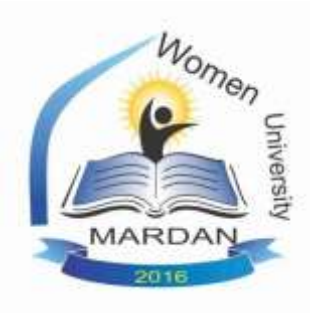
Proposed Curriculum
BS Zoology

(Policy -2023)



DEPARTMENT OF ZOOLGOGY
WOMEN UNIVERSITY MARDAN

WOMEN UNIVERSITY MARDAN
Department of Zoology

Undergraduate Scheme of Studies (New Policy-2023)

1st Year

Semester-I				
Course Code	**Course Name**	**Credit Hours**	**General Education Course /Major/Interdisciplinary**	**Marks**
BBA-322	Entrepreneurship	02	General Education Course	
SOC-301	Introduction to Sociology	02	General Education Course	
ENG-301	Functional English	03	General Education Course	
ISL-301	Islamic Studies	02	General Education Course	
PSC-301	Civic and Community Engagement	02	General Education Course	
ZOO-311	Principles of Animal Life-I	3(2-1)	Major Disciplinary Specific	
CHEM-311	Inorganic Chemistry	3(2-1)	Interdisciplinary	
Semester Credit Hours		**17**		
Semester-II				
CS-301	Application of Information and Communication Technology	3(2+1)	General Education Course	
ENG-302	Expository Writing	03	General Education Course	
ISL-302	History of Islamic Civilization	02	General Education Course	
PSC-302	Ideology and Constitution of Pakistan	02	General Education Course	
MTH-433	Quantitative Reasoning – I Exploring Quantitative skill	03	General Education Course	
ZOO-321	Principles of Animal Life-II	3(2-1)	Major Disciplinary Specific	
Semester Credit Hours		**16**		

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2nd Year

Semester-III				
Course Code	**Course Name**	**Credit Hours**	**General Education Course /Major/Interdisciplinary**	**Marks**
MTH-444	Quantitative Reasoning – II Tools for Quantitative Reasoning	03	General Education Course	
BOT-311	Diversity of Plants	3(2-~~+~~1)	General Education Course	
ZOO-432	Animal Diversity-I (Invertebrates)	3(2-1)	Major Disciplinary Specific	
ZOO-433	Animal Form & Function-I	3 (2-1)	Major Disciplinary Specific	
CHEM-321	Organic Chemistry	3(2-1)	Interdisciplinary	
Semester Credit Hours		**15**		
Semester-IV				
MBIO-314	Introduction to Microbiology	3(2-1)	Interdisciplinary	
BIOT-321	Introduction to Biotechnology	3~~(2-1)~~	Interdisciplinary	
ZOO-441	Animal Diversity-II (Chordates)	3(2-1)	Major Disciplinary Specific	
ZOO-442	Animal Form & Function-II	3(2-1)	Major Disciplinary Specific	
ZOO-443	Physiology-I	3(2-1)	Major Disciplinary Specific	
Semester Credit Hours		**15**		

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3rd Year

Semester-V				
Course Code	**Course Name**	**Credit Hours**	**General Education Course /Major/Interdisciplinary**	**Marks**
BOT-699	Plant Anatomy	3(2-1)	Interdisciplinary	
ZOO-551	Cell & Molecular Biology	3(2-1)	Major Disciplinary Specific	
ZOO-552	Physiology - II	3(2-1)	Major Disciplinary Specific	
ZOO-553	Genetics	3(2-1)	Major Disciplinary Specific	
ZOO-554	Wild Life	3(2-1)	Major Disciplinary Specific	
Semester Credit Hours		**15**		
Semester-VI				
ZOO-561	Entomology	3(2-1)	Major Disciplinary Specific	
ZOO-562	Parasitology	3(2-1)	Major Disciplinary Specific	
ZOO-563	Bioinformatics	3(2-1)	Major Disciplinary Specific	
ZOO-564	Fish Biology	3(2-1)	Major Disciplinary Specific	
ZOO-565	Research Methodology	03	Major Disciplinary Specific	
Semester Credit Hours		**15**		

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4th Year

Semester-VII				
Course Code	**Course Name**	**Credit Hours**	**General Education Course /Major/Interdisciplinary**	**Marks**
ZOO-671	Developmental Biology	3(2-1)	Major Disciplinary Specific	
ZOO-672	Techniques in Zoology	3(2-1)	Major Disciplinary Specific	
ZOO-673	Immunology	3(2-1)	Major Disciplinary Specific	
ZOO-674	Histology	3(2-1)	Major Disciplinary Specific	
ZOO-675	Field Experience	03		
Semester Credit Hours		**15**		
Semester-VIII				
ZOO-681	Animal Behavior	3(2-1)	Major Disciplinary Specific	
ZOO-682	Evolution & Principles of Systematics	3(2-1)	Major Disciplinary Specific	
ZOO-683	Zoogeography & Paleontology	3(2-1)	Major Disciplinary Specific	
ZOO-684	Fundamentals of Endocrinology	3(2-1)	Major Disciplinary Specific	
ZOO-685	Capstone Project	03	Major	
Semester Credit Hours		**15**		
Total Credit Hours		**123**		

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Course Breakdown

1st Semester

Semester-I				
Course Code	**Course Name**	**Credit Hours**	**General Education Course /Major/Interdisciplinary**	**Marks**
BBA-322	Entrepreneurship	02	General Education Course	
SOC-301	Introduction to Sociology	02	General Education Course	
ENG-301	Functional English	03	General Education Course	
ISL-301	Islamic Studies	02	General Education Course	
PSC-301	Civic and Community Engagement	02	General Education Course	
ZOO-311	Principles of Animal Life-I	3 (2-1)	Major Disciplinary Specific	
CHEM-311	Inorganic Chemistry	3 (2-1)	Interdisciplinary	
Semester Credit Hours		**17**		

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1st Semester

BBA-322 **Entrepreneurship** **Cr. Hrs. 02**

COURSE OBJECTIVE

With more than half of the new jobs being created in the world economy by small businesses, the particular problems and experiences encountered in starting and developing new enterprises are clearly worth studying. This course of Entrepreneurship has been designed to provide the participants with an overall understanding of the concept of entrepreneurship and small business management. Participants will be prepared to start, survive, and succeed in their own businesses.

COURSE CONTENT

- Entrepreneurship: an evolving concept
- Entrepreneurship – a perspective
- The Role of Entrepreneurship
- Kinds of Entrepreneurs
- Role and Functions of Entrepreneurs
- Understanding strategic issues in business plan development
- Pitfalls in selecting new ventures
- Innovation: the creative pursuit of ideas
- Opportunity identification: the search for new ideas
- Reason for failures of new ventures
- Legal challenges for entrepreneurial ventures
- Sources of capital for entrepreneurial ventures
- Assessment of entrepreneurial plan
- Marketing challenges for entrepreneurial ventures
- Developing an effective business plan
- Strategic entrepreneurial growth

Recommended Books:

- Small Business Management:Entrepreneurship and Beyond, Timothy S. Hatten.South-Western, Cengage Learning
- Norman M. Scarborough., Essentials of Entrepreneurship and Small Business Management.Pearson Education
- Donald F. Koratko , Entrepreneurship –Theory Process Practice (10th Edition), South Western -Cengage Learning.
- David L. Kurtz& Louis E. Boone, Contemporary Business (latest edition).
- Philip Kotler &Gary Armstrong, Principles of marketing (latest edition).
- Any Other Resources such as: Internet and Resource Notes and Modules
    - Local and international newspapers and financial journals

SOC-301 **Introduction to Sociology** **Cr. Hrs. 023**

Aims and Objectives

The course is designed to introduce the students with sociological concepts and the discipline. The focus of the course shall be on significant concepts like social systems and structures, socio-economic changes and social processes.

Introduction to Sociology

- Definition

- Scope of Sociology,
- Sociology as Science,
- Relationship of Sociology with other Social Sciences

Society

- Meaning and Definition of Society
- Characteristics of Society
- Types of Society
- Basis of Society

The Culture

- Definition of Culture
- Types of Culture
- Culture and Society
- Social and Cultural Change Characteristics of Culture

Social Stratification

- Definition of Social Stratification
- Types of Social Stratification
- Theories of Stratification

Social Groups

- Definition and Functions,
- Types of Groups
- Formal and Informal Groups and Pressure Groups

Social Mobility

- Definition of Mobility
- Types of Mobility
- Horizontal Mobility
- Vertical Mobility
- Zero Mobility
- Territorial Mobility/ Geographical
- Social Mobility
- Different Factor Favorable to Social Mobility

Family Institution

- Definition of Family
- Characteristics of Family
- Types/Classification of Families
- Functions of Family Institution

Religious Institutions

- Definition, Components of Religion, Beliefs, Symbols, Rituals,
- Sacred Objects, Functions of Religion,
- Religion of the World, Christianity, Judaism, Hinduism, Buddhism, Confucianism, Islam

Educational and Political institutions

- Social Functions of Education
- Education and Social Change
- Democracy & Dictatorship
- The welfare state

Recommended Books

1. Rao, C.N.S., SOCIOLOGY: Principles of Sociology with an Introduction to Social Thought, 7th revised edition
2. Paul B. Horton. and Chester L. Hunt. SOCIOLOGY-. 6th Edition
3. DOWN TO EARTH SOCIOLOGY- James Henslin

ENG-301 Functional English-I Cr. Hrs. 03

Course Description:

This course introduces the students with the basic grammatical / structural rules of English Language. It will help the students in improving their basic Language Skills to an optimum level so as to enable them to communicate effectively in English language through proper usage of vocabulary & knowledge of English grammar.

Outcomes:

1. Students will be familiarized with the technical methods of reading / comprehension.
2. They will be exposed to different reading materials, which will help them in improving their vocabulary, grammar and sentence structure etc.
3. The experience of this course will also help them to overcome those problems due to which they are unable to express themselves properly Parts of Speech

Course Contents:

- Vocabulary (Frequently confused / misused words,
- Phrases,
- synonyms,
- antonyms,
- idioms & General vocabulary),
- Practical Use of Grammar (Nouns, Pronouns, Verbs, Adjectives, Adverbs, Prepositions, Conjunctions, Articles, Interjections & Tenses),
- Sentences (Types of sentences, Parts of sentences),
- Direct and Indirect Speech,

- Active & Passive Voice & Conditional Sentences),

Recommended Reading:

1. High School English Grammar & Composition by Wren and Martin.
2. Practical English Grammar by A.J. Thomson &A.V. Martinet. Exercises 1 & 2. 3rdedition. Oxford University Press.
3. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand& Francoise Grellet. Oxford Supplementary Skills. 4thImpression 1993.4.Reading. Upper Intermediate. Brian Tomilson & Rod Ellis. Oxford Supplementary Skills. 3rdImpression 1992.
4. Précis writing by R. Dhillon.
5. Systems Student Companion English for lower secondary schools by Magdalene Chew &Surinder Kaur.

ISL- 301 Islamic Studies Cr. Hrs. 02

Aims and Objectives

The course is aimed

- To learn about Islam and its application in day to day life.
- To provide basic information about Islamic studies.
- To improve students skill to perform prayers and other worships.
- To enhance the skills of the students for understanding of issues related to faith andreligious life.

Course outline

- Holy Quran
- Sunnah
- Fundamentals Doctrine of Islam
- Life of Holy Prophet
- Islamic Economic system
- Islam and science
- Political system of Islam
- Social System of Islam
- Introduction to Islamic law and jurisprudence
- Islamic culture and civilization

Recommended Books

1. Hafiz Ahmed Yar, Madhamin.e.Quran
2. Prof. Arif Naseem, Islamiat for degree classes.
3. Hameed Ullah Muhammad, Introduction of Islam.
4. Islamiat, Compulsory for degree classes Published by Allama Iqbal University.
5. Syed Suleman Nadvi, Nabi Rehmat (P.B.U.H).

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PSC-301 Civic and Community Engagement Cr. Hrs 02

Learning Outcomes:

- Understand, critically think about, and reflect upon the history of democracy and civic engagement in the Pakistan.
- Identify and utilize - civic/community engagement skills such as: (advocacy, organizing, communications) and knowledge- (working in groups and teams, leadership, diversity, how systems work)
- Create civic sense and establish importance of civic and community engagement.
- Identify and explain the values and ethics for community engagement.
- Carry out a civic engagement activity incorporating some of their new knowledge and skills of civic engagement and reflect on their learning about the community, the issue addressed, and about themselves.

Course Contents-

Divided into categories for in-depth comprehension-

Category A: General

- The historical background of civic and community engagement
- Conceptual understanding of Human Rights and Minority Rights
- Dimensions of Citizens engagement in Community: Political, Social, Economic
- Rights and duties of Citizens in Community
- Organizations (National & International) and Groups
- Role of non-governmental organizations and their contributions
- NGOs: Nature and Scope
- International Commission for Red Cross (ICRC)
- Amnesty International
- Asia Watch

Category B: Pakistan's context

- Role of Citizens in Governance of Pakistan
- Democratic Accountability and Civic Engagement
- Enhancement of leadership skills among women and youth of Pakistan through civic community engagement programs

Recommended Books

1. Hoefer, R. (2012). Advocacy
2. for Practice. 3rd Edition. Chicago, IL: Lyceum Books, Inc. (ISBN-13: 978-1935871828)
3. Putnam, R. and Feldstein, L (2003). Better Together. New York, NY: Simon and Schuster. (ISBN-13: 978-0743235471
4. Civic Engagement—What Is It and Why Is It Important? Kerry J. Kennedy
5. Universal Human Rights in Theory and Practice by Jack Donnelly
6. Adamantia Pollis and Peter Schwab, Human Rights Cultural and Ideological Perspectives. Preager Publishers, Preager Publishers, London, 1980.
7. Promoting and Protecting Minority Rights- A Guide for Advocates by United Nations.
8. Human Rights in International Law, Council of Europe press, 1992.

9. United Nations, Human Rights Status of International Instruments, United Nations, Baltimore, New York, 1987.

ZOO-311 Principles of Animal Life-I Cr. Hrs. 3 (2-1)

Aims and Objectives

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

Course outline

Scope of Zoology:
•Introduction; significance and applications of zoology
•The Chemical Basis of Animal Life: Brief introduction to biomolecules; carbohydrates, lipids, proteins, and nucleic acids.

Cellular Organization:
•Structure of animal cells
•Cell and its organelles
•Animal tissues: epithelial, connective, muscle and nervous tissue; organs and organ systems.

Enzymes:
•Structure
•Types
•Function
•Factors affecting their activity
•Cofactors and coenzymes.

Energy Harvesting:
•Aerobic and anaerobic respiration: glycolysis, citric acid cycle and electron transport chain; fermentation, the major source of ATP.
•Reproduction and Development: Types; asexual and sexual, gametogenesis, fertilization, metamorphosis, zygote and early development.

Ecological Concepts:
•Ecosystem
•Types
•Homeostasis
•Biomes
•Energy flow and thermodynamics
•Biogeochemical cycles and limiting factors
•Populations and communities.

Practical
•Tests for different carbohydrates, proteins and lipids.
•Study of the prepared slides of epithelial tissue (squamous, cuboidal, columnar), connective tissue (adipose, cartilage, bone, blood), nervous tissue and muscle tissue (skeletal, smooth and cardiac).

Recommended Books

1.Miller, S.A. and Harley, J.B. 2005. Zoology, 6th Ed. (International), Singapore: McGraw-Hill.
2.Molles, M.C. 2005. Ecology: Concepts and Applications. 6th Ed. McGraw Hill, New York,

USA.
3.Hickman, C.P., Roberts, L.S. and Larson, A. 2004. Integrated Principles of Zoology, 12th Ed. (International), Singapore: McGraw Hill.
4.Campbell, N.A. 2002. Biology. 6th Ed. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.
5.Miller, S.A. 2002. General Zoology Laboratory Manual. 5th Ed. (International), Singapore: McGraw Hill.
6.Hickman, C.P. and Kats, H.L. 2000. Laboratory Studies in Integrated Principles of Zoology. Singapore: McGraw Hill.

CHEM-311 Inorganic Chemistry Cr. Hrs. 3 (2-1)

Aims and Objectives

The course is aimed:

To provide knowledge about the key introductory concepts of chemical bonding, acid- base chemistry, and properties of p-block elements as well as using this knowledge for qualitative and quantitative analysis of inorganic compounds during laboratory work

Course outline

Chemical Bonding:

- Types of chemical bonding
- Theories of chemical bonding.

Acids and Bases:

- Brief concepts of chemical equilibrium
- Acids and bases including soft and hard acids and bases (SHAB)
- Concept of 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.

p-Block Elements:

- Physical and chemical properties of p-block elements with emphasis on some representative compounds
- Inter-halogens, pseudo-halogens and polyhalides

Practical

- Lab safety and good laboratory practices
- Qualitative analysis of salt mixtures
- Acid- base titrations
- Preparation and standardization of acid and alkali solutions

- Gravimetric analysis, determination of barium in a given sample, determination of chloride in a given solution.

Recommended Books

1. Cotton, F. A. and Wilkinson, G., Advanced Inorganic Chemistry, 6th ed., John-Wiley& Sons, New York, (2007).
2. Huheey, J. E., Inorganic Chemistry: Principles of Structure and Reactivity, 3rd ed., Harper International SI Edition, (2006).
3. House, J. E., Inorganic Chemistry, Academic Press. USA, (2008).
4. Kathleen A. H., James E. H., Descriptive Inorganic Chemistry, 2nd ed., Brooks Cole, (2010).
5. Chaudhary S. U., Ilmi Textbook of Inorganic Chemistry, Ilmi Kitab Khana, Lahore, (2013).
6. Hill, R. H. JR and Fister, D. C., Laboratory Safety for Chemistry Students, John-Wiley & Sons, Inc., (2010).

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Course Breakdown

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Department of Zoology

2nd Semester

Semester-II				
CS-301	Application of Information and Communication Technology	3(2-1)	General Education Course	
ENG-302	Expository Writing	03	General Education Course	
ISL-302	History of Islamic Civilization	02	General Education Course	
PSC-302	Ideology and Constitution of Pakistan	02	General Education Course	
MTH-433	Quantitative Reasoning – I Exploring Quantitative skill	03	General Education Course	
ZOO-321	Principles of Animal Life-II	3(2-1)	Major Disciplinary Specific	
Semester Credit Hours		**16**		

2nd Semester

CS-301 Introduction to Information & Communication Technologies Cr. Hrs: 3 (2-1)

Pre-requisites: None

Course Introduction:

This is an introductory course in Computer Science designed for beginners. Apart from leading the participants through a whirlwind history of computing, the course also develops a feel for web programming through a series of lectures that help the students develop their own web page. Main objective of the course is to build an appreciation for the fundamental concepts in computing and to become familiar with popular PC productivity software.

CLO No. Course Learning Outcomes Bloom Taxonomy

CLO-1 Understand basics of computing technology C1 (Knowledge)
CLO-2 Do number systems conversions and arithmetic C2(Understand)
CLO-3 Have knowledge of types of software C2(Understand)
CLO-4 Have knowledge of computing related technologies C3 (Apply)

Course Outline:

Brief history of Computer, Four Stages of History, Computer Elements, Processor, Memory, Hardware, Software, Application Software its uses and Limitations, System Software its Importance and its Types, Types of Computer (Super, Mainframe, Mini and Micro Computer), Introduction to CBIS (Computer Based Information System), Methods of Input and Processing, Class2. Organizing Computer Facility, Centralized Computing Facility, Distributed Computing Facility, Decentralized Computing Facility, Input Devices. Keyboard and its Types, Terminal (Dump, Smart, Intelligent), Dedicated Data Entry, SDA (Source Data Automation), Pointing Devices, Voice Input, Output Devices. Soft- Hard Copies, Monitors and its Types, Printers and its Types, Plotters, Computer Virus and its Forms, Storage Units, Primary and Secondary Memories, RAM and its Types, Cache, Hard Disks, Working of Hard Disk, Diskettes, RAID, Optical Disk Storages (DVD, CD ROM), Magnetic Types, Backup System, Data Communications, Data Communication Model, Data Transmission, Digital and Analog Transmission, Modems, Asynchronous and Synchronous Transmission, Simplex. Half Duplex, Full Duplex Transmission, Communications, Medias (Cables, Wireless), Protocols, Network Topologies (Star, Bus, Ring), LAN, LAN, Internet, A Brief History, Birthplace of ARPA Net, Web Link, Browser, Internet Services provider and Online Services Providers, Function and Features of Browser, Search Engines, Some Common Services available on Internet.

Reference Materials:

1. Charles S. Parker, Understanding Computers: Today and Tomorrow, Course Technology, 25 Thomson Place, Boston, Massachusetts 02210, USA
2. Livesley, Robert Kenneth. An introduction to automatic digital computers. Cambridge University Press, 2017.
3. Zawacki-Richter, Olaf, and Colin Latchem. "Exploring four decades of research in Computers & Education." Computers & Education 122 (2018): 136-152.
4. Sinha, Pradeep K., and Priti Sinha. Computer fundamentals. BPB publications, 2010.
5. Goel, Anita. Computer fundamentals. Pearson Education India, 2010

ENG-302 **Expository Writing** **Cr. Hrs 03**

Course Description:

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

Outcomes:

1. Students will be familiarized with basic sources and methods of research and documentation on topics including on-line research.
2. They will be able to synthesize and integrate material from primary and secondary sources wedded to their own ideas in research papers.

Course Contents:

- Topic sentence
- Paragraph writing:
- Essay writing:
  - Introduction and Practice: Essay types: descriptive, narrative, discursive, argumentative.
- CV and job application
- Letter and memo writing
- Minutes of meetings
- Summary and précis writing
- Comprehension

Recommended Reading:

1. Boutin, M.,& Brinand,S.,& Grellet, F. (1993). Oxford Supplementary Skills. Fourth Impression. Pages 45-53.
2. Nolasco, R. (1992). Oxford Supplementary Skills (3rd ed.). Fourth Impression.
3. Langan, J. (2004). *College Writing Skills*. Mc-Graw-Hill Higher Education.

ISL-302 History of Islamic Civilization Cr. Hrs. 02

Objectives:

This course intends to explain the definition of Islamic Culture & Civilization and Analysis of the Rise and Fall of Islamic Culture in various parts of the World. It also emphasizes on critical study of the effect and benefits of Islamic Civilization on other Cultures

Course Outline:

- Introduction to civilization-1: Introduction of Civilization, Foundation of Civilization, Elements of Civilization.
- Important Civilization in the Pre-Islamic Era: Greek Civilization, Roman Civilization, Egypt Civilization, Hindu Civilization
- Principles of Islamic Civilization Pillars of Culture & Civilization
- Foundations of Islamic Civilization in the Era of the Prophet (SAW) and the Caliphates: Reasons for the evolution of Islamic Civilization in the Era of the Prophet (SAW), Islamic Civilization in the Era of the Caliphates, Elements of Islamic Civilization in the era of Caliphates, Islamic Civilization in the era of Banu Ummayads- 1, Introduction of Banu Ummayads, Intellectual development among the Banu Ummayads, Educational Centers for the Banu Ummayads.
- Islamic Civilization in the era of Banu Ummayads- 2: Social developments of the Banu Ummayads, Causes of the civilization development of the Banu Ummayads, Results of the civilization development of the Banu Ummayads.
- Islamic Civilization in the era of Banu Ummayads- 3: Battles of Crusades, Battlers of Tartarians, The Causes of the fall of the Abbasids and its Effects on Islamic Civilization
- Islamic Civilization in Spain: Causes of the spread of Islamic civilization in Spain, Manifestations of Islamic civilization in Spain, Influence of Islamic civilization in Spain on European civilization
- Islamic Culture and Civilization in the Sub-Continent: Islamic civilization achievements in the Sub-Continent, Reasons for the spread of Islamic cultural in Sub-Content, The effects of the publication of Islamic civilization in the Sub-content on other civilization.

Recommended Book List

1. Muslim History and Civilization by Ehsan ul Karim
2. Islamic Religion History and Civilization, Seyyed Hossein Nasr
3. Tareekh-e-Islam Shah Nadvu Moin-ud-din
4. Islamic History by Dr. Kabeer Ali
5. An Atlas of Islamic History, H.W.Hazard
6. A Short History of Islam, S.F.Mehmood

7. تاریخ تمدن اسلامی، شاہ معین الدین ندوی
8. تاریخ اسلام، اکبر شاہ نجیب آبادی

PSC-302 Ideology and Constitutional Development of Pakistan Cr. Hrs. 2(2+0)

Learning Objectives

- To develop critical thinking for understanding Constitutional development in Pakistan;
- To develop understanding of the legal and constitutional structure of the state;
- To develop comprehension of the interconnectivity between the Constitutional provisions and political practice;
- To develop the understanding of students regarding ideological basis of Pakistan as well as role of ideology in building national character.

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Contents of the Course

Course is divided into two sections to cover the maximum portion of the course.

Section A: Ideological understanding and development of Pakistan

1. Basis of Ideology of Pakistan and Two Nations Theory
2. Ideology of Pakistan: Vision of Quaide e Azam and Allama Iqbal
3. Role of ideology in building national character
4. Democratic system of Pakistan (Issues)
5. Major causes of the Imposition of martial Law (1958, 1969, 1977&1999).

Section B: Constitutional Development of Pakistan

6. Pakistan's Constitutional Development from 1947 onward.
7. An Overview of the Constitution of Pakistan (Features of 1973 Constitution).
8. Basic Concepts—Federalism and the 1973 Constitution.
9. Islam and the Constitution of Pakistan -1973.
10. Constitutional Amendments and Reforms- 1973.

Recommended Books:

Students are advised to take notes during lectures. Certain books have been recommended for reference and quality of analysis.

- Constitution of Pakistan
- The Constitutional History of Pakistan—1947-2012, Malik Muhammad Owais Khalid, 2012
- Constitutional History and Political Development, Hamid Khan, 2005
- Constitutional Development in Pakistan, G.W. Chaudhary
- Constitution Making in Pakistan 1947-85, Dr. Baz Muhammad
- Allen Gledhill, Pakistan: The Development of its Laws and Constitution
- "Military, State and Society in Pakistan" by Hasan Askari Rizvi, 2000.
- Kazmi, Raza, Pakistan Studies, Karachi Oxford University Press.
- Qureshi, I. H., A Short History of Pakistan, University of Karachi Press.
- Qureshi, I. H., Struggle for Pakistan, University of Karachi Press.
- Sayeed, K. B., Pakistan Formative Phase, National Book Service
- Ziring, Lawrance, Pakistan in Twentieth Century: A Political History, London; Oxford University Press
- Government and politics in Pakistan by Mushtaq Ahmad
- Ideology and Dynamics of Politics in Pakistan by Muhammad Asif Malik

MTH-433 QR -I---Exploring Quantitative Skills Cr. Hrs: 03

Specific Objectives of the Course:

Introduce students to importance of quantitative reasoning skills, history of mathematics and numbers inthe real World.

Course Outline:

- Different types of standard numbers and their operations.

- Understanding relationship between parts and whole
- Practical life scenarios involving parts & whole
- Money management (profit, loss, discount, zakat, simple interest, compound interest and taxation)
- Practical life scenarios involving units and rate, percentage, ratio, proportions
- Basic of Geometry (line, angles, circles, polygon etc)
- Golden ratio in sculptures
- Equating two expressions in one variable & using it to solve practical problems
- Sets and their operations, Venn diagrams
- Relations, Functions and their graphs
- Algebraic solution of quadratic equations and inequalities
- System of linear equations and their solutions
- Introduction to logic, prepositions, logical connectives, truth tables etc

Recommended Books:

- Bennett, J. & Briggs, W. (2015). Using and understanding mathematics (6th Edition). PearsonEducation, Limited.
http://xn--webducation-dbb.com/wp-content/uploads/2019/09/Jeffrey-Bennett-William-Briggs-Using-Understanding-Mathematics_-A-Quantitative-Reasoning-Approach-Pearson-2015.pdf

- Blitzer, R. (2014). Precalculus. (5th Edition). Pearson Education, Limited. https://www.ilearnacademy.net/uploads/3/9/2/2/3922443/precalculus edition_5f.pdf

ZOO -323 Principles of Animal Life-II Cr. Hrs. 3(2-1)

Objectives

The course will impart knowledge and understanding of:

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

Course outlines

- Cell Division

Cell cycles: Mitosis and meiosis; control of the cell cycle.

- Inheritance Patterns

Mendelian genetics; inheritance patterns; gene, structure, chemical composition and types. Chromosomes and Gene Linkage: Eukaryotic chromosomes; linkage and crossing over; chromosomal aberrations.

- Cellular Control

DNA: the genetic material; DNA replication in prokaryotes and eukaryotes; control of gene expression in eukaryotes; gene mutation; recombinant DNA technologies and their applications.

- Animal Behavior

Behaviour and its types, proximate and ultimate causes; anthropomorphism; development of behavior; learning; factors controlling animal behavior; communication; behavioral ecology; social behavior.

- Evolution: A Historical Perspective

Theories of evolution: Natural selection Lamarckism and neo larmarckism, Darwinism and neo Darwinian.

- Evolution and Gene Frequencies:

Hardy-Weinberg principle; evolutionary mechanisms: population size, genetic drift, gene flow, de Vries mutation theory and rates of evolution, polymorphism; species and speciation; molecular evolution; mosaic evolution.

Practical

- Study of mitosis in onion root tip.
- Study of meiosis in grasshopper testis (students should prepare the slide).
- Problem based study of Mendelian ratio in animals.
- Multiple alleles study in blood groups.
- Survey study of a genetic factor in population and its frequency.
- Study of karyotypes of Drosophila, mosquito.
- Study of cytochemical detection of DNA in protozoa and avian blood cell.

Recommended Books

1. Pechenik, J.A. 2012. Biology of Invertebrates, 4th Edition (International), Singapore: McGraw Hill.
2. Hickman, C.P., Roberts, L.S., Larson, A. 2004. Integrated Principles of Zoology, 11th Edition (International). Singapore: McGraw Hill.
3. Miller, S.A., Harley, J.B. 2002. Zoology, 5th Edition (International),Singapore: McGraw Hill.
4. Miller, S.A. 2002. General Zoology Laboratory Manual. 5th Ed. (International). Singapore: McGraw Hill.
5. Campbell, N.A. 2002. Biology. 6th Edition. Menlo Park, California

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Course Breakdown

3rd Semester

Semester-III				
Course Code	**Course Name**	**Credit Hours**	**General Education Course /Major/Interdisciplinary**	**Marks**
MTH-444	Quantitative Reasoning – II Tools for Quantitative Reasoning	03	General Education Course	
BOT-311`	Diversity of Plants	3 (2-1)	General Education Course	
ZOO-432	Animal Diversity-I (Invertebrates)	3(2-1)	Major Disciplinary Specific	
ZOO-433	Animal Form & Function-I	3 (2-1)		
CHEM-321	Organic Chemistry	3 (2-1)	Interdisciplinary	
Semester Credit Hours		**15**		

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3rd Semester

MTH-444 QR-II----Tools for Quantitative Reasoning Cr. Hrs. 03

Specific Objectives of the Course:
Introduce students to variables, sampling data and statistical approach in decision making.

Course Outline:

- Investigating relationships between variables
- Exploring tools to find relationship between variables
- Population and samples,
- Exploring and summarizing data
- Finding a representative value in a data
- Measure and spread of a data,measuring degree of relationship among variables
- Measure of central tendency, dispersion, data interpretation
- Basic probability theory
- Basics of estimation and confidence interval
- Testing hypothesis
- Statistical inferences in decision making
- Survey sampling

Recommended Books:

- Heumann, Christian, and Schomaker, Michael. Introduction to Statistics and Data Analysis: With Exercises, Solutions and Applications in R. Switzerland, Springer International Publishing, 2023.
- James, Gareth, et al. An Introduction to Statistical Learning: With Applications in R. Germany, Springer New York, 2013.
- Reid, Howard M.. Introduction to Statistics: Fundamental Concepts and Procedures of Data Analysis. United States, SAGE Publications, 2013.

BOT-311 Diversity of Plants Cr. Hrs 3(2-1)

Aims and Objectives

The course is designed to enable students

- To learn about the evolutionary history of plants.
- To learn about the characteristics of different groups of plants.
- To understand how different processes occur in different plants and about its economic importance.

Course outline

- Introduction

- Diversity of life
- Arranging Diversity of life into kingdoms
- Prokaryotes and origin of metabolic diversity
- The origin of eukaryotic diversity: eukaryotic origin by symbiosis among prokaryotes
- Eukaryotic algae as key producers in aquatic ecosystems
- Major characteristics of phyla of kingdom, plant and colonization
- Plant diversity and evolutionary history of plant kingdom
- Structural and reproductive adaptations for colonization of land
- Plant structure and growth
- Reproduction and Development: life cycle of plant mechanism in plants
- Control systems of plants to cope with environment stresses

Practical

- Morphology and reproductive system of prokaryotes and eukaryotes
- Identification of various types of prokaryotes and eukaryotes from slides
- Collection of specimens of plants and their identification.

Recommended books

1. M. K. Rai, Geoffrey A. Cordell, Jose L. Martinez, Mariela Marinoff, Luca Rastrelli. (2012) Medicinal Plants: Biodiversity and Drugs.
2. David L. Hawksworth, Alan T. Bull. (2007) Plant Conservation and Biodiversity, 6th ed.
3. Barbara J. E.s., Christine J. C. B. and Thomas N. S. (2010). Microbial Roots Endophytes. Springer.
4. Shelly (2010). Stern's Introductory Plant Biology. McGraw-Hill Sciences.
5. Larissa I. Weisfeld, Anatoly I. Opalko, Nina A. Bome, Sarra A. Bekuzarova. (2015).Biological Systems, Biodiversity, and Stability of Plant Communities

ZOO-432 Animal Diversity I: Invertebrates Cr. Hrs. 3(2-1)

Aims and Objectives

The course is designed to provide:

- Taxonomic characteristics and classification of each phylum
- Concepts of evolutionary relationship of animal kingdom
- Knowledge about animal kingdom, emphasizing their phylogenetic relationships and simple to complex mode of animal life

Course Outline

- Introduction
- Architectural pattern of an animal, taxonomy and phylogeny, major subdivisions of animal kingdom with evolutionary perspective.
- Animal-Like Protists
- The Protozoa; life within a single plasma membrane; symbiotic life-styles. Protozoan taxonomy: (up to phyla, subphyla and super classes, wherever applicable). Pseudopodia and amoeboid locomotion; cilia and other pellicular structures; nutrition; genetic control and

reproduction; symbiotic ciliates; further phylogenetic considerations.

- Multicellular and Tissue Levels of Organization

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

- Triploblastics and Acoelomate Body Plan

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

- Pseudocoelomate Body Plan

Aschelminths: general characteristics; classification up to phyla with external features; feeding and the digestive system; other organ systems; reproduction and development of Phylum Rotifera and Phylum Nematoda; Phylum Kinorhyncha. Some important nematode parasites of humans; further phylogenetic considerations.

- Molluscan Success

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

- Annelida

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

- Arthropods

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

- Echinoderms

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

- Lesser Invertebrates

The lophophorates, entoprocts, cycliophores, and chaetognaths.

Practical

Museum study of representative Phyla, Permanent slide preparations

- Study of Euglena, Amoeba, Entamoeba, Plasmodium, Trypanosoma,
- Paramecium as representative of animal like protists. (Prepared slides).
- Study of sponges and their various body forms.
- Study of principal representative classes of Phylum Cnidaria.
- Study of principal representative classes of Phylum Platyhelminthes.
- Study of representative of Phylum Rotifera, Phylum Nematoda.
- Study of principal representative classes of Phylum Mollusca.

- Study of principal representative classes of Phylum Annelida.
- Study of principal representative classes of groups of PhylumArthropoda.

Recommended Books:

1. Hickman, C.P., Roberts, L.S., Larson, A. 2011. Integrated Principles of Zoology, 15th Ed. (International).Singapore: McGraw Hill.
2. Miller, S.A., Harley, J.B. 2011. Zoology, 8th Ed. (International), Singapore: McGraw Hill.
3. Pechenik, J.A. 2010. Biology of Invertebrates, 4th Ed. (International), Singapore: McGraw Hill.
4. Campbell, N.A. 2002. Biology, 6th Ed. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.
5. Miller, S.A., 2002. General Zoology Laboratory Manual. 5th Ed. (International). Singapore: McGraw Hill.

ZOO-433 Animal Form and Function–I Cr. Hrs: 3~~4~~(2~~3~~-1)

Aims and Objectives:

The course aims to teach about:

- Animals diversity adapted in different ways for their functions through modifications in body parts.
- 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.
- Organ systems, their specialization and coordination with each other and constantly changing internal and external environment, inside and outside the animal's body.
- The basic structure of each system that determines its particular function.

Course Outline:

- 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.

- Communication I: Nerves: Neurons: structure and function; neuron-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 ventral nerve cord and ganglia, the vertebrate brain, the spinal cord, cranial and spinal nerves; autonomic nervous system.
- Communication II: Senses

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

- Communication III: The Endocrine System and Chemical Messengers

Chemical messengers: hormones chemistry; and their feedback systems; mechanisms of

hormone action; 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.

- 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.

Practical:

•Study of insect chitin, fish scale, amphibian skin, reptilian scales, feathers and mammalian skin.
•Study and notes of skeleton of Labeo, Rana tigrina, Varanus, fowl and rabbit.
•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.
•Study of models or preserved brains of representative animals and notes on adaptations.
•Study of nervous system of earthworm and a fish.
•Study of endocrine system in an insect and a rabbit.

Recommended Books:

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

CHEM-321 Organic Chemistry Cr. Hrs. 3(2-1)

Aims and Objectives

•To provide knowledge about basic concepts of organic chemistry
•To provide knowledge chemistry of hydrocarbons and functional groups and the mechanism of organic reactions.

Course outline

•Basic Concepts of Organic Chemistry
Bonding and hybridization, Structure aromaticity, Inductive effect, Dipole moment, resonance and its rules, Hyperconjugation, Classification and nomenclature of organic compounds including IUPAC system and types of organic reactions (an overview).

•Chemistry of Hydrocarbons

Saturated, unsaturated and aromatic hydrocarbons with emphasis on synthesis and free radical, electrophilic addition and electrophilic substitution reactions.

•Chemistry of Functional Groups

Hydroxyl, ether and amino groups, preparation and properties of alcohols, phenols, ethers, and amines with focus on reaction mechanism and applications, carbonyl compounds, preparations and reaction mechanism of aldehydes and ketones and their applications, carboxylic acids and their derivatives, acidity of carboxylic acids and effect of substituents on their acidity, preparation and reactions of carboxylic acids and their derivatives including esters, amides, acid halides and acid anhydrides.

Practical

•Qualitative analysis of compounds with different functional groups

•Synthesis of organic compounds using as a tool for understanding techniques like reflux, distillation, filtration, recrystallization and yield calculation..

Recommended Books:

1. Brown, W. and Poon, T., Introduction to Organic Chemistry, 3rd ed., JohnWiley & Sons, Inc., (2005).
2. John, E. M. Organic Chemistry, 8th ed., Brooks/Cole Publishing Co, USA, (2012).
3. Younus, M., A Textbook of Organic Chemistry, Ilmi Kitab Khana, Urdu Bazar, Lahore, Pakistan, (2006).
4. Sykes, P., A Guide Book to Mechanism in Organic Chemistry, 6th ed., Pearson Education Limited, England, (1986).
5. Solomons, T. W. G. and Fryhle, C. B., Organic Chemistry, 10th ed., JohnWiley & Sons, Inc., (2011).
6. Pavia, D. L., Kriz, G. S., Lampman, G. M. and Engel, R. G., A Microscale Approach to Organic Laboratory Techniques, 5th ed., Brooks/ Cole Cengage Learning, (2013).

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Course Breakdown

4th Semester

Semester-IV				
MBIO-314	Introduction to Microbiology	3(2-1)	Interdisciplinary	
BIOT-321	Introduction to Biotechnology	3(3-0~~2-1~~)	Interdisciplinary	
ZOO-441	Animal Diversity-II (Chordates)	3(2-1)	Major Disciplinary Specific	
ZOO-442	Animal Form & Function-II	3(2-1)	Major Disciplinary Specific	
ZOO-443	Physiology-I	3(2-1)	Major Disciplinary Specific	
Semester Credit Hours		**15**		

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4th Semester

MBIO-314 **Introduction to Microbiology** **Cr. Hrs. 3(2-1)**

Aims and Objectives:

The course aims to:

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

Course Outline:

- **What is Microbiology**
  Definition, Scope, Types of Microbes, Nomenclature and Introduction to Bergey's manual.
- **Viruses**
  Types of Viruses, Viruses of animals and plants, Effects of virus infection on cells.
- **Morphology and fine structure of bacteria**
  Size, shape and arrangement of bacterial cells, Flagella and motility, Pili, Capsules, sheaths, Prosthecae and stalks, structure and chemical composition of cell wall, cytoplasmic membrane, protoplasts, spheroplasts, the cytoplasm, nuclear material.
- **The Cultivation of Bacteria**
  Nutritional requirements, nutritional types of bacteria, bacteriological media, physical conditions required for growth, choice of media, conditions of incubation.
- **Reproduction and growth of bacteria**
  Modes of cell division, Normal growth cycle of bacteria, synchronous growth, continuous culture, quantitative measurement of bacterial growth; Direct microscopic count, Electronic enumeration of cell numbers, the plate count method, Membrane-filter count, Turbidimetric method, The selection of a procedure to measure growth, Importance of measurement of growth
- **Cultural characteristics**
  Pure cultures, Methods of isolating pure cultures, Maintenance and preservation of pure cultures, Culture collections, Cultural characteristics; Colony characteristics, Characteristics of broth cultures.
- **Eukaryotic Microorganisms**
  Algae: Biological and economic importance of algae; Characteristics of algae; Lichens. Fungi: Importance of fungi; Intro to Morphology; Physiology and reproduction, Cultivation of fungi. Economic importance of protozoa.

- **Prokaryotic diversity Bacteria**
  Purple and green bacteria cyanobacteria, prochlorophytes, chemolithotrophs, methanotrophs and methylotrophs, sulfate and sulfur-reducing bacteria, homoacetogenic bacteria, Free living aerobic nitrogen fixing bacteria, Acetic acid bacteria, Zymomonous and chromobacterium, Vibrio, Facultatively aerobic, Gram-negative rods, Neisseria and other Gram-negative cocci, Rickettsias, Chlamydias, Gram-positive cocci, Lactic acid bacteria. Endospore forming Gram-positive rods and cocci, Mycoplasmas, High GC Gram-positive bacteria; Actinomycetes, Coryneform bacteria, propionic acid bacteria, Mycobacterium, Filamentous Actinomycetes.

Practical:

- Preparation of culture media
- Pure culturing and cultivation of bacteria
- Simple, Gram, endospore, capsular, flagellar and acid fast stainings of different genera of bacteria\Vital staning and microscopic observations of protozoa
- Cultivation methods of fungi
- Isolation of bacteriophages.

Recommended Books:

1. Eugene W. N., Denise, G., Anderson, M. T., Nester, C., Roberts, E. Nancy, N. 2001. Microbiology: A Hhuman Perspective, McGraw Hill Higher Education.
2. Jacquelyn, G.G. 2001. Microbiology: Principles and Explorations, John Wiley & Sons Inc.
3. Madigan, M.T., Martinko, J.M. and Parker, J. 1997. Brock Biology of Microrganisms, Prentice-Hall, London.
4. Benson, H.J. 1994. MICROBIAL APPLICATIONS: LABORATORY MANUAL IN GENERAL MICROBIOLOGY, WMC Brown Publishers, England.

BIOT-321 Introduction to Biotechnology Cr. Hrs. (3-0)

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 (food, livestock, fisheries, algae, fungi, etc.); protection of biotechnological products; safety in biotechnology; public perception of biotechnology; biotechnology and ethics; biotechnology and the developing world.

Recommended Books:

2. Daugherty E, 2012. Biotechnology: Science for the New Millennium. 1st Edition, Revised; Paradigm Publication.
3. Smith JE, 2009. Biotechnology. 5th Edition; Cambridge University Press.

4. Nicholl TSD, 2004. An Introduction to Genetic Engineering. 2nd Edition; Cambridge University Press, UK.
5. Purohit SS, 2005. Biotechnology Fundamentals & Application. 4th Edition; Agro Bios, India.
6. Ratlegde C and Kristiansen B, 2006. Basic Biotechnology. 2nd Edition; Cambridge University Press, UK.
7. Thomas JA and Fuchs RL, 2002. Biotechnology and Safety Assessment. 3rd Edition; Academic Press, UK.

ZOO-441 Animal Diversity II: Chordate Cr. Hrs. 3(2-1)

Aims and Objectives

The course aims to:

- Provide understanding about taxonomic characteristics and classification of each phylum
- Develop concepts of evolutionary relationship of animal kingdom
- Provide knowledge and understanding about the different animal groups with special emphasis on their phylogenetic relationships

Course Outline

- Protochrodates

Structure, anatomy and organ systems; reproduction; life histories and metamorphosis; phylogenetic relationships; further phylogenetic considerations.

- Fishes

Vertebrate Success in Water: phylogenetic relationships; Agnatha and Gnathostomata: locomotory adaptations, nutrition and the digestive system, circulation, gas exchange, nervous and sensory functions, excretion and osmoregulation, reproduction and development; further phylogenetic considerations.

- Amphibians

The first terrestrial vertebrates: phylogenetic relationships; Caudata, Gymnophiona, and Anura;Structure and locomotory adaptations, nutrition and the digestive system, circulation, gas exchange, temperature regulation, nervous and sensory functions, excretion and osmoregulation, reproduction, development, and metamorphosis; further phylogenetic considerations.

- Reptiles

The First Amniotes: cladistic interpretation of the amniotic lineage; Testudines or Chelonia, Rhynchocephalia, Squamata, and Crocodilia; 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.

- Birds

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

- Mammals

Specialized teeth, endothermy, hair and viviparity; diversity of mammals; adaptations in external

structure and locomotion, nutrition and the digestive system, circulation, gas exchange, and temperature regulation, nervous and sensory functions, excretion and osmoregulation, behavior, reproduction and development.

Practical

Museum study of:

- Protochordates
- Pisces
- Amphibia
- Reptilia
- Aves
- Mammalia
- Field trips to study animal diversity in an ecosystem.

Recommended books:

1. Hickman, C.P., Roberts, L.S., Larson, A. 2011. Integrated Principles of Zoology, 15th Ed. (International). Singapore: McGraw Hill.
2. Campbell, N.A. Biology, 9th Ed. 2011. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc. Miller, S.A. and Harley, J.B. 2010. Zoology, 8th Edition (International) Singapore: McGraw Hill.
3. Miller, S.A. 2002. General Zoology Laboratory Manual. 5th Ed. (International), Singapore: McGraw Hill.
4. Kent, G.C., Miller, S. 2001. Comparative Anatomy of Vertebrates. Latest edition New York: McGraw Hill.
5. Hickman, C.P., Kats, H.L. 2000. Laboratory Studies in Integrated Principles of Zoology. Singapore: McGraw Hill.

ZOO-442 Animal Form & Function-II Cr. Hrs. 3(2-1)

Aims and Objectives:

- To provides understanding of the basis of structure and functions of animal nutrition, digestion, homeostasis and temperature regulation.
- Introduce the basic concepts in reproduction and development in animal kingdom.
- Impart knowledge about the development of chordate body plan and fate of germinal layers.

Course Outline:

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

Homeostasis and Temperature Regulation; The Impact of Temperature on Animal Life; Heat Gains and Losses; Some Solutions to Temperature Fluctuations; Temperature Regulation in Invertebrates, Fishes, Amphibians, Reptiles, Birds and Mammals; Heat Production in Birds and Mammals; Control of Water and Solutes (Osmoregulation and Excretion); Invertebrate and

Vertebrate Excretory Systems; How Vertebrates Achieve Osmoregulation; Vertebrate Kidney Variations; Mechanism in Metanephric Kidney Functions.

- Reproduction and Development

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

- Descriptive Embryology

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

Practical:

- Study of excretory system in an invertebrate and a vertebrate representative (Model).
- Study of nutritive canal in an invertebrate and a vertebrate representative (Dissection).
- Study of male reproductive system in an invertebrate and a vertebrate representative (Dissection).
- Study of female reproductive system in an invertebrate and a vertebrate representative (Dissection).
- Study of hormonal influence of a reproductive function (Model).
- Study of preserved advanced stages of avian and mammalian development for amniotic membranes and placenta (Model).
- Study of stages in the development of an Echinoderm.

Recommended Books

1. Pechenik, J.A. 2013. Biology of Invertebrates, 4th Ed. (International), Singapore: McGraw Hill.
2. Hickman, C.P., Roberts, L.S., Larson, A. 2004. Integrated Principles of Zoology, 11th Ed. (International), Singapore: McGraw Hill.
3. Miller, S.A., Harley, J.B. 2002. Zoology, 5th Ed. (International), Singapore: McGraw Hill.
4. Campbell, N.A. 2002. Biology, 6th Ed. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.
5. Miller, S.A. 2002. General Zoology Laboratory Manual. 5th Ed. (International), Singapore: McGraw Hill.

ZOO-443 Physiology-I Cr. Hrs. 3(2-1)

Aims and Objectives:

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

temperature and its maintenance

Course Outline:

- Central Themes in Physiology

Homeostasis, Concepts of conformity and regulation; physiological adaptations.

- Membrane Physiology

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

- Nerve and Muscle Physiology

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

- Receptor Physiology

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

- Endocrine Physiology

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

- Cardiovascular Physiology

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

- Respiratory Physiology

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

- Renal Physiology

Osmoregulation: Osmoregulation in aquatic and terrestrial animals; Kidney and Vertebrate nephron as osmoregulatory and excretory organ: Glomerular filtration, Tubular absorption and secretion; Nitrogenous waste products; Patterns of nitrogenous excretion and their phylogenetic significance.

- Physiology of Digestion

Physiologic anatomy of digestive tract (mammalian model), Regulation of digestive secretions; Absorption of water, ions and nutrients; Potential and Movements in gastrointestinal tract; Control of motility. Deglutition, Peristalsis, Absorption, Assimilation and defecation.

- Temperature Regulation

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

Practical:

- Determination of haemoglobin content, haematocrit and cell counting.

- Preparation of blood smears.
- Nerve muscle preparation, Muscle twitch, Comparison of muscle andnerve irritability, effect of stimulus strength, effect of stimulus frequency (tetany), effect of load or stretch, effect of prolonged activity (fatigue), neuromuscular fatigue, stimulation of motor points in human.
- Recording of action potential by oscilloscope and demonstration of its various features. Experiments to demonstrate characteristic of reflex arc.
- Normal cardiac activity, effect of temperature, effect of drug, heart block, tetanization of heart. Measurement of blood pressure.
- Oxygen consumption in fish and effect of temperature (by dissolved oxygen meter) and terrestrial animal (mouse).
- Effect of insulin on glycemia, study of stages in estrous cycle

Recommended Books:

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

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Course Breakdown

5th Semester

Semester-V				
Course Code	**Course Name**	**Credit Hours**	**General Education Course /Major/Interdisciplinary**	**Marks**
BOT-699	Plant Anatomy	3(2-1)	Interdisciplinary	
ZOO-551	Cell & Molecular Biology	3(2-1)	Major Disciplinary Specific	
ZOO-552	Physiology – II	3(2-1)	Major Disciplinary Specific	
ZOO-553	Genetics	3(2-1)	Major Disciplinary Specific	
ZOO-554	Wild Life	3(2-1)	Major Disciplinary Specific	
Semester Credit Hours		**15**		

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5th Semester

Plant Anatomy **Credit Hours: 3(2-1)**

Aims and Objectives:

- To provide understanding about anatomical features of vascular plants

Course Outline:

- The plant body and its development

Fundamental parts of the plant body, internal organization, different tissue systems of primary and secondary body.

- Meristematic tissues

Classification, cytohistological characteristics, initials and their derivatives.

- Apical meristem

Delimitation, different growth zones, evolution of the concept of apical organization. Shoot and root apices.

- Leaf Types, origin, internal organization, development of different tissues with special reference to mesophyll, venation, bundle-sheaths and bundle-sheath extensions. Enlargement of epidermal cells
- Vascular cambium

Origin, structure, storied and non-storied cell types, types of divisions: additive and multiplicative; cytoplasmic characteristics, seasonal activity and its role in the secondary growth of root and stem. Abnormal secondary growth.

- Origin, structure, development, functional and evolutionary specialization of the following tissues.

Epidermis and epidermal emergences, Parenchyma, Collenchyma, Sclerenchyma, Xylem, Phloem with special emphasis on different types of woods, Periderm.

- Secretory tissues

Laticifers (classification, distribution, development, structural characteristics, functions) and Resin Canals.

- Anatomy of reproductive parts i.e flower, seed & fruit
- Economic aspects of applied plant anatomy
- Anatomical adaptations
- Molecular markers in tree species used for wood identification

Practical:

- Study of organization of shoot and root meristem, different primary and secondary tissues from the living and preserved material in macerates and sections, hairs, glands and other secondary structures.
- Study of abnormal/unusual secondary growth.
- Peel and ground sectioning and maceration of fossil material.
- Comparative study of wood structure of Gymnosperms and Angiosperms with the help of prepared slides

Recommended Books:

1. Dickison, W. C. 2000. Integrative plant anatomy. Academic Press, U. K
2. Raymond, E. S. and E. Eichhorn. 2005. Esau's Plant Anatomy; Meristematic cells and tissues of plant body. John Willey Sons
3. Eames, A. J. and L. H. Mac Daniels. 2002. An introduction to Plant Anatomy. Tat McGraw-Hill Publishing Company Limited, New Delhi.
4. Vaughan, J. G. 1990. The structure and Utilization of Oil Seeds. Chapman and Hall Ltd. London.

ZOO-551 Cell & Molecular Biology Cr. Hrs. 3(2-1)

Aims and Objectives:

The course aims to:

- Impart knowledge about the animal cell and its complex organization of architecture
- Provide understanding about the unified role of a cell for the ultimate sustainability of the organisms
- Enable students to understand various ultra-structural, molecular and functional aspects of the cells will be communicated in this course.

Course Contents:

- Introduction to Prokaryotic and Eukaryotic Cell

Plasma membrane, its chemical composition structure and functions of plasma membranes, cell permeability, active transport, endocytosis, phagocytosis.

- Cytoplasmic Organelles

Membrane system, structural and functional commonalities. Ultrastructure, chemical composition and functions of Endoplasmic Reticulum and their role in protein synthesis and drug metabolism, Golgi apparatus its role in synthesis of glycoprotein, Mitochondrial respiration and its significance as semi-autonomous organelle; Lysosome, its diverse roles due to hydrolytic activity of enzymes, Peroxisome, its role in metabolism of hydrogen peroxide, Glycoxysome with reference to glyoxylic acid cycle. Cytoskeleton and its types, Nucleus and chromosome structure and function.

- Replication

Mechanism, DNA replication in prokaryotes specially with reference to variety of DNA polymerases and other proteins involved, DNA replication in Eukaryotes with emphasis on 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

Specific role of Ribosomes, various factors, and posttranslational processing, control of gene expression in Prokaryotes.

Practical:

- Identification of cell organelles through model
- Preparation of temporary whole mount.
- Preparation of permanent whole mount (demonstration)

- Preparation of human blood smear and identification of Leucocytes.
- Tissues (permanent slides of epithelial tissues, striated muscle, smooth muscle, cartilage, bone).
- Squash preparation of onion root tip for mitotic stages.
- Cultural and staining of bacteria and yeast.
- DNA detection by Gel Electrophoresis

Recommended Books:

1.Burton E. Tropp. 2014. Principles of Molecular Biology.
2.Robert F. Weaver. 2011. Molecular Biology, 5th edition.
3. H. D Kumar. 2014. Molecular Biology, 2nd edition.
4.Verma P.S, Agarwal V.K. 2004. Cell Biology, Genetics, Molecular Biology, Evolution & Ecology.
5.Gerald Karp. 2013. Cell and Molecular Biology 7th Edition.
6.Damell Jr. J., Lodisch, H., Balimore, D. 2013. Molecular Cell Biology, Scientific American Inc. N.Y.

ZOO-552 Physiology-II Cr. Hrs: 3(2-1)

Aims and Objectives:

- Provide information about the physiological mechanisms underlying animal functions.
- Impart information on respiratory and cardiac physiology
- Give understanding about the mechanism of homeostasis, physiological regulation of temperature and its maintenance

Course Contents:

Cardiovascular Physiology

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

Respiratory Physiology

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

Physiology of Digestion

Physiologic anatomy of digestive tract (mammalian model), Regulation of digestive secretions; Absorption of water, ions and nutrients; Potential and Movements in gastrointestinal tract; Control of motility. Deglutition, Peristalsis, Absorption, Assimilation and defecation.

Temperature Regulation

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

Practical:

- Determination of haemoglobin content, haematocrit and cell counting.
- Preparation of blood smears.
- Normal cardiac activity, effect of temperature, effect of drug, heart block. Measurement of blood pressure
- Oxygen consumption in fish and effect of temperature (by dissolved oxygen meter) and

terrestrial animal (mouse).

Recommended Books:

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

ZOO-553 Genetics Cr. Hrs: 3(2-1)

Aims and Objectives:

- To develop the concept that continuity not only transfers the traits of the parents but also imparts variations that render the generations sustainable in changing environment.

Course outline:

- Scope and Importance
- Multiple Alleles

Blood groups and coat color in rabbits.

- Chromosomal Basis of Inheritance

Interaction of genes, changes in chromosomal number, euploidy, aneuploidy, polyploidy; structural changes, insertion, deletion (Cri du chat syndrome), duplication and translocation Pedigree Analysis: Normal human chromosome complement; Karyotyping.

- Sex-determination and Sex-linkage

Sex determination in animals and humans, linkage, recombination and chromosome mapping in eukaryotes.

- Molecular Genetics

Elements of genetic engineering; genetic basis of diseases, like cancer, genetic control of animal development

- Human Genetics Single and Multifactorial Disorders

Autosomal anomalies, Pseudoautosomal genes, (eg. Down syndrome, Edwards syndrome and), Single gene disorders Gene mutation and disorders; autosomal single gene disorders (Sickle cell anemia, brachydactyly; Polygenic traits - Cleft lip and cleft palate

- Sex-linked Chromosomal anomalies Klinefelters syndrome, and Turners syndrome.
- Sex-influence inheritance

Baldness

Practical

- Mitosis (Onion root tips.)
- Meiosis (Grass hopper testes)
- Blood groups.
- Salivary gland Chromosomes of Drosophila melanogaster

- Construction of ideogram or Karyptypes
- Study of Polygenic inheritance in Human (Body weight, standing height and arm stretch length
- General morphology of Drosophila melanogaster
- Human Pedigree analysis problems
- Human Genetics problems

Recommended Books

1. Maria Alvarez. (2011) Genetic Transformation.
2. Leland, H., Leroy, H. (2010). Genetics: From Gene to Genome. McGraw Hill Sciences.
3. Asche, 2013. Recent Advances in Cloning Genetics and Stem Cell Technology. RDM.
4. Robert J. Booker. (2008) Genetics: Analysis and Principals 3rd ed. Stanley Fields, Mark Johnston. (2010). Genetic Twist of Fate.

ZOO-354 Wildlife Cr. Hrs: 3(2-1)

Aims and Objectives:

- To understand about wildlife and its distribution pattern
- Threatened and endangered species of Pakistan,
- Modern techniques used in animal tracking, data collection
- How to protect, maintain, control and preserve the health and environment of wildlife.

Course outline:

- Wildlife

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

- Introduction to wild plants

Endemic species of plants in Pakistan and their status, distribution and conservation.

- Wildlife of Pakistan

Identification, distribution, status, conservation and management of fishes, reptiles, birds and mammals of major importance in Pakistan.

- Wildlife Conservation

Philosophy and significance, Biodiversity and sustainability of wildlife.

- Wildlife Agencies

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

- Wildlife rules and regulations in Pakistan

Sanctuaries, Game Reserves and National Parks in Pakistan. Endangered species of Pakistan.

Practical:

- Aerial counts
- Sex and age determination
- Capture and marking of animals
- Procedure of study species richness
- Field trip to study local flora and fauna of the area

Recommended Books

1. Ali, S.S. 1999. Paleontology, Zoogeography& Wildlife Management. Nasim Book Depot. Hyderabad, India.
2. Roberts, T. J. 1998. The Birds of Pakistan, (Vol. II), Oxford University Press.
3. Roberts, T. J. 1992. The Birds of Pakistan, (Vol.I). Oxford University Press.
4. Magon, C.F. 1988. Biology of Freshwater Ponds. Longman and Scientific Publication.
5. Bailey, J.A. 1986. Principles of Wild life Management. John Wiley and Sons.

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Course Breakdown

6th Semester

Semester-VI				
ZOO-561	Entomology	3(2-1)	Major Disciplinary Specific	
ZOO-562	Parasitology	3(2-1)	Major Disciplinary Specific	
ZOO-563	Bioinformatics	3(2-1)	Major Disciplinary Specific	
ZOO-564	Fish Biology	3(2-1)	Major Disciplinary Specific	
ZOO-565	Research Methodology	03	Major Disciplinary Specific	
Semester Credit Hours		**15**		

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6th Semester

ZOO 561 Entomology Cr. Hrs. 3(2-+1)

Learning Outcomes:

The students would be able to;

- Know about arthropods and especially insects with their morphological features
- Identify insects of economic importance and acquire working skills for collecting, mounting, and preserving insects
- Understand the comparative morphology of insect organ systems.
- Understand how the morphology of an organ is related to its function Digestive system, circulatory system, nervous system, respiratory, reproductive system
- The student should be able to identify, collect and management of different insects of household, man and animals.
- To learn about the taxonomic keys and different control methods

Outline

Introduction:- Introduction about entomology and its branches of entomology

Adaptations to diverse environment and Economic Importance causes of success and economic importance of insects;

Morphology -integument and its derivatives; body regions; segmentation, sclerites, sulci and appendages, head, thorax and abdomen with their modifications in economically important insect.

Physiology: internal organ systems (Digestive system, circulatory system, nervous system, respiratory, reproductive system; exocrine and endocrine organs).

Mouth Parts and modifications: Different type of mouth parts and their adaptations and function.

Taxonomy: Introduction; history, functions and concepts of insect taxonomy; tasks of taxonomist; taxonomic categories; taxonomic procedures: collection and methods of sampling, identification, taxonomic characters

Introduction; Identification, Biology of house hold insects

Introduction; identification, biology and control of different insect pests like ants, termites, cockroaches, silver-fish, , carpet beetle, lice, bed-bugs, fleas, mosquitoes, house flies, wasps, sand flies flies, blow flies, tsetse flies, black flies and midges..

Control of insects:- principles and methods of insect control i.e. cultural, biological, physical, mechanical, reproductive, legislative, chemical and bio-technological control;

Practical:

- Structure of integument and its derivatives; comparative external and internal morphology of economically important insect preparation for illustrations.
- Dissection of cockroaches for study of different systems e.g Digestive system, circulatory system, nervous system, respiratory, reproductive system
- Collection, identification. and emonstration of management of different household, man

and animal insect pests.

- Methods of collection, preservation and labeling of insects; preparation of taxonomic keys; identification of insects and cataloguing

Recommended Books:

1. Beutel, R. G.,Friedrich, F., Yang, Xing-Ke and Ge, Si-Qin. 2014. Insect Morphology and Phylogeny. Walter De Gruyter Inc publisher.
2. Chapman, R. F. 2012. The insects: Structure and Function (5 th Ed.). Cambridge University Press.
3. Dunston P.A. 2004. The Insect Structure, Function and Bio-Diversity. Kalyani Publishers, Ludhiana.
4. DuPorte, E. M. 1959. Manual in Insect morphology. Reinhold Press. University of Minnesota, USA.
5. Gilbert, L.I., Iatrou, K. and Gill, S. S. 2005. Comprehensive Molecular Insect Science. 2nd edition, Elsevier/Pergamon. 6. Kerkut, G.A. and Gilbert, L.I. 1985. Comprehensive Insect Physiology, Biochemistry and Pharmacology. Vols. 1-12, Perg
6. Daly, H.V. Doyen, J.T. Purcell, A.H. and Daly, B.B. 1998. Introduction to Insect Biology and Diversity. Oxford University Press.
7. Kitching, I. Forey, P.L. and Humphries, C.J.1998. Cladistics: Theory and Practice of Parsimony Analysis, Oxford University, Press, UK.
8. Manzoor, F. 2006. Morphometric Studies on Termite Genus Odontotermes. Published by, Higher Education Commission, Islamabad. 4. Mayer, E. and Ashlock, P.D. 1991. Principles of Systematic Zoology, 2 nd .Ed. McGraw-Hill Inc. New York.
9.. Schuh, R. T. and Andrew V. Z. B. 2009. Biological Systematics Principles and Applications. Cornell University Press, Sage House, 512 East State Street, Ithaca, New Yark, USA.
10. Atwal, A.S. 2005. Agricultural Pests of Southeast Asia and their Management. Kalyani Publishers, Ludhiana

ZOO-562 Parasitology Cr. Hrs: 3(2-1)

Course Objectives

This course will

- Introduction to general parasitology
- provide knowledge regarding different modes of transmission of parasites of medical and veterinary importance
- knowledge about their pathology, host parasite relationship and control measures

Course Outcomes

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

- Understand and explain the concept of parasitism.
- Understand and explain the nature of host-parasite relationship.
- Understand and explain epidemiology, lifecycle, pathogenesis, transmission, control and treatment of various human and veterinary parasite.
- Demonstrate practical skills in fundamental parasitological techniques.
- Present and interpret results obtained from using these techniques.
- Present information clearly in both written and oral form

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Course Content

Introduction to parasitology: Relationship to other sciences, parasitology and human welfare. Parasites of domestic and wild animals. Careers in parasitology. Some basic definitions. Parasitic ecology and evolution. 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.

Pathology of Helminths: Host parasite relationships and control of parasitic helminths with particular reference to Helminths of medical and veterinary importance.

Arthropods, Vectors of diseases. parasitic insects; bugs, fleas, flies,mosquito, lice, ticks and mites.

Practicals

i. Preparation of temporary and permanent slides and identification of parasitic protozoan and local helminthes of medical and veterinary importance.
ii. Section cutting of the infected tissues and the study of their pathology.
iii. Methods of collection, preservation and transportation of parasitic material.
iv. Qualitative and quantitative faecal examination for helminth ova.
v. Collection, preservation and preparation of slides of local helminthes and their identification.
vi. Identification of insects of medical and veterinary importance.

Books Recommended

1. Roberts, L.S. and Janovy, J. Foundation of parasitology, 8th Edition. 2008. McGraw Hill Book Co
2. Roberts, L.S. and Janovy, J. Foundation of parasitology, 8th Edition. 2008. McGraw Hill Book Co
3. Hausman, K. and Hulsmann, N. T. Protozoology, 2nd Edition.1996. Medical Publishers, Inc. New York
4. Noble, E.R. and Noble, G.A. Parasitology. The biology of animal parasites. 5th Edition. 1982. Lea and Febiger Publisher
5. Becks, J.W. and Davies, J.E. Medical parasitology. 3rd Edition. 1981. C.V. Mosby Company, Toronto, London
6. Cheesbrough, M. Medical laboratory manual for tropical medicine. Vol.I. 1987. University Press Cambridge
7. Smyth, J.D. Introduction to animal parasitology. 1994. Cambridge University Press
8. Becks, 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. Urquhart, G.M., Hucan, J.L., Dunn, A.M. and Jennings, F.W.VETERINARY parasitology. 2000. Longman Scientific and Technical publications, Longman Group, UK

Rollinson. D, Hay. S. I.Advances in Parasitology, Volume 69. 2009. Academic Press

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ZOO-563 Bioinformatics Cr. Hrs: 3(1-2)

Aims and Objectives:

- An introduction to bioinformatics with a focus on fundamental bioinformatics problems,
- Information on the tools used to compute solutions to those problems, and the theory upon which those tools are based.

Course Outline:

- Introduction to Bioinformatics

What is BI; history of BI; Uses of BI (Protein, Gene); comparison of BI with experimental tools

- Basic principles of computing in bioinformatics

Basic acquisition and database: DDBJ, NCBI and EMBL

- Retrieving protein sequences from database (FASTA)

Alignment of protein\ nucleotide sequences (BLAST, CLUSTALW); Computing physicochemical parameters of proteins (eg. PROTPARAM); Predicting elements of secondary structure of proteins (eg. PSSP); Retrieval, understanding and predicting 3D structure of protein from sequence; PTMs (eg NETPHOS etc.)

- Enzymes Classification: Retrival Database
- Short introduction to DNA/RNA

Amino acids, sequence; analyzing Protein sequence by the use of BI tools; sequence- structure function.

- Retrieving the DNA sequence

Computing the sequence Identifying restriction sites; Predicting elements of DNA/RNA secondary structure; Computing the optimal alignment between two or more DNA sequences

- PRIMER Designing for PCR.
- Short introduction to proteomics and genomics, and the role of bioinformatics in the pharmaceutical industry.

Practical:

- Retrieval of FASTA sequence
- Determination of proteins physical and chemical parameters
- Finding similar sequences for protein and DNA
- Multiple alignment
- Predicting proteins secondary structure
- Predicting RNA secondary structure
- Predicting protein PTM
- Finding protein families
- Determination of gene location on chromosome.
- SNPs
- Primer design

Recommended Books:

1. Baxevanis, A.D., Ouellette, B.F.F, 2011. Bioinformatics: A Practical Guide to The Analysis of Genes and Proteins. John Wiley & sons, Inc.
2. Rastogi, S.C., Mendiratta, N.,Rastogi, P. 2011. Bioinformatics Methods and Applications: Genomics, Proteomics and Drug Discovery. PHI publishing.
3. Selzer, P., Marhofer, R. and Rohwer, A. 2008. Applied Bioinformatics: An Introduction. Springer publishing, Germany.

4. Baxevanic, A.D., Ouellette, B.F.F. 2004. Bioinformatics: A Practical Guide to The Analysis of Genes and Proteins, 3rd Ed. O'Reilly publishers.
5. Moody, G. 2004. Digital Code of Life: How Bioinformatics is Revolutionizing Science, Medicine and Business. John Wiley and Sons.

ZOO-564 Fish Biology Cr. Hrs. 3(2-1)

Aims and Objectives:

- To disseminate the history, needs and importance of fish culture
- To elaborate the basic components of pond fish culture
- To describe the culturable fish species and their biology
- To impart knowledge regarding pond fertilization and feeding of fish

Course Outline:

- Aims and evolution of fish culture.
- Pond fish culture.
- Culturable fishes of Pakistan.
- Fertilization of fish pond.
- Integrated fish farming: Concepts and practices.
- Fish enemies.
- Fish diseases and remedial measures.
- Fish hatchery management.
- Fishing gears, pre- and post-harvesting care of fish, maintenance of fish catch quality during transportation, storage and marketing.
- Fish processing technology.

Practical

- Uses of different organic and inorganic fertilizers in fish ponds
- Identification of various fishes
- Study of morphological characters and identification of cultureable fish species.
- Practical demonstration of induced fish breeding

Recommended Books:

1. Sharma, O. P. 2009. Handbook of Fisheries and Aquaculture. Agrotech Publishing Academy, Udaipur, New Delhi, India.
2. Hart, P. J. B. and J. D. Reynolds. 2008. Handbook of Fish Biology and Fisheries, Volume 2. Blackwell Science Ltd., New York, USA.
3. Horvaph, L., G. Tanes and C. Seagrave. 2002. Carp and Pond Fish Culture Fishing News Book, New York, USA
4. Huet, M. 1998. Text Book of Fish Culture - Breeding and Cultivation of Fish. Fishing News, London, UK

ZOO-565 Research Methodology Credit Hours: 3

Aims and Objectives:

- Introduce the methods involved in research
- Learn about the misconduct, copyright and patents law.

Course Outline:

- Introduction: Research and professions.
- Understanding the research process
- History and Principles of research ethics
- Originality of Research
- Conflicts of interest
- Copyright and Patent Law
- Aims of research, the research topic
- Title and research problem
- Literature review: Search
- Retrieve and manage information
- Research design
- Parametric, non-parametric and semi-parametric methods
- Qualitative Methodologies and interpretation of results
- Conclusions and its validity
- Report writing and the research proposal
- Community Research
- Principles of presentation
- Communication-oral, posters
- Abstract and manuscript preparation

Recommended Books:

1. Ann Bowling, A. and Ebrahim S., 2005. Handbook of Health Research Methods. Open University Press, Two Penn Plaza, New York, NY.
2. Baumgartner, T. and Hensley, L. 2006. Conducting and Reading Research in Health and Human Performance 4th ed. McGraw-Hill, New York.
3. Kumar, R., 2010.Research Methodology: A Step-by-Step Guide for Beginners. 3rd edition. SAGE Publications, London
4. Flick,U., 2011.Introducing Research Methodology: A Beginner's Guide to Doing a Research Project SAGE Publications London
5. Chilisa, B.,2011. Indigenous Research Methodologies SAGE Publications, London.

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Course Breakdown

7th Semester

Semester-VII				
Course Code	**Course Name**	**Credit Hours**	**General Education Course /Major/Interdisciplinary**	**Marks**
ZOO-671	Developmental Biology	3(2-1)	Major Disciplinary Specific	
ZOO-672	Techniques in Zoology	3(2-1)	Major Disciplinary Specific	
ZOO-673	Immunology	3(2-1)	Major Disciplinary Specific	
ZOO-674	Histology	3(2-1)	Major Disciplinary Specific	
ZOO-675	Field Experience	03		
Semester Credit Hours		**15**		

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7th Semester

ZOO-671 Developmental Biology Cr. Hrs. 3(2-1)

Aims and Objectives:

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

Course 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.

Practical:

- Study of the structure of gametes in some representative cases, i.e. frog, fish, fowl and a mammal. Slab gel electrophoresis.
- Study of cleavage and subsequent development from prepared slides and/or whole mounts in various animals i.e., frog, chick etc.
- Preparation and study of serial sections of frog or chick embryos.

Recommended Books:

1. Gilbert, S. F. 2012. Developmental Biology, Sinauer Associates, Sunderland, MA.

2. Klaus, K. 2001. Biological Development. 2nd Ed., McGraw Hill.
3. Balinsky, B. I. 1985. An Introduction to Embryology, Saunders.
4. Oppenheimer, S.S. 1984. Introduction to Embryonic Development, Allen and Bacon.
5. Saunders, J. W. 1982. Developmental Biology, McMillan and company.

ZOO-672 Techniques in Zoology Cr. Hrs. 3(2-1)

Aims and Objectives:
The course aims to:
- Develop scientific technical expertise, culture and work habits.
- Familiarize with the basic tools and techniques of scientific study with emphasis on biological sciences.
- Develop basic understanding of the equipment's usage.

Course Outline:
- Microscopy

Principles of light microscopy. Magnification, Resolution, Contrast. Types of microscopy, Bright field (Compound Microscope), Scanning microscopy, Eyepiece micrometers, Camera Lucida 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).
- Standard system for weight, length, volume

Concentrations- percent volume; ppt; ppm - Chemical molarity, normality -Temperature- Celsius, centigrade, Fahrenheit. Preparation of stock solutions of various strengths
- Specimen preparation for optical microscopy: Microtomy

Fixation, embedding, Section cutting (transverse, longitudinal section, mounting and staining. Sections in paraffin and cryosections.
- Extraction Techniques

Centrifugation, Ultracentrifugation, cell fractionation, filtration, Distillation, Use of Soxhlet and Rotary evaporator for extraction.
- Separation Techniques

Chromatography: Principle, applications, types, thin layer, column, gas, ion exchange chromatography. Electrophoresis: Principle, applications, types.
- Spectrophotometry

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. Preservation techniques – Taxidermy - Rearing techniques, Laboratory and field.

Practical:
- Observation of wet mounts of human cheek cells employing bright and dark field microscopy
- Measurement of cell size: bacterial and eukaryotic
- Liquid handling: proper use of pipettes and micropittes

- Histological preparations: skeletal muscle, intestine liver and testes
- Handling of centrifuge machines
- Spectrophotometric estimation of glucose

Recommended Books:

1. Cheesbrough, M. 1998. District Laboratory Practice in Tropical Countries. Part I. Cambridge University Press, UK.
2. Cheesbrough, M. 1998. District Laboratory Practice in Tropical Countries. Part II. Cambridge University Press, UK.
3. Curos, M. 1997.Environmental Sampling and Analysis: Lab Manual. CRC Press LLC. USA.
4. Curos, M. 1997.Environmental Sampling and Analysis: For Technician. CRC Press LLC. USA.
5. Slings by, D., Cock, C.1986. Practical Ecology. McMillan Education Ltd. London.

Course code 673 Immunology Cr.Hrs. 3(2+1)

Objectives the course aims to

- Give understanding of the basic concepts of immunology and its importance in biological sciences
- Provide information about immunological mechanisms against different diseases
- Give understanding of immunization, immunological tolerance etc.

Course Contents

Immunology: Immunobiology, Immunophysiology, Immunopathology.
Immunity: Natural and acquired immunity, Active and passive immunity.
Antigens and elicitation of immune responses: antigens and their types, antigenicity and immunogenicity, factors important for immunogenicity of an antigen, cell mediated and humoral: nature of antigens, genetic constitution of individuals and route of administration.
Immunoglobulins: Synthesis of antibodies, Theories of antibodies synthesis.
Detection and application of antigen-antibody reactions: in vivo and in vitro reactions.
Monoclonal antibodies: Importance, synthesis, isolation and applications
Major histocompatibility complex: types and importance, diversity in MHC proteins.
Cellular basis of immune response: Origin of lymphocytes, Primary and secondary lymphoid organs, Specific response of individual lumphocytes to antigenic stimulation, Histological features of immune response.
Hypersensitivity: Immediate hypersensitivity (anaphylaxis, antibody dependent cytotoxicity, Immune-complex mediated disease and stimulatory hypersensitivity), Delayed type or cell mediated hypersensitivity.
Autoimmunity: Tolerance, autoimmune diseases and types, factors responsible for autoimmunity.
Immunization; Immunization procedures, Vaccines and their types.

Practicals

1. Study of different types of leucocytes in: Blood, Bone marrow, Spleen and Thymus in mammals.

2. Estimations of total serum proteins, albumins and globulin concentrations in mammalian blood.
3. Differentiation of globulin proteins in blood serum of mouse by electrophoresis.
4. Diagnosis of immunoglobulin proteins by enzyme linked immunosorbant assay (ELISA).
5. Isolation of lymphocytes and resetting technique.
6. Antigen-antibody reaction by agglutination and precipitation reaction.

Books Recommended

1. Essential immunology.Roitt, I. 1990. 2nd ed. Black well Scientific Publications. Oxford, UK.
2. Stites, D. P., Stobo, J. D., Fudnberg, H. H. and Wells, J. V. 1990. Basic and clinical immunology. Lange Medical Publications, USA.
3. Essentials of haematology. Hoff - Brand, A. B. a

ZOO- 674 Histology Cr. Hrs. 3(2-1)

Course Description

Histology is a discipline which examines the structure and correlating functions of tissues and cells using light microscopy, electron microscopy and other specialized microscopic methods. The course will involve a study of general tissue characteristics and will explore histologically and ultrastructurally the different tissue types in the body including epithelial, connective, skeletal, blood/vascular, muscular, and neurological tissues as well as the various organ systems including cardiovascular, lymphatic, integumentary (skin), digestive, respiratory, urinary, endocrine, male and female reproductive, and special senses (eye and ear). While the course's emphasis will be a study of the appearance of normal cells and tissues, selected abnormal/diseased tissues will be examined as well (e.g., bone osteoporosis, heart myocardial infarctions, neurological diseases, etc.) and functional correlations.

Outlines

- Introduction to histology and histopathology and its importance.
- Understand the basic concepts of tissue fixation, dehydration, embedding, sectioning, staining and mounting of slides for histological examination, immunofluorescent staining and electron microscopy.
- Recognize, identify and describe the characteristic structures of cells of the body at the light microscope histologic level, and for selected tissues, at the electron microscopic ultrastructural level.
- Know and understand the characteristics of tissues of the body (epithelium, connective, muscle, nerve) and their relationships in the various organ systems of the human body. (The Basic Histology component of the course will concentrate on the microanatomy of the four basic tissues, namely: epithelial tissue, including glandular tissue, connective tissue, muscular tissue, and nervous tissue)
- Understand the basic functions of cells and cellular organelles, tissues and organ systems of the body as correlated with their histological structures (Integumentary. Digestive. Respiratory. Cardiovascular. Urinary, Endocrine. Male Reproductive System. Female Reproductive System)

Practicals

- Demonstrate proficiency and expertise in the proper use of the light microscope in examining histological specimens on glass slides.

- Demonstration of the Preparation and staining of slides.
- Histological examination of slides: Epithelium, Muscle tissue and Connective tissue.
- Histological examination of slides of different organs lie liver, stomach, ovary, testes, kidney, brain and heart.
- Demonstrate use of safe laboratory techniques and practices.

Recommended Books

1.Combined Texts and Atlas Young, B., Lowe, J., Stevens, A. & Heath, J. (2006) Wheater's Functional Histology. A Text and Color Atlas 5th ed.
2. Churchill Livingstone, Edinburgh. ISBN 0-44306850X. Junqueira L. (2009) Basic Histology Text & Atlas 12th ed,
3. McGraw-Hill, ISBN 9780071630207 Textbook Kerr, J. B. (2010) Functional Histology 2nd ed. Mosby Elsevier. ISBN 9780729538374.
4. Atlas Eroschenko, V.P. (2008) di Fiore's Atlas of Histology. 11th ed Lippincott, Williams & Wilkins Int., Baltimore. ISBN 9781608314928.

WOMEN UNIVERSITY MARDAN
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Course Breakdown

8th Semester

Semester-VIII				
ZOO-681	Animal Behavior	3(2-1)	Major Disciplinary Specific	
ZOO-682	Evolution & Principles of Systematics	3(2-1)	Major Disciplinary Specific	
ZOO-683	Zoogeography & Paleontology	3(2-1)	Major Disciplinary Specific	
ZOO-684	Fundamentals of Endocrinology	3(2-1)	Major Disciplinary Specific	
ZOO-685	Capstone Project	03	Major	
Semester Credit Hours		**15**		

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8th Semester

ZOO-681 Animal Behavior Cr. Hrs. 3(2-1)

Aims and Objectives:

- Impart knowledge about animal responses to external stimuli
- Emphasize different kinds of behaviors classical and modern concepts
- Explain through examples development, evolution and occurrence of behavior
- Understand the genetic and neurophysiological basis of behavior

Course Outline:

- Foundation of Animal Behavior.

Ethology, classical ethology

- Kinds of behavior

Innate mechanisms, imprinting

- Mechanisms of behavior

Nervous system and behavior, hormones and behavior,

- Social Behavior.

Agonistic, altruistic, kinship, mating, ritualization, dominance, territoriality

- Biological rhythms

Circadian clocks, clock genes etc.

- Social Organization

Conflict, sexual behavior, reproduction and fitness, parental care, social system.

- Animal Communication

Chemical attraction, in moths, honey bees, communication displays, pheromones etc.

Practical

- Locomotory behavior of small animals, earthworm, garden snails etc.
- Ear pinna reflex responses in domestic cats
- Preparation of skinner box or maze for study of mouse or rat behavior
- Mother-pup bond in mice and rats
- Infant killing behavior
- Pecking behavior of chickens
- Hiding behavior of chicks
- Observation of birds nests and study of parental behavior
- Altruistic behavior in monkeys.

Recommended Books:

1. Dugatkin, L. A. 2012. Principles of Animal Behavior. W.W. Nortan and Co. New York.
2. Scott, G. 2005.Essential Animal Behavior. Blackwell Pub. New York.
3. Goodenough, J., McGuire, B., Wallace, R.A. 2001.Perspective on Animal Behavior. John Wiley & Sons, New York.

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ZOO-682 Evolution & Principles of Systematics Cr. Hrs. 3(2-1)

Aims and Objectives:

- To provide in-depth knowledge of origin of life
- Develop concepts about forces responsible for evolutionary changes
- Study the importance and history of systematics with basic rules and regulations about the identification and naming of organisms

Course Outline:

- Evolution

The nature and origin to life: Evidences of evolution (molecular, embryological & paleontological). Theories of Evolution: Theories to explain the diversity of life – Modern synthetic theory, factors initiating elementary evolutionary changes micro-evolution) by changing gene frequencies, mutation pressure, selection pressure, immigration and crossbreeding, genetic drift. Role of isolation in evolution: Factors of large evolutionary changes (macro/mega evolution) - allometry, orthogenesis, adaptive radiation.

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

- Importance and applications of systematics

Taxonomy in Animal science, systematics as a profession and its future perspectives.

- History of Taxonomy

Systematics, basic terminology of systematics, theories of biological classifications.

- Taxonomic Characters

Kinds and weightage, microtaxonomy, taxonomic categories: specific category, infraspecific category, higher categories; Species concept.

- Typological species concept

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

- Systematics publications

International code of zoological nomenclature; its objective, principles, interpretation, application of important rules, with reference to: Zoological nomenclature, law of priority and validity of names.

Practical:

- Study of preserved invertebrate species and their classification up to class level.
- Collection, preservation and identification of common species with the help of keys.
- Preparation of keys for the identification of specimens.

- Methods of statistical analysis of samples from populations T-test,
- Analysis of variance etc.

Recommended Books:

1. Strickberger. M.W. 2012.Evolution. Jones & Barrett Publishers.
2. Ridley, M. 1993. Evolution. Blackwell Scientific Publications.
3. Moody, P.A. 1989. Introduction to Evolution, Harper and Row Publishers, New York.
4. Dobzhansky, T., Ayala, F.J., Stebbins, G.L., Valentine, J.W. 1973. Evolution. W.H. Freeman and Company.
5. Mayr, E. 1965.Populations, Species and Evolution, Harvard University Press.
6. Wiley, E. O. and Lieberman, B. S. 2011. Phylogenetics: Theory and practice of phylogenetic systematics. 2nd Ed. Wiley-Blackwell.

ZOO-683 Zoogeography & Paleontology Cr. Hrs. 3(2-1)

Aims and Objectives:

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

Course Outline:

- Branches of zoogeography

Branches of zoogeography: descriptive, chorology, faunistics, systematic, biocoenotic, causal, ecological, historical, experimental and applied zoogeography.

- Animal Distribution

Cosmopolitan distribution, discontinuous distribution, isolation distribution, bipolar distribution and endemic distribution, barriers and dispersal.

- Zoogeographical regions

Zoogeographic division and boundaries,geographic ranges, physical features, climates, faunas and affinities of Palaearctic, Nearctic regions, Oriental, Ethiopian, Australian, and Neotropical Regions, insular fauna

- Paleogeography

Theories of continental drift and plate tectonics; Pangea.

- Zoogeography of Pakistan
- The Planet Earth

History, age, shells of earth; atmosphere, hydrosphere, biosphere and lithosphere.

- Rocks

Types; lgneous rocks, sedimentary rocks and metamorphic rocks. Fossil types and uses of fossils, nature of fossils.

- Fossilization

Geological time scale. Pre-Cambrian life. Post Cambrian life, Palaeozoic life, Mesozoic life, Cenozoic life.

- Geochronometry

Uranium/Lead dating, radiocarbon dating, methods, index fossils; evolutionary history of man, elephant, horse and camel, Paleoecology, Paleomagnetism

Practical:

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

Recommended Books:

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

ZOO-484 Fundamentals of Endocrinology Cr. Hrs. 3(2-1)

Aims and Objectives

The aim of course is

- To provide knowledge about the fundamental biochemical and molecular aspects of endocrinology and chemistry of blood and other extracellular fluids

Course outline

- General introduction to endocrinology
- Chemical nature of hormones,
- Common characteristics of Endocrines
- Mode of action of hormones
- Hormones receptors, chemistry, biosynthesis, metabolism and biological functions of pituitary, adrenal, thyroid, parathyroid, pancreatic and gonadal hormones, hormones of GIT, renal and pineal Glands.
- General composition of blood
- Function of blood plasma, plasma protein
- Composition and functions, composition, development and functions of red blood cells, white blood cells and platelets, Hemoglobin, chemistry properties, synthesis, functions and derivatives Degradation of hemoglobin, respiration and gas transport, blood coagulation and clotting of blood, blood pressure, blood groups, composition of urine, extracellular.

Practical

- Lab techniques for analysis of biochemical materials including biological activity assay
- Chromatographic and electro phoretic separation of macromolecules
- Estimation of water soluble vitamin-C and fat soluble vitamin-D.
- Characterization of proteins by SDS-PAGE.

- Isolation and characterization of DNA by Agarose gel electrophoresis

Recommended books

1. Nelson, D. L. and Cox, M. M., Lehninger's Principles of Biochemistry, 6th ed., W. H. Freeman, (2012).
2. Voet, D. and Voet, J. D, Biochemistry, 4th ed., illustrated. John Wiley & Sons, (2011).
3. Hall, J. E., Guyton & Hall Textbook of Medical Physiology, 12th ed., Elsevier Health Sciences, (2011).
4. Orten, James. M. and Neuhaus, O. W., Human Biochemistry, 10th ed., Mosby, Incorporated, (1982).
5. Devlin, T. M., Textbook of Biochemistry with Clinical Correlations, 7th ed., Wiley, (2010).
6. Hadley, M. and Levine, J. E., Endocrinology, 6th ed., Pearson, (2006).