME: Biodiversity and Conservation	**COURSE CODE:** ZG-442
COURSE STRUCTURE: Lectures: 2, Labs: 1	**CREDIT HOURS:** 3
PREREQUISITES: None	

Course Objective

To familiarize the students with the diversity of nature. Importance of biodiversity for survival and proper functioning of ecosystems.

Course Outline

1. Definition of biodiversity as defined in the convention of biological diversity (CBD).
2. Introduction of species on each other for their survival.
3. Extent of known and estimated biodiversity of earth.
4. Measuring biodiversity: Alpha, Beta, and Gamma diversity, Systematic diversity , functional diversity, taxic diversity.
5. Ecological services, indirect value of ecosystem by virtue of their ecological functions, direct value of ecosystem (i.e. Utility of living resources).
6. Sustainable and unsustainable use of ecosystem resources, consequences of unsustainable use, ecosystem degradation, extinct species, desertification and deforestation.
7. Biodiversity Hot spots of the world.
8. International treaties/agreements regarding Biodiversity and conservation; CBD, CITES, Ramsar.
9. IUCN categorised protected areas in Pakistan.

10. Environmental Impact Assessment.
11. Use of herbarium and Botanical Garden in biodiversity and conservation.

Lab Outline

1 Inventory of plant biodiversity in various habitats.
2 Field survey for baseline studies and Impact Assessment.
3 Identification of wild plant species used by local communities in different ecosystems.

Recommended Books

1. Heywood, V. (ed.). 1995. Global Biodiversity Assessment. Published for the United Nations Environment Programme. Cambridge University Press, Cambridge, UK.
2. Falk, D.A. & Holsinger, K.E. 1991. Genetics and Conservation of Rare Plants. Center for Plant Conservation. Oxford University Press, Oxford, UK.
3. Frankel, O.H., Brown, A.H.D. & Burdon, J.J. 1995. *The Conservation of Plant Biodiversity*. Cambridge University Press, Cambridge, UK.
4. IUCN. 1994. *IUCN Red List Categories.* As Approved by the IUCN Council. IUCN.
5. Leadlay, E. and Jury, S. 2006 Taxonomy and Plant Conservation. CUP.
6. Bush, M.B. 1997 Ecology of a changing Planet. Prentice hall. New Jersy.
7. French, H. 2000 Vanishing Borders- protecting the Planet in the age of globalization. W.W. Norton & Co
8. Swanson, T. 2005 Global Action for Biodiversity. Earth Scan Publication Ltd.
9. Taylor, P. 2005 Beyond Conservation. Earth Scan Publication Ltd.

Course Name: Animal Diversity-II	**Course Code:** ZG-443
Course Structure: Lectures: 3, Lab:1	**Credit Hours:** 4
Prerequisites: None	

Aims and Objectives:

The course provides knowledge and understanding about the different animal groups, emphasizing their phylogenetic relationships.

Course Contents

1. Echinoderms

Evolutionary perspective: relationships to other animals; echinoderm characteristics; classification up to class. Maintenance functions, regeneration, reproduction, and development in asteroidea, ophiuroidea, echinoidea, holothuroidea and crinoidea; further phylogenetic considerations; some lesser-known invertebrates: the lophophorates, entoprocts, cycliophores, and chaetognaths.

2. Hemichordates and Invertebrate Chordates

Evolutionary Perspective: Phylogenetic Relationships; Classification up to subphylum or class where applicable; Further Phylogenetic Considerations.

3. Fishes: Vertebrate Success in Water

Evolutionary perspective: phylogenetic relationships; survey of super class agnatha

and gnathostomata; evolutionary pressures: adaptations in locomotion, nutrition and the digestive system, circulation, gas exchange, nervous and sensory functions, excretion and osmoregulation, reproduction and development; further phylogenetic considerations.

4. Amphibians: The First Terrestrial Vertebrates

Evolutionary perspective: phylogenetic relationships; survey of order caudata, gymnophiona, and anura. Evolutionary pressures: adaptations in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, temperature regulation, nervous and sensory functions, excretion and osmoregulation, reproduction, development, and metamorphosis; further phylogenetic considerations.

5. Reptiles: The First Amniotes

Evolutionary perspective: cladistic interpretation of the amniotic lineage; survey of order testudines or chelonia, rhynchocephalia, squamata, and crocodilia; evolutionary pressures: adaptations in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, and temperature regulation, nervous and sensory functions, excretion and osmoregulation, reproduction and development; further phylogenetic considerations.

6. Birds: Feathers, Flight, and Endothermy

Evolutionary perspective: phylogenetic relationships; ancient birds and the evolution of flight; diversity of modern birds; evolutionary pressures: adaptation in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, and temperature regulation, nervous and sensory systems, excretion and osmoregulation, reproduction and development; migration and navigation.

7. Mammals: Specialized Teeth, Endothermy, Hair, and Viviparity

Evolutionary perspective: diversity of mammals; evolutionary pressures: adaptations in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, and temperature regulation, nervous and sensory functions, excretion and osmoregulation, behavior, reproduction and development.

Lab Outline

Practicals

1. Study of a representative of Hemichordate and Invertebrate Chordate.
2. Study of representative groups of class Fishes.
3. Study of representative groups of class Amphibia.
4. Study of representative groups of class Reptilia.
5. Study of representative groups of class Aves.
6. Study of representative groups of class Mammalia.
7. Field trips to study animal diversity in an ecosystem.

Note: *Preserved specimen and/or colored projection slide and/or CD-ROM projection of computer must be used.*

Recommended Books

Books Recommended

1. Hickman, C.P., Roberts, L.S. and Larson, A. INTEGRATED PRINCIPLES OF ZOOLOGY, 11th Edition (International), 2004. Singapore: McGraw Hill.
2. Miller, S.A. and Harley, J.B. ZOOLOGY, 5th Edition (International) 2002. Singapore: McGraw Hill.
3. Pechenik, J.A. BIOLOGY OF INVERTEBRATES, 4th Edition (International), 2000. Singapore: McGraw Hill.
4. Kent, G.C. and Miller, S. COMPARATIVE ANATOMY OF VERTEBRATES. 2001. New York: McGraw Hill.
5. Campbell, N.A. BIOLOGY, 6th Edition. 2002. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.

Books Recommended (Practical)

1. Hickman, C.P. and Kats, H.L. LABORATORY STUDIES IN INTEGRATED PRINCIPLES OF ZOOLOGY. 2000. Singapore: McGraw Hill.
2. Miller, S.A. GENERAL ZOOLOGY LABORATORY MANUAL. 5th Edition (International), 2002. Singapore: McGraw Hill.

Course Name: Animal Form and Function-I	**Course Code:** ZG-444
Course Structure: Lectures: 3, Lab:1	**Credit Hours:** 4
Prerequisites: None	

Aims and Objectives*:*

The course aims to teach the students about:

a. Animals diversity adapted in different ways for their functions through modifications in body parts.
b. The diversity in integumentary, skeletal, muscular, nervous and sensory, endocrine, circulatory, respiratory, nutritive, excretory, osmoregulatory and reproductive systems according to strategies to survive in their specific conditions.
c. Organ systems, their specialization and coordination with each other and constantly changing internal and external environment, inside and outside the animal's body.
d. The basic structure of each system that determines its particular function.

Course Contents

1. Protection, Support, and Movement

Protection: the integumentary system of invertebrates and vertebrates; movement and support: the skeletal system of invertebrates and vertebrates; movement: non-muscular movement; an introduction to animal muscles; the muscular system of invertebrates and vertebrates.

2. Communication I: Nerves

Neurons: structure and function; neuron communication: introductory accounts of resting membrane potential, action potential (nerve impulse) and transmission of the action potential between cells; invertebrate and vertebrate nervous systems: the spinal cord, spinal nerves, the brain, cranial nerves and the autonomic nervous system.

3. Communication II: Senses

Sensory reception: baroreceptors, chemoreceptors, georeceptors, hygroreceptors, phonoreceptors, photoreceptors, proprioceptors, tactile receptors, and thermoreceptors of invertebrates; lateral-line system and electrical sensing, lateral-line system and mechanoreception, hearing and equilibrium in air, hearing and equilibrium in water, skin sensors of damaging stimuli, skin sensors of heat and cold, skin sensors of mechanical stimuli, sonar, smell, taste and vision in vertebrates.

4. Communication III: The Endocrine System and Chemical Messengers

Chemical messengers: hormones chemistry; and their feedback systems; mechanisms of hormone action; some hormones 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, Immunity, and Gas Exchange

Internal transport and circulatory systems in invertebrates: characteristics of invertebrate coelomic fluid, hemolymph, and blood cells; 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; gas exchange: respiratory surfaces; invertebrate and vertebrate respiratory systems: cutaneous exchange, gills, lungs, and lung ventilation; human respiratory system: gas transport.

Lab Outline

Practicals

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

2. Study and notes of skeleton of *Labeo, Rana tigrina, Varanus,* fowl and rabbit.

Note: *Exercises of notes on the adaptations of skeletons to their function must be done.*

3. Earthworm or leech; cockroach, freshwater mussel, *Channa* or *Catla catla* or *Labeo* or any other local fish, frog, pigeon and rat or mouse and rabbits are representative

animals for study in dissections.

4. Study of models or preserved brains of representative animals and notes on adaptations.
5. Study of nervous system of earthworm and a fish.
6. Study of endocrine system in an insect and a rabbit.
7. Study of different types of blood cells in blood smear of rabbit.
8. Study of heart, principal arteries and veins in a representative vertebrate (dissection of representative fish/mammals).
9. Study of respiratory system in cockroach or locust and a vertebrate representative (Model).

Recommended Books

Books recommended

1. Hickman, C.P., Roberts, L.S. and Larson, A. INTEGRATED PRINCIPLES OF ZOOLOGY, 11th Edition (International), 2004. Singapore: McGraw Hill.
2. Miller, S.A. and Harley, J.B. ZOOLOGY, 5th Edition (International), 2002. Singapore: McGraw Hill.
3. Pechenik, J.A. BIOLOGY OF INVERTEBRATES, 4th Edition (International), 2000. Singapore: McGraw Hill.
4. Kent, G.C. and Miller, S. COMPARATIVE ANATOMY OF VERTEBRATES. 2001. New York: McGraw Hill.
5. Campbell, N.A. BIOLOGY, 6th Edition. 2002. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.

Books Recommended (Practicals)

1. Hickman, C.P. and Kats, H.L. LABORATORY STUDIES IN INTEGRATED PRINCIPLES OF ZOOLOGY. 2000. Singapore: McGraw Hill.
2. Miller, S.A. GENERAL ZOOLOGY LABORATORY MANUAL. 5th Edition (International), 2002. Singapore: McGraw Hill.

Course Name: Animal Form and Function-II	**Course Code:** ZG-445
Course Structure: Lectures: 3, Lab:1	**Credit Hours:** 4
Prerequisites: None	

Aims and Objectives:

The course deals with the:

. Basis of structure and functions of animal nutrition, digestion, homeostasis and temperature regulation.

. It introduces the basic concepts in reproduction and development in animal kingdom.

. Provides knowledge about the development of chordate body plan and fate of germinal layers.

Course Contents

1. Nutrition and Digestion

Evolution of nutrition; the metabolic fates of nutrients in heterotrophs; digestion; animal strategies for getting and using food, diversity in digestive structures of invertebrates and vertebrates; the mammalian digestive system: gastrointestinal motility and its control, oral cavity, pharynx and esophagus, stomach, small intestine: main site of digestion; large intestine; role of the pancreas in digestion; and role of the liver and gallbladder in digestion.

2. Temperature and Body Fluid Regulation

Homeostasis and Temperature Regulation; The Impact of Temperature on Animal Life; Heat Gains and Losses; Some Solutions to Temperature Fluctuations; Temperature Regulation in Invertebrates, Fishes, Amphibians, Reptiles, Birds and Mammals; Heat Production in Birds and Mammals; Control of Water and Solutes (Osmoregulation and Excretion); Invertebrate and Vertebrate Excretory Systems; How Vertebrates Achieve Osmoregulation; Vertebrate Kidney Variations; Mechanism in Metanephric Kidney Functions.

3. Reproduction and Development

Asexual reproduction in invertebrates; advantages and disadvantages of asexual reproduction; sexual reproduction in invertebrates; advantages and disadvantages of sexual reproduction; sexual reproduction in vertebrates; reproductive strategies; examples of reproduction among various vertebrate classes; the human male reproductive system: spermatogenesis, transport and hormonal control, reproductive function; the human female reproductive system: folliculogenesis, transport and hormonal control, reproductive function; hormonal regulation in gestation; prenatal development and birth: the placenta; milk production and lactation.

4. Descriptive Embryology

Fertilization; embryonic development: cleavage, and egg types; the primary germ layers and their derivatives; echinoderm embryology; vertebrate embryology: the chordate body plan, amphibian embryology, development in terrestrial environments, avian embryology, the fate of mesoderm.

Lab Outline

Practicals

1. Study of excretory system in an invertebrate and a vertebrate representative (Model).

2. Study of nutritive canal in an invertebrate and a vertebrate representative (Dissection).
3. Study of male reproductive system in an invertebrate and a vertebrate representative (Dissection).
4. Study of female reproductive system in an invertebrate and a vertebrate representative (Dissection).
5. Study of hormonal influence of a reproductive function (Model).
6. Study of preserved advanced stages of avian and mammalian development for amniotic membranes and placenta (Model).
7. Study of stages in the development of an Echinoderm.
8. Study of early stages in the development of a frog, chick and a mammal.

Note for 9-10: Prepared slides and preserved specimen and/or projection slides and/or CD ROM computer projections may be used.

Recommended Books

Books Recommended

1. Hickman, C.P., Roberts, L.S. and Larson, A. INTEGRATED PRINCIPLES OF ZOOLOGY, 11th Edition (International), 2004. Singapore: McGraw Hill.
2. Miller, S.A. and Harley, J.B. ZOOLOGY, 5th Edition (International), 2002. Singapore: McGraw Hill.
3. Pechenik, J.A. BIOLOGY OF INVERTEBRATES, 4th Edition (International), 2000. Singapore: McGraw Hill.
4. Kent, G.C. and Miller, S. COMPARATIVE ANATOMY OF VERTEBRATES. 2001. New York: McGraw Hill.
5. Campbell, N.A. BIOLOGY, 6th Edition. 2002. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.

Books Recommended (Practicals)

1. Hickman, C.P. and Kats, H.L. LABORATORY STUDIES IN INTEGRATED PRINCIPLES OF ZOOLOGY. 2000. Singapore: McGraw Hill.
2. Miller, S.A. GENERAL ZOOLOGY LABORATORY MANUAL. 5th Edition (International), 2002. Singapore: McGraw Hill.

SHAHEED BENAZIR BHUTTO WOMEN UNIVERSITY PESHAWAR
DEPARTMENT OF ZOOLOGY

DETAILED COURSE OUTLINE OF BS ZOOLOGY (SESSION: 2012-2016, 2013-2017, 2014-2018 AND 2015-2019)

SEMESTER-V

Course Name: Introduction to Psychology	**Course Code:** ZG-551
Course Structure: Lectures: 2	**Credit Hours:** 2
Prerequisites: None	

Course Objectives:

- To describe psychology with major areas in the field,
- To identify the parameters of this discipline. Distinguish between the major perspectives on human thought and behavior. Appreciate the variety of ways psychological data are gathered and evaluated.

To gain insight into human behavior and into one's own personality or personal relationships. Explore the ways that psychological theories are used to describe, understand, predict, and control or modify behavior.

Course Outline:

1. Introduction to Psychology:
   a. Nature and Application of Psychology with special reference to Pakistan.
   b. Historical Background and Schools of Psychology (A Brief Survey)

2. Methods of Psychology
   a. Observation
   b. Case History Method Experimental Method
   c. Survey Method
   d. Interviewing Techniques

3. Biological Basis of Behavior
   a. Neuron: Structure and Functions
   b. Central Nervous System and Peripheral Nervous System
   c. Endocrine Glands

4. Sensation, Perception and Attention

a. Sensation
   i. Characteristics and Major Functions of Different Sensations
   ii. Vision: Structure and function of the Eye.
   iii. Audition: Structure and functions of the Ear.

b. Perception
   i. Nature of Perception
   ii. Factors of Perception: Subjective, Objective and Social
   iii. Kinds of Perception
   iv. Spatial Perception
   v. Temporal Perception; Auditory Perception

c. Attention
   i. Factors, Subjective and Objective
   ii. Span of Attention
   iii. Fluctuation of Attention
   iv. Distraction of Attention (Causes and Control)

5. Motives
   a. Definition and Nature
   b. Classification

   Primary (Biogenic) Motives: Hunger, Thirst, Defection and Urination, Fatigue, Sleep, Pain, Temperature, Regulation, Maternal Behavior, Sex

   Secondary (Sociogenic) Motives: Play and Manipulation, Exploration and Curiosity, Affiliation, Achievement and Power, Competition, Cooperation, Social Approval and Self Actualization.

6. Emotions
   a. Definition and Nature
   b. Physiological changes during Emotions (Neural, Cardial, Visceral, Glandular), Galvanic Skin Response; Pupilliometrics
   c. Theories of Emotion
   d. James Lange Theory; Canon-Brad Theory
   e. Schechter-Singer Theory

7. Learning
   a. Definition of Learning
   b. Types of Learning: Classical Operant Conditioning, Methods of Learning: Trial and Error; Learning by Insight; Observational Learning

8. Memory
   a. Definition and Nature
   b. Memory Processes: Retention, Recall and Recognition
   c. Forgetting: Nature and Causes

9. Thinking
   a. Definition and Nature
   b. Tools of Thinking: Imagery, Language, Concepts
   c. Kinds of Thinking
   d. Problem Solving, Decision Making, Reasoning

10. Individual References

a. Definition concepts
   Intelligence, Personality, aptitude, achievement

Recommended Books

1. Atkinson R. C., & Smith E. E. (2000). *Introduction to psychology* (13th ed.). Harcourt Brace College Publishers.
2. Fernald, L. D., & Fernald, P. S. (2005). *Introduction to psychology*. USA: WMC Brown Publishers.
3. Glassman, W. E. (2000). *Approaches to psychology*. Open University Press. Hayes, N. (2000). *Foundation of psychology* (3rd ed.). Thomson Learning. Lahey, B. B. (2004). *Psychology: An introduction* (8th ed.). McGraw-Hill Companies, Inc.
4. Leahey, T. H. (1992). *A history of psychology: Main currents in psychological thought*. New Jersey: Prentice-Hall International, Inc.
5. Myers, D. G. (1992). *Psychology*. (3rd ed.). New York: Wadsworth Publishers
6. Ormord, J. E. (1995). *Educational psychology*: *Developing learners*. Prentice- Hall, Inc

Course Name: Developmental Biology	**Course Code:** ZG-552
Course Structure: Lectures: 3, Labs:1	**Credit Hours:** 4
Prerequisites: None	

Course Objectives:

The course will provide detailed knowledge about the principal features of development, cellular basis of morphogenesis, mechanisms of cellular differentiation and concepts of

induction in development. It will provide understanding of the mechanisms of organogenesis, factors controlling growth and oncogenesis. The concept related to the theory in Developmental Biology will be practically demonstrated in this course. In the continuity of the animals during reproduction following the union of the traits from the parents in their gametes, the zygote proceeds through enormous phenomena of development up to their emergence resembling to the parents. The concepts of all these developmental mechanisms will be communicated to the students in this course.

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.
Hormones as mediators of development; Regeneration in vertebrates.

Recommended Books

1. Gilbert, S. F. DEVELOPMENTAL BIOLOGY, 2006.Sinauer Associates, Sunderland, MA.
2. Balinsky, B. I. AN INTRODUCTION TO EMBRYOLOGY, 1985. Saunders.
3. Saunders, J. W. DEVELOPMENTAL BIOLOGY, 1982. McMillan and company.
4. Oppenheimer, S.S. INTRODUCTION TO EMBRYONIC DEVELOPMENT, 1984. Allen and Bacon.
5. Ham, R. G. and Veomett, M. J. MECHANISM OF DEVELOPMENT. 1980. C. V. Mosby Co.

6. Klaus, K. BIOLOGICAL DEVELOPMENT. 2nd Edition, 2001.McGraw Hill.

Lab Outline:

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

Course Name: Cell & Molecular Biology	**Course Code:** ZG-553
Course Structure: Lectures: 3, Labs:1	**Credit Hours:** 4
Prerequisites: None	

Course Objectives:
Objectives of the course are to impart knowledge about the animal cell and its complex organization of architecture and the unified role it plays for the ultimate sustainability of the organisms. The various ultra-structural, molecular and functional aspects of the cells will be communicated in this course.

Course Contents:

Introduction to prokaryotic and eukaryotic cells: Plasma membrane**,** its chemical composition structure and functions: of plasma membranes, cell permeability, active transport, endocytosis, phagocytosis.

Cytoskeleton: Microfilaments, Microtubules, Intermediate filaments.

Cytoplasmic Organelles: Membrane system (structural and functional commonalities). Ultrastructure, chemical composition and functions of Endoplasmic Reticulum with special reference to their role in protein synthesis and drug metabolism), Golgi Apparatus (with reference to its role in synthesis of glycoprotein), Mitochondria (with reference to its role in cellular respiration, and its significance as semi-autonomous organelle), Lysosome (with reference to its diverse roles due to hydrolytic activity of enzymes), peroxisome (with reference to metabolism of hydrogen peroxide), glycoxysome (with reference to glyoxylic acid cycle).

Nucleus, chromatin, heterochromatin, euchromatin, chromosome structure with reference to coiling and nucleosome during different phases of cell cycle, Replication (mechanism, DNA replication in prokaryotes specially with reference to variety of DNA polymerases and other proteins involved, DNA replication in Eukaryotes with special reference to DNA polymerases, concept of Replicons etc.), Transcription (variety of RNA and their characteristics, synthesis of mRNA, rRNA and tRNA with special reference to enzymes, involved, RNA splicing, split genes, concept of Ribozymes and posttranscriptional processing), RNA transduction, Genetic code, point mutations, Translation (with

reference to the specific role of Ribosomes, various factors, and posttranslational processing).Control of Gene expression in Prokaryotes.

Recommended Books

1. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J.D. MOLECULAR BIOLOGY OF THE CELL, 1989. Garland Publishing Inc., New York.
2. Damell Jr. J., Lodisch, H. and Balimore, D. MOLECULAR CELL BIOLOGY, 1990. Scientific American Inc. N.Y.
3. De Robertis, E. D. P. and De Robertis Jr. E. N. F. CELL AND MOLECULAR BIOLOGY, 1987. Lea & Febiger, New York.
4. Karp, J. CELL AND MOLECULAR BIOLOGY, CONCEPTS AND EXPERIMENTS, 2005. Jhon Wiley and Sons, INC.
5. Geoffrey M.C., Robert E.H. THE CELL: A MOLECULAR APPROACH, 2007. Sinauer Associates, INC.

Practicals

1. Detection and quantitative determination of chromosomal DNA and RNA.
2. Cultural and staining of bacteria and yeast.
3. Identification of different type of blood cells in human blood through smear technique.
4. Counting of prokaryotic cells (bacteria) and blood cells by using haemocytometer.
5. Isolation and characterization of proteins on polyacrylamide gel electrophoresis (native and sub-unit molecular weights).
6. Separation of different sized DNA fragments on agarose gel.

Course Name: Animal Behaviour	**Course Code:** ZG-554
Course Structure: Lectures: 2, Labs:0	**Credit Hours:** 2
Prerequisites: None	

Course Contents:

Mechanism of behavior: Nervous system and behavior, hormones and behavior, biological rhythm, development of behavior, learning behavior, communication.

Social organization: conflict, sexual reproduction, parental care, social system.

Recommended Books

1. Goodenough, J., McGuire, B. and Wallace, R.A. PERSPECTIVE ON ANIMAL BEHAVIOUR. 2001.John Wiley & Sons, New York.
2. Scott, G. ESSENTIAL ANIMAL BEHAVIOUR. 2005.Blackwell Pub. New York
3. Dngatkin, L. A. PRINCIPLES OF ANIMAL BEHAVIOUR. 2006.W.W. Nortan and Co.New York.

Course Name: Physiology	**Course Code:** ZG-555
Course Structure: Lectures: 3, Labs: 1	**Credit Hours:** 4
Prerequisites: None	
Course Objectives:	

The basic functional expression in animals is the membrane irritability understood in the form of nerve impulse. This course particularly imparts the concepts and mechanisms of integration in the different functional systems of the animals. These mainly constitute the mechanisms of nervous system and the hormonal system for the coordination. The motility and locomotion also contributes in the integration of the animal to its environment, therefore, also included in this section.

Course Contents:

Central themes in Physiology: Structure-function relationship, Adaptations, Homeostasis, Conformity and Regulation.

Physiological basis of Membrane Function: Mechanisms in resting membrane potentials: Electrogenic ion pump, Donnan equilibrium, Diffusional potentials, Ion channels, Ionic mechanisms in action potentials: Roles of ion channels, Properties of action potential. Propagation of action potential in neurons; Synaptic transmission; Structure and function of electrical synapse structure and function of chemical synapse; Neurotransmitters; Synaptic receptors; Excitatory postsynaptic potentials; Inhibitory postsynaptic potentials; Presynaptic inhibitions; Integration at synapses: Facilitation, Posttetanic Potentiation.

Receptors Physiology: Transduction; Sensory coding; Range fractionation; Sensory adaptations; Mechanoreception: Hair cell mechanism particularly in acoustico-lateralis system of vertebrates; Cutaneous receptors; Cellular and molecular mechanisms in taste and olfactory reception; Photoreception: Ultrasttructure of photoreceptors, Photochemistry, Phototransduction and physiological basis of color vision; Physiological mechanisms in electroreception.

Chemical Messenger and Regulators/Endocrine Physiology: Types and functions of secretions. An overview of invertebrate endocrine structures, their hormones and physiological roles. An overview of hormones, their chemistry and physiological roles of Hypothalamus, Pituitary, Thyroid, Parathyroid and associated structures, Endocrine pancreas, Gastropancreatic system, Adrenal medulla (Chromaffin Tissue), Adrenal cortex, Ovary, Testis and Placenta. A generalized model account of hormone synthesis, storage and secretion (a peptide hormone model and steroid hormones); Hormonal interactions in metabolic and developmental function; Water and electrolyte balance and reproduction. Integrated endocrine and neural responses in glycemia and calcium homeostasis and reproductive cycles; General account of hormonal regulations, hormonal turnover, recognition; Mechanisms of action in hormones involving membrane receptors and nuclear modulated gene expression; Endocrine functions of kidneys, heart and pineal gland.

Movements and Muscles: Structural basis of muscle contraction: molecular structures of contractile components and their interaction, sarcoplasmic reticulum, calcium and membrane mechanisms in regulation of contraction.

Cardiovascular Mechanisms: Electrical activity of heart: Automaticity, Rhythmicity,

Electrocardiography, Kymography; Hemodynamics, Blood
flow, pressures and resistance and their interrelationships. Control of cardiac activity (cardiac output) and peripheral circulation.

Exchange of Gases: Transport of O_2 and CO_2 between respiratory surface (the lungs) and body cells. Regulation of lungs respiration; Gas transfer in water (gills) and its regulation. Respiratory responses in extreme conditions as hypoxia; Hypercapnia in air breathing divers.

Excretion and Osmoregulation: Osmoregulation in aquatic and terrestrial environment. Vertebrate nephron as osmoregulatory organ: Physiological anatomy, Glomerular filtration, Tubular absorption and secretion; Nitrogenous waste products; Patterns of nitrogenous excretion and their phylogenetic development.

Nutrition: Regulation of digestive secretions; Physiological anatomy of digestive tract (mammalian model), Absorption of water, ions and nutrients; Potential and Movements in gastrointestinal tract; Control of motility.

Temperature Relations: 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, Estivation.

PRACTICALS

Practicals Muscle and Neuromuscular Activity: 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.

Excitability, Sensation and Behaviour: 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.

Cardiovascular Activity: Normal cardiac activity, effect of temperature, effect of drug, heart block, tetanization of heart. Measurement of blood pressure.

Respiration and Exercise: 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.

Endocrine and Reproductive Mechanisms: Effect of insulin on glycemia, study of stages in estrous cycle.

Recommended Books

1. Randall, D., Burggren, W., French, K. and Fernald, R. ECKERT ANIMAL PHYSIOLOGY: MECHANISMS AND ADAPTATIONS, 5th Edition. 2002. W.H. Freeman and Company, New York
2. Bullock, J., Boyle, J. and Wang, M.B. PHYSIOLOGY, 4th Edition. 2001. Lippincott, Williams and Wilkins, Philadelphia.
3. Berne, R.M. and Levy, M.N. PRINCIPLES OF PHYSIOLOGY, 3rd Edition. 2000. St.

Lious, Mosby.
4. Guyton, A.C. and Hall, J.E. TEXTBOOK OF MEDICAL PHYSIOLOGY, 10th Edition. 2000. W.B. Saunders Company, Philadelphia.
5. Withers, P.C. COMPARATIVE ANIMAL PHYSIOLOGY. 1992. Saunders College Publishing, Philadelphia.
6. Schmidt-Nelsen, K. ANIMAL PHYSIOLOGY, ADAPTATION AND ENVIRONMENT, 5th Edition. 1997. Cambridge University Press, Cambridge.
7. Bullock, J., Boyle, J. and Wang, M.B. PHYSIOLOGY, 4th Edition. 2001. Lippincott, Williams and Wilkins, Philadelphia.

Books Recommended for Practicals

1. Tharp, G. and Woodman, D. EXPERIMENTS IN PHYSIOLOGY, 8th Edition. 2002. Prentice Hall, London.

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DETAILED COURSE OUTLINE OF BS ZOOLOGY (SESSION: 2012-2016, 2013-2017, 2014-2018 AND 2015-2019)

SEMESTER-VI

Course Name: Biological Techniques	**Course Code:** ZG-561
Course Structure: Lectures: 1, Lab:2	**Credit Hours:** 3
Prerequisites: None	

Course Outline:
(Theory and Practical)

Microscopy: Principles of light microscopy. Magnification, Resolution, Contrast. Types of microscopy, Phase Contrast Dark field Interference microscope, Electron microscope.

Micrometery and Morphometry: Use of stage and ocular micrometer. Calibration of ocular micrometer. Size measurement (length, width, diameter).

Specimen preparation for optical microscopy.
Standard system for weight, length and volume. Preparation of stock solutions of various strengths.

Microtomy: Fixation, embedding, Section cutting (transverse, longitudinal section, mounting and staining. Sections in paraffin and cryosections.

Extraction techniques: Centrifugation, Ultra centrifugation, cell fractionation, filtration, Distillation, Use of Soxhalet and Rotary evaporator for extraction.

Separation Techniques: Chromatography: Principle, applications, types, thin layer, paper, column, gas, ion exchange chromatography. Electrophoresis: principle, applications, types.

Spectrophotometery: Principle, applications, types, visible spectrum, UV spectrum, atomic absorption.

Basic principles of Sampling and Preservation: Sampling soil organisms, Invertebrates, Aquatic animals, Mammals, Estimation of population size, Preservation of dry and wet specimens.

Books Recommended

1. Dean, J. R. EXTRACTION METHODS FOR ENVIRONMENTAL ANALYSIS. 1999. John Wiley and Sons Ltd. UK.
2. Curos, M. ENVIRONMENTAL SAMPLING AND ANALYSIS: LAB MANUAL. 1997. CRC Press LLC. USA.
3. Curos, M. ENVIRONMENTAL SAMPLING AND ANALYSIS: FOR TECHNICIAN. 1997. CRC Press LLC. USA.
4. Cheesbrough, M. DISTRICT LABORATORY PRACTICE IN TROPICAL COUNTRIES. Part I. 1998. University Press Cambridge, UK.
5. Cheesbrough, M. DISTRICT LABORATORY PRACTICE IN TROPICAL COUNTRIES. Part II. 1998. University Press Cambridge, UK.
6. Slingsby, D. and Cock, C.

Course Name: Evolution and Principles of Systematics	**Course Code:** ZG-562
Course Structure: Lectures: 4, Lab: 0	**Credit Hours:** 4
Prerequisites: None	

Course Objectives:

The course is designed to provide in depth knowledge or origin of life, and about forces responsible for evolutionary changes. The students will be taught basic rules and regulations about the identification and naming of organisms.

Course Contents

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

Systematic Zoology: Contribution of systematics to Biology: History of Taxonomy (Downward classification, upward classification, impact of the origin of species, population systematics, current trends); Microtaxonomy, phenon, Taxon; Taxonomic categories: specific category, infraspecific category, higher categories; species concepts (Typological concept; nominalistic concept, Biological concept, evolutionary concept), species mate recognition concept; non-dimensional species concept; Multidimenstional species concept; Cohesion species concept; Difficulties in the application of biological species concepts; polytypic species, subspecies, super species, sibling species; study of major type of variation within a single population. Speciation and taxonomic decision, various types of characters, cladistic analysis, Macrotaxonomy; different kinds of taxonomic characters; Taxonomic collection and identification; definitions of Synonym,

Homonym, Keys; Evolution of the theory of Nomenclature; interpretation and application of the code (stability, priority, first revisor principle) range of authority of code; concept of availability, type method formation of specific names.

Practicals

Study of preserved invertebrate species and their classification upto class level. Collection, preservation and identification of common species with the help of keys. Methods of statistical analysis of samples from populations T-test, Analysis of variance etc. Preparation of keys for the identification of specimens.

Books Recommended

Evolution

1. Ridley, M. EVOLUTION. 1993. Blackwell Scientific Publications.
2. Dobzhansky, T., Ayala, F.J., Stebbins, G.L. and Valentine, J.W. EVOLUTION. 1973. W.H. Freeman and Company.
3. Dobzhansky, T. GENETICS AND THE ORIGIN OF SPECIES, 1951. Columbia University Press, New York.
4. Mayr, E. POPULATIONS, SPECIES AND EVOLUTION, 1965. Harvard University Press.
5. Moody, P.A. INTRODUCTION TO EVOLUTION, 1989. Harper and Row Publishers, New York.
6. Strickberger. M.W. EVOLUTION. 2000. Jones & Barrett Publishers

Systematic Zoology

1. Mayer, E. PRINCIPLES OF SYSTEMATIC ZOOLOGY. 1994. McGraw Hill, New York.
2. Mayer, E. and Asblock, P.D. PRINCIPLES OF SYSTEMATIC ZOOLOGY. 1991. McGraw Hill, New York
3. Mayr, E. ANIMAL SPECIES AND EVOLUTION, 1985. Harvard University Press.
4. Heywood, V.H. TAXONOMY AND ECOLOGY. 1975. Academic Press, London.
5. Whili, M.J.D. MODES OF SPECIATION, 1978. W.H. Freeman and Co., San Francisco.

Course Name: Biochemistry	**Course Code:** ZG-563
Course Structure: Lectures: 2, Lab: 1	**Credit Hours:** 3
Prerequisites: None	

Aims and Objectives:

The course will provide in depth knowledge about the polymerized organic compounds of life. The dynamism of the life proceeds with inter-conversion of the chemicals from feeding to the liberation of energy for work. It will deal with the inter-conversion is performed by various tools called as enzymes. Thus, in this course the concepts of the chemical basis of life and all the mechanisms involved in harvesting of energy for growth, duplication etc., are given.

Course Contents

Amino acids, peptides and proteins: standard amino acids, their structure and classification; acid/base properties of amino acids and their titration curves; natural modifications of amino acids in proteins; non-standard amino acids, their structure and role; peptides, their ionic behavior and amino acid composition, cytochrome c; Macromolecular separation techniques in biochemistry; ion exchange chromatography; isoelectric focusing; density gradient centrifugation.

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 enzyme activity; kinetics of bisubstrate and multisubstrate reactions.

Carbohydrates: classification, types, important characteristics and structure of carbohydrates; history of developments in structure of glucose; monosaccharides; cyanohydrin 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 of b- complex group.

Bioenergetics: concept of free energy; standard free energy change: energy rich compounds.

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 of glycogen and starch; regulation of glycogen metabolism; utilization of dietary polysaccharides (starch) and disaccharides (sucrose and galactose). Biosynthesis of glycogen, starch and sucrose.

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.

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) multienzyme complex; biosynthesis of unsaturated fatty acids. Ketone bodies their biosynthesis, utilization and role in the tissues; cholesterol metabolism: cholesterol biosynthesis and its regulation; 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; Biosynthesis of some amino acids; incorporation of ammonia in glutamate and glutamine; purine and pyrimidine.

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. and Cox, M.M. LEHNINGER PRINCIPLES OF BIOCHEMISTRY, 3rd Edition, 2000. McMillan Worth Publishers, New York.
2. Murray, R.K., Granner, D.K., Mayer, P.A. and Rodwells, V.W. HARPER'S BIOCHEMISTRY, 25th Edition, 2000. McGraw Hill, New York.
3. Voet. D., Voet, J.G., and Pratt, C.W. FUNDAMENTALS OF BIOCHEMISTRY, 1999. John Wiley and Sons, Inc., New York.
4. Zubay, G. BIOCHEMISTRY, 4th Edition, 1995. Wm. C. Brown Publishers, Inc., Oxford, England.
5. Lubert, S. BIOCHEMISTRY, 4th Edition, 1995. W.H. Freeman & Company, New York.
6. McKee, T. and McKee, J.R. BIOCHEMISTRY, THE MOLECULAR BASIS OF LIFE. 3rd Edition, 2003. McGraw Hill.

Books Recommended (Practicals)

1. Plummer, David T. AN INTRODUCTION TO PRACTICAL BIOCHEMISTRY, 1990. 4th Edition McGraw-Hill Book Company, London.
2. Wilson, K & Walker, J. PRACTICAL BIOCHEMISTRY: PRINCIPLES AND TECHNIQUES, 4th Edition, 1994. Cambridge University Press.

Course Name: Ecology	**Course Code:** ZG-564
Course Structure: Lectures: 3, Lab: 1	**Credit Hours:** 4
Prerequisites: None	

Aims and Objectives:

The aim of this course is to make the students aware that all the living organisms including human beings are part of the environment, which consists of biotic and abiotic factors. The abiotic factors consist of all the physical factors while biotic factors include all the living things. However with the increase in population densities increase in productivity is also needed. High technology measures used for this purpose have caused various problems like pollution.

Course Contents:

An overview of concepts of ecosystem with emphasis on interaction and homeostasis. Basic global ecosystems (atmosphere, hydrosphere, lithosphere, ecosphere). Biogeochemical cycle: nitrogen, phosphorus, sulpher, water, carbon, nutrient. Limiting factors: basic concepts, temperature, soil, water and humidity, light, fire. Energy: laws of thermodynamics, primary and secondary productions, trophic levels and energy variation with increasing trophic levels, energy flow, food chains and food webs. Population ecology: basic population characters, growth and growth curves, population dynamics and regulations. Community ecology: basic concepts, community analysis, ecotones, inter-population interactions. Ecological niche: basic concepts and types. An overview of major biomes of the world. Applied Ecology: Resources and their ecological management (mineral, agricultural and forest, range management, desalination and weather modification, landscape and land use); Pollution (definition, types, cost, origin and management); water (sources, domestic and industrial pollution, heavy metals, water purification, waste water treatment); air (sulpher dioxide, nitrogen oxide, carbon monoxide, ozone, smog and PAN, MTBE & CFCs); land pollution (pesticides, bacterial toxins, synthetic hormones); noise pollution. Radiation. Space biology. Contemporary environmental themes: (ozone depletion, acid rain, green house effect and global warming, desertification, deforestation, exotic and invasive species, radioactivity leakage, environmental laws).

PRACTICALS

Measurement of environmental factors on land, water and air. Study of different ecosystems: pond, agricultural or grassland, forest. Community analysis through different sampling techniques (quadrat, Transect). Population dynamics of grasshoppers. Adaptive features of animals in relation to food and environment. Food chain studies through analysis of gut contents. Analysis of polluted and fresh water for biotic and abiotic variations. Field visits for study of selected terrestrial habitat and writing notes. Development of an ecological management plan of some selected area.

Books Recommended

1. Odum, E. P. 1994. FUNDAMENTALS OF ECOLOGY. 3rd Edition W.B. Saunders.Philadelphia.
2. Molles, M.C. 2005 Ecology: CONCEPTS AND APPLICATIONS. 6th Edition, McGraw Hill, New York, USA.
3. Dondson, S.I., Allen, T.F.N., Carpenter, S.R., Ives, A., Jeanne, R.L., Kitchell, J.F., Langston, N.E. and Turner, M.G., 1998. ECOLOGY. Oxford Univ. Press, UK.
4. Slingsby, D. and Cook, C., 1986. PRACTICAL ECOLOGY. McMillan Education

Ltd. UK.
5. Chapman, J.L. and Reiss, M.J.1997. ECOLOGY: PRINCIPLES AND APPLICATIONS. Cambridge Univ. Press, UK.
6. Smith, R.L. 1980. ECOLOGY AND FIELD BIOLOGY, Harper and Row.
7. Newman, I. 1993. APPLIED ECOLOGY. Black Well Scientific Publications Oxford. UK.
8. Cox, C.B and Morre, D. 2000. BIOGEOGRAPHY: AN ECOLOGICAL AND EVOLUTIONARY APPROACH, 6th Edition. Life Sciences King's College, London, UK.

Course Name: Wildlife	**Course Code:** ZG-565
Course Structure: Lectures: 0, Lab: 3	**Credit Hours:** 3
Prerequisites: None	

Aims and Objectives:

Wildlife of Pakistan, identification, distribution, status, conservation and management (population estimate technology) of fishes, reptiles, birds and mammals of major importance in Pakistan. Philosophy and significance of wildlife conservation. Biodiversity and sustainability of wildlife. Wildlife rules and regulations in Pakistan. National and International agencies involved in conservation and management of wildlife. Sanctuaries, Game Reserves and National Parks in Pakistan. Ramsar convention, wetlands, endangered species of Pakistan.

(Note: The teacher is suggested to provide blank maps of Pakistan in the theory class to the students to indicate the distribution of the animals. Similar blanks maps should be attached with the question paper, if distribution of animals is asked from the student in the theory paper).

Books Recommended

9. Bailey, J.A. PRINCIPLES OF WILDLIFE MANAGEMENT, 1986. John Wiley and Sons.
10. Ali S. and Ripley S.D. A HANDBOOK OF BIRDS OF INDIA & PAKISTAN, 1973. Oxford University Press, London.
11. Roberts, T. J. THE BIRDS OF PAKISTAN, (Vol. I). 1992. Oxford University Press.
12. Roberts, T. J. THE BIRDS OF PAKISTAN, (Vol. II), 1998. Oxford University Press.
13. Roberts, T.J. MAMMALS OF PAKISTAN. 1977. Ernest Benon Ltd, London.
14. Robinson, W.L. and Bolen, E.G. WILDLIFE ECOLOGY AND MANAGEMENT. 1984. McMillan, Cambridge.
15. Magon, C.F. BIOLOGY OF FRESHWATER POLLUTION. 1988. Longman and Scientific Publication.
16. Boyd, C.E. and Tucker, C. S. POND AQUACULTURE AND WATER QUALITY MANAGEMENT. 1998. Boston, Kluwer Publishers Alabama.
17. Ali, S.S. PALEONTOLOGY, ZOOGEOGRAPHY & WILD-LIFE MANAGEMENT. 1999. Nasim Book Depot. Hyderabad, India.

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DETAILED COURSE OUTLINE OF BS ZOOLOGY (SESSION: 2012-2016, 2013-2017, 2014-2018 AND 2015-2019)

SEMESTER-VII

Course Name: Genetics	**Course Code:** ZG-671
Course Structure: Lectures: 3, Lab: 0	**Credit Hours:** 3
Prerequisites: None	

Aims and Objectives

The continuity of the life from one generation to other generation is based on the mechanisms involving nucleus, chromosomes and genes etc. The process of continuity not only transfers the traits of the parents but also imparts variations that render the generations sustainable in changing environment. These concepts will be imparted to the students in this course.

Course Contents

Classical genetics – multiple alleles, genetics of blood groups, chromosomal basis of inheritance, interaction of genes, chromosomal changes (euploidy, aneuploidy, structural changes), sex-determination and sex-linkage, linkage, recombination and chromosome mapping in eukaryotes, quantitative inheritance. gene concept (classical and modern), genetics of viruses, bacteria, transposons.

Molecular genetics – analysis and techniques of molecular genetics (elements of genetic engineering), genetic basis of cancer, genetic control of animal development, the genetic control of the vertebrate mmune system, complex inheritance patterns.

Population genetics – Hardy-Wienberg equilibrium, systematic and dispersive pressures, inbreeding and heterosis.

Practicals

1. Mitosis (Onion root tips.)
2. Meiosis (Grass hopper testes)
3. Blood groups.
4. Salivary gland Chromosomes of *Drosophila melanogaster*
5. General morphology of *Drosophila melanogaster*
6. Human Pedigree analysis problems
7. Human Genetics problems
8. Probability problems. Tossing of coins. X^2 test

9. Study of transformed bacteria on the basis of antibiotic resistance.
Books Recommended 1. Snustad, D.P. and Simmons, M.J. PRINCIPLES OF GENETICS. 3rd Edition, 2003. Johan Wiley and Sons Ins. New York, USA. 2. Lewin, B. GENE-VIII. 2000. Oxford University Press. UK. 3. Tamarin, R.H. PRINCIPLES OF GENETICS. 7th Edition, 2001.WCB publishers USA. 4. Gardener, E.J., Simmons, M.J. and Snustad, D.P. PRINCIPLES OF GENETICS. 1991. John Wiley and Sons Ins. New York, USA. 5. Strickberger, M.W. GENETICS. 1985.McMillan, New York. USA.

Course Name: Bioinformatics	**Course Code:** ZG-672
Course Structure: Lectures: 3, Lab: 0	**Credit Hours:** 3
Prerequisites: None	

Aims and Objectives

The course provides an introduction to bioinformatics with a focus on fundamental bioinformatics problems, the tools used to compute solutions to those problems, and the theory upon which those tools are based. The students will be able to

1. Access, retrieve, and analyze bioinformatics data available from several bioinformatic databases;
2. Assess the quality of bioinformatics data available from the Internet;
3. Use standard bioinformatics tools to answer specific biological questions;
4. Understand the theories used to build the tools and their relationship to biology;
5. Critically assess solutions to bioinformatics problems.

Course Contents

(THEORY AND PRACTICAL)

1. **Overview of Bioinformatics**: the scope of bioinformatics, bioinformatics and internet, Useful Bioinformatics sites on Web.
2. **Data Acquisition**: Sequencing DNA, RNA and proteins, Determination of protein structure, Gene and protein expression data, Protein interaction data.
3. **Database**: Contents, Structure and Annotation: File formats, Annotated sequence databases, Genome and organism-specific databases, Miscellaneous databases.
4. **Retrieval of Biological Data**: Data retrieval with Entrez and DBGET/LinkDB, Data retrieval with SRS (sequence retrieval system).
5. **Searching Sequence Databases by Sequence similarity Criteria**: Sequence similarity searched, Amino acid substitution matrices, Database searched (FAST and BLAST), sequence filters, Interactive database searches and PSI-BLAST.
6. **Multiple Sequence Alignment**: Genes and Protein Families: Multiple sequence alignment and family relationships, protein families and pattern databases, protein domain families.
7. **Phylogenetics**: Phylogenetics, cladistics and ontology, Building phylogenetic trees, Evolution of macromolecular sequences.
8. **Sequence Annotation**: Principles of genome annotation, Annotation tools and resources.
9. **Structural Bioinformatics**: Conceptual models of protein structure, relationship of protein three-dimensional structure to protein function, The evolution of protein structure and function, Obtaining, viewing and analyzing structural data, Structural alignment, classification of proteins of known three-dimensional structure: CATH and SCOP, Introduction to protein structure prediction by comparative modeling, secondary structure prediction, advanced protein structure prediction and prediction strategies.
10. **Microarray Data Analysis**: Analysis methods, tools and resources, sequence sampling and SAGE.
11. **Proteomic Data Analysis**: Analyzing data from 2D-PAGE gels, analyzing protein spectrometry data.
12. **Higher-order System**: Modeling and reconstructing molecular pathways, protein interaction informatics, Higher-order models.
13. **Chemoiformatics in Biology**: Conventions for representing molecules, Chemoinformatics resources.
14. **Bioinformatics in Pharmaceutical industry**: Bioinformatics and drug discovery,

Pharmainformatics resources

15. **Basic Principles of Computing in Bioinformatics**: Running computer software, Computer operating systems, software downloading and installation, Database management.

Books Recommended

1. Gibas, C. and Jambeck, P. DEVELOPING BIOINFORMATICS COMPUTER SKILLS. 2001. O'Reilly publishers.
2. Westhead, D.R., Parish, J.H. and Twyman, R.M. INSTANT NOTES ON BIOINFORMATICS. 2003.Viva Books Private Limited.
3. Lest, A.M. INTRODUCTION TO BIOINFORMATICS. 2002. Oxford University Press.
4. Baxevanic, A.D. and Ouellette, B.F.F. BIOINFORMATICS: 2004. A PRACTICAL GUIDE TO THE ANALYSIS OF GENES AND PROTEINS, 3rd Edition. O'Reilly publishers.
5. Krane, D.E. and Raymer, M.L. FUNDAMENTAL CONCEPTS OF BIOINFORMATICS. 2002. Benjamin Cummings.
6. Moody, G. DIGITAL CODE OF LIFE: HOW BIOINFORMATICS IS REVOLUTIONIZING SCIENCE, MEDICINE AND BUSINESS. 2004. John Wiley and Sons.
7. Orengo, C. A., Jones, D.T. and Thornton, J.M. BIOINFORMATICS: GENES, PROTEINS AND COMPUTERS (Advanced Text) 2003. Roultledge.
8. http://www.ncbi.nlm.nih.gov
9. http://www.ebi.ac.uk
10. http://foldoc.doc.ic.ac.uk/foldoc/index.html
11. http://wit.integratedgenomics.com/GOLD/

Course Name: Zoogeography & Paleontology	**Course Code:** ZG-673
Course Structure: Lectures: 3, Lab: 0	**Credit Hours:** 3
Prerequisites: None	

Aims and Objectives

The course imparts knowledge and concepts of evolution mainly based on the past fossil records. The fossil records also provide the information regarding the distribution of animals in the past eras. This course provides information on the distribution of animals and their associations in the past; thus, to rationalize their relationship in the present time.

Course Contents

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 (division, geographic ranges, physical features, climates, faunas and affinities of Holarctic (Palaearctic, Nearctic regions), Oriental, Ethiopian, Australian, and New tropical Regions. Palaeogeography (Theories of Continental drift and Plate tectonics).

Principles of Paleontology: Earth, Shells of earth; (atmosphere, hydrosphere, biosphere and lithosphere). Rock, types of rocks (lgneous rocks, sedimentary rocks and metamorphic rocks) Fossil, types and uses of fossils, nature of fossils. Processes of fossilization. Geological time scale. Pre-Cambrian life. Post Cambrian life (Palaeozoic life, Mesozoic life, Cenozoic life). Geochronometry (Uranium/Lead dating, radiocarbon dating, methods), 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. Darlington, P. J. Jr. ZOOGEOGRAPHY, 1963. John Wiley and Sons.
2. DeBeaufort, L. F. ZOOGEOGRAPHY OF THE LAND AND INLAND WATERS. 1951. Sidgwick and Jackson.
3. Ali, S.S. PALAEONTOLOGY, ZOOGEOGRAPHY AND WILDLIFE MANAGEMENT. 1999. Nasim Book Depot, Hyderabad, India

Paleontology:

1. Dunbar C.O. HISTORICAL GEOLOGY, 1969. John Wiley and Sons Inc. New York.
2. Brouwer, A. GENERAL PALAEONTOLOGY, 1977. Oliver and Boyed, London.
3. Gilbert, L. I. and Colbert, E.H. EVOLUTION OF VERTEBRATES, 1980. John Wiley and Sons Inc. New York.
4. Ali, S.S. PALAEONTOLOGY, ZOOGEOGRAPHY AND WILDLIFE MANAGEMENT. 1999. Nasim Book Depot, Hyderabad, India.

Course Name: Principles of Parasitology	**Course Code:** ZG-674
Course Structure: Lectures: 1, Lab: 2	**Credit Hours:** 3
Prerequisites: None	

Aims and Objectives

This course aims to provide knowledge regarding different modes of transmission of parasites of medical and veterinary importance along with their pathology, host parasite relationship and control measure**.**

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 protozoa, form, function and classification: 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. Class Rhombozoa, class orthonectida, Phylogenetic position, physiology and Host parasite relationship. Classification of Phylum Mesozoa.

Systematics, morphology and biology of Arthropods (Causing or responsible for transmission of disease). Chemical and non-chemical control of Arthropods of Medical and Veterinary importance.

Pathology of Helminths: Host parasite relationships and control of parasitic Helminths with particular reference to Helminths of Medical and Veterinary importance.

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. FOUNDATION OF PARASITOLOGY, 6th Edition. 2000. McGraw Hill Book Co.
2. Hausman, K. and Hulsmann, N. T. PROTOZOOLOGY, 2nd Edition. 1996. Medical Publishers, Inc. New York.
3. Noble, E.R. and Noble, G.A. PARASITOLOGY. THE BIOLOGY OF ANIMAL PARASITES. 5th Edition. 1982. Lea and Febiger Publisher.
4. Beck, J.W. and Davies, J.E. MEDICAL PARASITOLOGY. 3rd Edition. 1981. C.V. Mosby Company, Toronto, London.
5. Cheesbrough, M. MEDICAL LABORATORY MANUAL FOR TROPICAL MEDICINE. Vol.I. 1987. University Press Cambridge.
6. Smyth, J.D. INTRODUCTION TO ANIMAL PARASITOLOGY. 1994. Cambridge University Press.
7. Roberts, L.S. and Janovy, J. Jr. FOUNDATIONS OF PARASITOLOGY. 7th Edition. 2005.

W.M. Brown Publishers, Chicago, London, Tokyo, Toronto.
8. Beck, J.W. and Davies, J.E. MEDICAL PARASITOLOGY. 3rd Edition. 1981. C.V. Mosby Company, Toronto, London.
9. Cheesbrough, M. MEDICAL LABORATORY MANUAL FOR TROPICAL MEDICINE. Vol.I. 1987. University Press Cambridge.
10. Smyth, J.D. INTRODUCTION TO ANIMAL PARASITOLOGY. 1994. Cambridge University Press.
11. Roberts, L.S. and Janovy, J. Jr. FOUNDATIONS OF PARASITOLOGY. 7th Edition. 2005. Wm Brown Publishers, USA.
12. Urquhart, G.M., Hucan, J.L., Dunn, A.M. and Jennings, F.W. VETERINARY PARASITOLOGY. 2000. Longman Scientific and Technical publications, Longman Group, UK.

Course Name: Biotechnology	**Course Code:** ZG-675
Course Structure: Lectures: 3, Lab: 0	**Credit Hours:** 3
Prerequisites: None	

Course Objectives

To acquaint students with the basic concepts and significance of biotechnology as it stands today.

Course Contents

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

NOTE: The course has been taken from "CURRICULUM OF BIOTECHNOLOGY BS (4 Years)/MS & MPhil (2013)", Higher Education Commission, H-9, Islamabad.

Books Recommended

1. Daugherty E, 2012. Biotechnology: Science for the New Milenium. 1st Editon, Revised; Paradigm Publication.
2. Smith JE, 209. Biotechnology. 5th Editon; Cambridge University Pres.
3. Nichol TSD, 204. An Introduction to Genetic Enginering. 2nd Editon; Cambridge University Pres, UK.
4. Purohit SS, 205. Biotechnology Fundamentals & Aplication. 4th Editon; Agro Bios, India.
5. Ratlegde C and Kristiansen B, 206. Basic Biotechnology. 2nd Editon; Cambridge University Pres, UK.
6. Thomas JA and Fuchs RL, 202. Biotechnology and Safety Asesment. 3rd Editon; Academic Pres, UK.

SHAHEED BENAZIR BHUTTO WOMEN UNIVERSITY PESHAWAR
DEPARTMENT OF ZOOLOGY

DETAILED COURSE OUTLINE OF BS ZOOLOGY (SESSION: 2012-2016, 2013-2017, 2014-2018 AND 2015-2019)

SEMESTER-VIII

Course Name: Physiology of Coordination	**Course Code:** ZG-681
Course Structure: Lectures: 2, Lab: 1	**Credit Hours:** 3
Prerequisites: None	

Aims and Objectives:

a. To study the details of nervous and hormonal coordination at molecular and cellular level in animals.
b. Biosynthetics, secretary and regulatory aspects of coordination.

Course Contents

Physiological Mechanisms at Cell: Cellular membrane and transmembrane transport; resting membrane potentials; Generation and conduction of action potentials; synaptic transmission; Membrane receptors, Second messenger and signal-transduction pathways.

Nervous System: Organization of nervous system; General sensory system; Visual, Auditory, Vestibular and Chemical sensory system; Motor system with brainstem, Cortical, Cerebellar and basal ganglia control of posture and movements; Autonomic system and its control; Higher functions of nervous system including state of consciousness, learning, memory.

Muscle and Movements: Molecular basis of contraction; Muscles activity on skeleton; Adaptation of muscles for various activities; Muscles in the walls of hollow organs.

Endocrine System: General principles of endocrine physiology; Hormones in homeostasis of metabolism; Endocrine regulation of metabolism of calcium and phosphate; Parathyroid gland, Calcitonin and Cholecalciferol; Hypothalamus and Pituitary: Hypothalamic regulation of pituitary, pituitary gland hormone in physiological coordination; Thyroid gland: Functional anatomy, biosynthesis, regulation and roles in physiological functions, mechanism of thyroid hormones action; Adrenal cortex: Hormones biosynthesis, physiological roles and control; Adrenal medulla: Hormones biosynthesis, physiological roles, and hypothalamic-pituitary-adrenocortical axis, adrenal medulla and sympathetic nervous system together integrate responses to stress; Endocrine function of kidney, heart and pineal gland; General reproductive mechanisms: Energetics of reproduction; Functional anatomy, synthesis and regulation of gonadal steroids, secretary pattern of gonadal steroid at different stage of life; Male reproduction: Roles of androgen, biology and regulation of spermatogenesis, male puberty; Female reproduction: Roles of ovarian steroids, biology and regulation of oogenesis, female puberty, cyclic changes and adaptations in gestation, parturition, lactation and menopause.

Practicals

Recording of action potentials on oscilloscope and effects of various factors on its characters; Study of synaptic activity with neuromuscular preparations; Sciatic nerve compound action potential. Demonstration of nervous system organization while studying brain, cranial nerve, spinal cord and spinal nerves. Experiments on sensory organs study. Experiments on characteristics of skeletal muscle contractions; Responses of intestinal muscles and effect of drugs. Demonstration of endocrine glands in a mammal

(mouse). Effect of hormones on glycemia and calcemia; Effect of thyroxine on oxygen consumption; Effect of androgen on accessory sex organs and of estrogens on target tissues; Study of estrous cycle and effects of the hormones.

Books Recommended

1. Randall, D., Burggren, W., French, K. and Fernald, R. ECKERT ANIMAL PHYSIOLOGY: Mechanisms and Adaptations, 5th Edition. 2002. W.H. Freeman and Company, New York
2. Bullock, J., Boyle, J. and Wang, M.B. PHYSIOLOGY, 4th Edition. 2001. Lippincott, Williams and Wilkins, Philadelphia.
3. Berne, R.M. and Levy, M.N. PRINCIPLES OF PHYSIOLOGY, 3rd Edition. 2000. St. Lious, Mosby.
4. Guyton, A.C. and Hall, J.E. TEXTBOOK OF MEDICAL PHYSIOLOGY, 10th Edition. 2000. W.B. Saunders Company, Philadelphia.
5. Withers, P.C. COMPARATIVE ANIMAL PHYSIOLOGY. 1992. Saunders College Publishing, Philadelphia.
6. Schmidt-Nelsen, K. ANIMAL PHYSIOLOGY: ADAPTATION AND ENVIRONMENT, 5th Edition. 1997. Cambridge University Press, Cambridge.
7. Tharp, G. and Woodman, D. EXPERIMENTS IN PHYSIOLOGY, 8th Edition. 2002. Prentice Hall, London.

Course Name: Cancer Biology	**Course Code:** ZG-682
Course Structure: Lectures: 3, Lab: 0	**Credit Hours:** 3

Prerequisites: None

Course Objectives

This course will teach the students to be conversant on issues related to cancer, its etiology, development, carcinogenic agents, treatment and prevention. The main aim and objective of this course is to educate the students on various genetic and molecular changes in normal cells that undergo during transformation into malignant cells.

Course Outlines

Cell cycle, Check Points, M.Phase Kinase, Regulatory activities in S and M. Phase (Heterokaryon experiments), Oncogenes: Growth factors, Receptors, Signal Transducer, Transcriptional Factors and Cell Cycle Genes. Tumor Suppressing genes: (Rb and P53 etc.), Tumor inducing DNA Virus, Tumor inducing RNA Virus, Human Colon Cancer, Breast Cancer, cervical Cancer, Lung cancer, Hepatic carcinoma, Cancer Epidemiology and Prevention, Risk factors and Carcinogenic agent: Chemicals and Radiations, Tumor Invasion and Metastasis, Role of Nutrients, Hormones and Gene Interaction in Carcinogenesis, Cancer Therapy.

PRACTICAL (if lab facilities available)

Heterokaryon experiments; study of DNA damage by physical and chemical methods; Ames test for identification of mutagenic agent; case study of chromosomal abnormalities in human and agricultural specimen.

NOTE: The course has been taken from "CURRICULUM OF BIOCHEMISTRY (BS/MS) (Revised 2013)", Higher Education Commission, H-9, Islamabad.

Books Recommended

1. The Biology of Cancer by Robert A Weinberg.
2. Cancer Biology by Raymond W. Rudon, latest editon, Oxford University Press.
3. Wintrobe's Clinical Haematology by Maxwel, M. Wintrobe, G. Richard Le, Wiliams and Wilking Publishers, New York.

Course Name: Clinical Biochemistry	**Course Code:** ZG-683
Course Structure: Lectures: 2, Lab: 1	**Credit Hours:** 3
Prerequisites: None	

Course Objectives

Provide students with advanced understanding and applied knowledge in the theory and practice of Clinical Biochemistry and equip them with a critical understanding of how biochemical investigations are employed to develop a clinical diagnosis. Emphasis will also be placed on understanding the biochemical basis of human disease.

Course Contents

Diagnostically important Plasma Enzymes & Proteins: Identification and treatment of enzyme deficiencies, Assessment of cell damage, Factors affecting results of plasma enzyme assays. Abnormal plasma enzymes activities: isoenzymes in plasma (lactate dehydrogenase, creatine kinase, Amylase): Abnormalities of proteins in plasma: immunoglobins deficiencies, Disorders of carbohydrate metabolisms and Clinical correlations: Diabetes mellitus, Fructose intolerance, Lactic acidosis, Hypoglycemia, Galactosaemia; Glycogen storage Diseases (enzyme defect in different forms of glycogen storage diseases); Disorders of Lipid Metabolism (lipoproteins, classification of lipoproteins, hyperlipidemia, cholesterol and cardiovascular diseases); Disorders of purine and pyrimidine metabolism (Gout, Arthrits); Metabolic Bone Diseases (Calcium balance, Biological functions of calcium, phosphate and magnesium metabolism); Liver Diseases (cirrhosis', specific liver diseases); Hemoglobinopathies, Disorders of Iron and porphyrin metabolism. Cancer and its consequences- tumor progresion, tumor markers, oncogenes, local efects of tumor, cancer cachexia, Ectopic hormone production, consequences of cancer treatment.

PRACTICAL

Phelobotmy (blood sampling), serum/plasma isolation procedure, Complete blood count, isolation of tissues samples and storage; Total protein determination in serum and plasma; Blod glucose test, Glucose tolerance test for diabetes mellitus, Glycation (HbA1c); Liver function tests, Renal Function tests, Cardiac enzymes, Albumin determination; Determination of lipid profile, serum and urine electrolytes.

NOTE: The course has been taken from "CURRICULUM OF BIOCHEMISTRY (BS/MS) (Revised 2013)", Higher Education Commission, H-9, Islamabad.

Books Recommended

1. Clinical Chemistry: Principles, Procedures, Corelations by Michael L. Bishop, Edward P. Fody, Lary E. Schoef Publisher: Lipincot Wiliams & Wilkins; 5th Edition (July 6, 2004)
2. Tietz Fundamentals of Clinical Chemistry by Carl A. Burtis, Edward R. Ashwod. Publisher: W.B. Saunders Company; 5th Edition (January 15, 2001).
3. Lecture Notes on Clinical Biochemistry, Alistaire F Smith, Geofrey Becket, Simon Walker, Peter Rae 6th Edition, John Wiley & Sons, 1998.

Course Name: Environmental Pollution	**Course Code:** ZG-684

Course Structure: Lectures: 3, Lab: 0	**Credit Hours:** 3
Prerequisites: None	

Course Objectives

The course is focused on introducing environmental pollution and its sources. It will also cover the existing laws related to pollutants in Pakistan and the conventions ratified internationally.

Course Outline

Environmental Pollution, sources, types and causes. Types of pollutants: Physical, chemical and biological; Characteristics of domestic & industrial effluents; Effects of Pollutants on human & other living organisms; Industrial and Municipal Solid Waste. Principles of Waste Management & Disposal; Fate of pollutants; Factors affecting movement of pollutants in soil, air and water. Monitoring of Environmental Pollution; Pollution Control Strategies; Environmental Laws: Pollutants Guidelines; International Protocols; Case Studies.

NOTE: The course has been taken from "CURRICULUM OF ENVIRONMENTAL SCIENCE BS/MS (Revised 2013)", Higher Education Commission, H-9, Islamabad.

Books Recommended

1. Understanding Environmental Pollution, Hil, M.K., 2nd Edition. Cambridge University Press, Cambridge UK, 2005.
2. Environment Pollution: Types, Sources & Management. Ghafoor, A., G. Murtaza, M.Z. Rehman, M. Sabir, H.R. Ahmad and Saifulah. Allied Book Centre, Lahore, Pakistan. 2012.

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