

REVISED SCHEME OF STUDIES FOR 2-YEAR ASSOCIATE DEGREE/BS (4-YEAR) IN BOTANY

Shaheed BB University, Sheringal



**Revised scheme of studies for the Department of Botany in Accordance with HEC new Under Graduate
Education Policy-2023: Effective from Fall-2023 onward**

SCHEME OF STUDIES (1-8 SEMESTERS) FOR BS / ASSOCIATE DEGREE IN BOTANY

Semester-I				
Course Category	Course Code	Course Title	Credits	Marks
Gen	ENG-31	Functional English	3	100
Gen	ISL-312	Islamic Studies	2	50
Gen		Quantitative Reasoning-I (Exploring Quantitative Skills)	3	100
Major	BOT-311	Diversity of Plants	3+1	100
Allied	ZOO-316	Animal Diversity-I (invertebrates)	2+1	100
Allied	CHEM-151	Inorganic Chemistry	2+1	100
Total Credits			18	550

Semester-II				
Course Category	Course Code	Course Title	Credits	Marks
Gen	ENG-321	Expository Writing	3	100
Gen	PS-322	Ideology and Constitution of Pakistan	2	50
Gen		Quantitative Reasoning-II (Tools for Quantitative Reasoning)	3	100
Major	BOT-321	Plant Systematic Anatomy & Development/ Embryology	3+1	100
Allied	ZOO-326	Animal Diversity-II (Chordates)	2+1	100
Allied	CHEM-161	Organic Chemistry	2+1	100
Total Credits			18	550

Semester III				
Course Category	Course Code	Course Title	Credits	Marks
Gen		Natural Science	3(2+1)	100
Gen		Civics and Community Engagement	2	50
Gen		Islamic History (Arts and Humanities)	2	50
Major	BOT-411	Cell Biology, Genetics and Evolution	3+1	100
Major	BOT-412	Morphology of Plants (Terminology)	3+1	100
Major	BOT-413	Introductory Horticulture	2+1	100
Total Credits			18	550

Semester-IV				
Course Category	Course Code	Course Title	Credits	Marks
Gen		ICT	3 (2+1)	100
Gen		Entrepreneurship	2	50
Gen		Human Rights Law (Social Science)	2	50
Major	BOT-421	Plant Physiology and Ecology	3+1	100
Major	BOT-422	Biostatistics	2+1	100
Major	BOT-423	Biodiversity and Conservation	3+1	100
Total Credits			18	550

Semester-V				
Course Category	Course Code	Course Title	Credits	Marks
Major	BOT-511	Bacteriology and Virology	2+1	100
Major	BOT-512	Phycology and Bryology	2+1	100
Major	BOT-513	Mycology and Plant Pathology	2+1	100
Major	BOT-514	Diversity of Vascular Plants	2+1	100
Major	BOT-515	Plant Systematics	2+1	100
Total Credits			15	500

Semester-VI				
Course Category	Course Code	Course Title	Credits	Marks
Major	BOT-521	Plant Anatomy	2+1	100
Major	BOT-522	Genetics-I	2+1	100
Major	BOT-523	Plant Biochemistry-I	2+1	100
Major	BOT-524	Plant Ecology-I	2+1	100
Major	BOT-525	Plant Physiology-I	2+1	100
Total Credits			15	500

Semester VII				
Course Category	Course Code	Course Title	Credits	Marks
Major	BOT-611	Molecular Biology	2+1	100
Major	BOT-612	Plant Biochemistry-II	2+1	100
Major	BOT-613	Plant Ecology-II	2+1	100
Major	BOT-614	Plant Physiology-II	2+1	100
Major	BOT-615	Genetics-II	2+1	100
Major	BOT-616	Field Experience	3+0	100
Total Credits			18	600

Semester-VIII				
Course Category	Course Code	Course Title	Credits	Marks
Major	BOT-621	Environmental Biology	2+1	100
Major	BOT-622	Plant Tissue cultures	2+1	100
Major	BOT-623	Capstone Project/ Thesis	3+0	100
Major	BOT-624	Plant Breeding	2+1	100
Major	BOT-625	Stress Physiology	2+1	100
Total Credits			15	500

Category	I	II	III	IV	V	VI	VII	VIII	CHR
General Courses	08	08	07	07	00	00	00	00	30
Inter dis. Course	06	06	00	00	00	00	00	00	12
Major Courses	04	04	11	11	15	15	15	12	87
Field Experience	00	00	00	00	00	00	03	00	03
Capstone Project	00	00	00	00	00	00	00	03	03
Semester-wise CHR	18	18	18	18	15	15	18	15	135

Semester-I				
Course Category	Course Code	Course Title	Credits	Marks
Gen	ENG-31	English-I (Functional English)	3	100
Gen	ISL-312	Islamic Studies	2	50
Gen	QRZ-311	Quantitative Reasoning-I (Exploring Quantitative Skills)	3	100
Major	BOT-311	Diversity of Plants	3+1	100
Allied	ZOO-316	Animal Diversity-I (invertebrates)	2+1	100
Allied	CHEM-151	Inorganic Chemistry	2+1	100
Total Credits			18	550

General Edu.	ENG- 311	Functional English	03
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Course Outline:

Basics of Grammar: Parts of speech and use of articles, Sentence structure, Active and passive voice, Practice in unified sentence, Analysis of phrase, clause and sentence structure, Transitive and intransitive verb, Punctuation and spelling Comprehension: Answers to questions on a giventext

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

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

Translation skills: Urdu to English

Paragraph writing: Topics to be chosen at the discretion of the teacher
Presentation skills: Introduction to presentations and deliberations **Note: Extensive reading is required for vocabulary building**

Reference Materials

1. Thomson, A.J., Martinet, A.V. Practical English Grammar and Exercises Latest Ed. Oxford University Press
2. Boutin, M-C., Brinand, S., Grellet, F. Writing. Intermediate and Supplementary Skills. Oxford Fourth Impression Latest Edi.
3. Tomlinson, B., Ellis, R. Latest Edition. Reading. Upper Intermediate. Oxford Supplementary Skills. Third impression

General Edu.	ISL-312	Islamic Studies/Ethics (Only for Non-Muslims)	02
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Course Contents

Introduction to Quranic Studies: Basic Concepts of Quran: History of Quran; Uloom-ul -Quran

Study of Selected Text of Holy Quran: Verses of Surah Al-Baqra Related to Faith (Verse No-284-286), Verses of Surah Al-Hujrat Related to Adab AlNabi (Verse No-1-18), Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11), Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77), Verses of Surah Al-Inam Related to Ihkam(Verse No-152-154)

Study of Selected Text of Holy Quran: Verses of Surah Al-Ihزاب Related to Adab al-Nabi (Verse No.6,21,40,56,57,58.), Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment, Verses of Surah Al-Saf Related to Tafakar, Tadabar (Verse No-1,14)

Seerat of Holy Prophet (S.A.W) I: Life of Muhammad Bin Abdullah (Before Prophet Hood); Life of Holy Prophet (S.A.W) in Makkah; Important Lessons Derived from the life of Holy Prophet in Makkah

Seerat of Holy Prophet (S.A.W) II: Life of Holy Prophet (S.A.W) in Madina: Important Events of Life Holy Prophet in Madina; Important Lessons Derived from the life of Holy Prophet in Madina

Introduction to Sunnah: Basic Concepts of Hadith; History of Hadith; Kinds of Hadith; Uloom –ul-Hadith; Sunnah & Hadith; Legal Position of Sunnah

Selected Study from Text of Hadith

Introduction to Islamic Law & Jurisprudence: Basic Concepts of Islamic Law & Jurisprudence; History & Importance of Islamic Law & Jurisprudence; Sources of Islamic Law & Jurisprudence; Nature of Differences in Islamic Law; Islam and Sectarianism

Islamic Culture & Civilization: Basic Concepts of Islamic Culture & Civilization; Historical Development of Islamic Culture & Civilization; Characteristics of Islamic Culture & Civilization; Islamic Culture & Civilization and Contemporary Issues

Islam & Science: Basic Concepts of Islam & Science; Contributions of Muslims in the Development of Science; Quran & Science

Islamic Economic System: Basic Concepts of Islamic Economic System; Means of Distribution of wealth in Islamic Economics; Islamic Concept of Riba; Islamic Ways of Trade & Commerce

Political System of Islam; Basic Concepts of Islamic Political System; Islamic Concept of Sovereignty; Basic Institutions of Govt. in Islam

Social System of Islam; Basic Concepts of Social System of Islam; Elements of Family; Ethical Values of Islam.

General Edu.		Ethics (Only for Non-Muslims)	02
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Ethics (for Non-Muslims only)

Course Outlines

- Defining Ethics; and its relation to Philosophy
- Morality as Compared with other Normative Subjects
- Characteristics of Moral Principle
- The Purposes of Morality
- Cultural Relativism
- Cultural Relativism as a theory of Morality
- Judging a Cultural Practice to be Undesirable
- Ethical Subjectivism
- The First Stage: Emotivism
- Emotivism, Reason and Moral Facts
- The Presumed Connection between Morality and Religion
- The Natural Law Theory
- The Utilitarian Approach: a Revolution in Ethics:
- Mill’s Utilitarianism: a modified version
- Implications of Utilitarianism
- Is Happiness the Only Thing That Matters? Are Consequences All That Matters?
- Defense of Utilitarianism
- Kant and the Categorical Imperative
- Absolute Rules and the Duty Not to Lie
- Kant and the Respect for Person
- Retribution and Utility in the Theory of Punishment
- The Ethics of Virtue and the Ethics of Right Action
- Some Advantages of Virtue Ethics
- Business Ethics
- The Nature of Business Ethics

- The Ethics of Advertising and Green Issues in Business
- Environmental Ethics
- Arguments for and against the Use and Exploitation of the Natural Environment
- Bioethics---Ethical Issues in Medicine
- Confidentiality, Guilt and Innocence in Treating Patients, Euthanasia, Ethics and Behavior Control, Genetics

Recommended Books

1. Rachels, J., & Rachels, S. (2012). The Elements of Moral Philosophy 7e. McGrawHill. ISBN: 0-07-247690-7
2. Loue, S. (2007). Textbook of research ethics: Theory and practice. Springer Science & Business Media.
3. Hendin, J. (1999). The Right Thing to Do. Feminist Press at CUNY.
4. Pojman, L. P., & Fieser, J. (2016). Cengage advantage ethics: Discovering right and wrong. Cengage Learning.
5. Vaughn, L. (2015). Doing ethics: Moral reasoning and contemporary issues. WW Norton & Company

General Edu.	QRZ-311	Quantitative reasoning-I (Exploring Quantitative Skills)	03
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WEEKLY BREAKDOWN

MODULE-I Exploring Importance of Quantitative Reasoning Skills (1 WEEK):

1. What is quantitative reasoning?
2. Overview of Contributions of Mathematicians especially Muslim scholars.
3. Different types of Standard numbers and their role in practical life scenarios.

MODULE-II Problem Solving Techniques (2.5 WEEKS):

1. Understanding relationship between parts and whole
2. Practical life scenarios involving units and rate
3. Unit Analysis as a problem-solving tool.

MODULE-III Number and the Universe (2.5 WEEKS)

1. Understanding our World through numbers.
2. Dealing with very big and small numbers & their applications.
3. Understanding uncertainty and its applications.

MODULE- IV Financial Issues (3 WEEKS)

1. Money management (profit, loss, discount, taxation, and other scenarios involving percentage)
 2. Money management in practical life scenarios like investments and federal budget, simple and compound interest, Saving plans, and economy.
- ##### MODULE-V Exploring Expressions (2 WEEKS)

1. Practical scenarios involving expressions.
2. Equating two expressions in one variable & using it to solve practical problems.

MODULE-VI Exploring Beauty in Architecture and Landscape (2 WEEKS)

1. Introduce geometrical objects through architecture and landscape.
2. Dealing with social and economic issues involving geometrical objects.

MODULE-VII Venn Diagrams (1 WEEK)

Venn diagrams and their applications.

TEACHER MANUAL

[Quantitative Reasoning Courses\Quantitative Reasoning Teacher Manual - Sept 2021 - HEC.pdf](#)

RECOMMENDED RESOURCES:

1. Using and understanding mathematics, 6th edition by Jeffrey Bennet and William Briggs, published by Pearson USA.
2. Mathematical thinking and reasoning 2008 by Aufmann, Lockwood, Nation & Clegg published by Houghton Mifflin Company USA.
3. Precalculus by Robert Blitzer, 5th edition published by Pearson USA.
4. Precalculus Graphical, Numerical, Algebraic 8th edition by Franklin D. Demana, Bert K. Waits, Gregory D. Foley &

Daniel Kennedy published by Addison Wesley USA.

5. Precalculus Mathematics for Calculus, 6th edition by James Stewart, Lothar Redlin and Saleem Watson published by Brooks/Cole Cengage Learning USA.

6. GRE Math Review https://www.ets.org/s/gre/pdf/gre_math_review.pdf

7. OpenAlgebra.com A free math study guide with notes and YouTube video tutorials

Allied	BOT-314	Botany – I (Diversity of Plants)	3(2+1)
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Course Contents

Comparative study of life form, structure, reproduction and economic significance of:

1. Viruses (RNA and DNA types) with special reference to TMV
2. Bacteria and Cyanobacteria (Nostoc, Anabaena, Oscillatoria) with specific reference to biofertilizers, pathogenicity and industrial importance;
3. Algae (Chlamydomonas, Spirogyra, Chara, Vaucheria, Pinnularia, Ectocarpus, Polysiphonia)
4. Fungi (Mucor, Penicillium, Phyllactinia, Ustilago, Puccinia, Agaricus), their implication on crop production and industrial applications.
5. Lichens (Physcia)
6. Bryophytes
 - i. Riccia
 - ii. Anthoceros
 - iii. Funaria
7. Pteridophytes.
 - i. Fossils and fossilization
 - ii. Psilopsida Psilotum)
 - iii. Lycopsida (Selaginella)
 - iv. Sphenopsida (Equisetum)
 - v. Pteropsida (Marsilea)
 - vi. Seed Habit h)
8. Gymnosperms
 - i. Cycas
 - ii. Pinus
 - iii. Ephedra

Practicals:

Culturing, maintenance, preservation and staining of microorganisms. Study of morphology and reproductive structures of the types mentioned in theory.

Identification of various types mentioned from prepared slides and fresh collections.

Allied	CHEM-151	Inorganic Chemistry	3(2+1)
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Course Contents:

Chemical Bonding: Types of chemical bonding, ionic and covalent bonding, localized bond approach, theories of chemical bonding, valence bond theory (VBT), hybridization and resonance, prediction of molecular shapes using Valence Shell Electron Pair Repulsion (VSEPR) model, molecular orbital theory (MOT) applied to diatomic molecules, delocalized approach to bonding, bonding in electron deficient compounds, hydrogen 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.

Practicals:

Lab safety and good laboratory practices, knowledge about material safety data sheets (MSD), disposal of chemical waste and first-aid practices, qualitative analysis of salt mixtures, quantitative analysis, acid- base titrations, preparation and standardization of acid and alkali solutions, redox titrations, preparation and standardization of potassium permanganate solution and its use for the determination of purity of commercial potassium oxalate or oxalic acid, preparation and standardization of sodium thiosulfate solution and its use in determination of copper in a given sample, gravimetric analysis, determination of barium in a given sample, determination of chloride in a given solution.

Recommended Books:

1. Inorganic chemistry, principles of structure and Reactivity 4th Ed. By J.EHuheey, E.A. Keiter and R.L Keiter, Harper international.
2. Basic inorganic chemistry by F.A Cotton and G.Willinson, Advanced chemistry 5th Ed. F.A cotton john wiley and sons New York.
3. Housecroft.C. Sharpe. A.G. Inorganic Chemistry (2nd Edition).2004. PrenticeHall
4. House.J.E. Inorganic Chemistry.2008. Academic Press

Major	ZOO-316	Animal Diversity-I (Invertebrates)	3+1
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Course Contents:

Note: The minimum details of the titles in the content must be of the principal book Zoology by Miller and Harley. This must be kept in view in teaching and assessments.

1. INTRODUCTION

a. Classification of Organisms:

2. ANIMAL-LIKE PROTISTS: THE PROTOZOA

a. Characteristics. b. Classification up to class c. Symbiotic Life-styles. d. Locomotion in protozoa, e. Nutrition and Reproduction; f. Economic importance of protozoa. g. Parasitism in protozoa, h. Protozoa and human diseases

3. MULTICELLULAR AND TISSUE LEVELS OF ORGANIZATION

Phylum Porifera

a. Characteristics and classification. Cell Types, Body Wall, and Skeletons; b. types of canal system; c. Reproduction.

Phylum Cnidaria (Coelenterate)

a. Characteristics. b. Classification up to Class. c. The body Wall and Nematocysts, d. Reproduction: Alteration of generations. f. Corals and coral reefs

Phylum Ctenophore;

a. Characteristics, body organization

4. THE TRIPLOBLASTIC ORGANIZATION

PHYLUM PLATYHELMINTHES (ACOELOMATE)

a. Characteristics. b. Classification up to class, c. The Free-Living Flatworms and the Tapeworms, parasitic adaptations in platyhelminths

5. PHYLUM ASCHELMINTHS (PSEUDOCOELOMATE)

a. General Characteristics, b. Classification up to class, c. Helminths and human diseases,

COELOMATIC ORGANIZATION

6. PHYLUM ANNELIDA

a. General Characteristics, b. Metamerism and Tagmatization, c. Classification up to Class. d. Locomotion, Feeding and the Digestive system, Gas Exchange and Circulation, e. Nervous and Sensory Functions, Excretion, f. Reproduction; Regeneration,

7. PHYLUM MOLLUSCA

a. General Characteristics, b. Classification up to class. c. Shell, Feeding, Digestion, Gas Exchange, Locomotion, d. Reproduction and Development, e. Economic importance

8. PHYLUM ARTHROPODA

a. General Characteristics, b. Classification up to class. c. Biological success; d. Insects mouth parts, e. Economic importance of insects, f. Reproduction: Development, Metamorphosis; g. Economic importance of crustaceans.

9. PHYLUM ECHINODERMS

a. General Characteristics, b. Classification up to class. c. Reproduction; Regeneration, Larval forms.

Practical:

Note: Classification of each members of each phylum up to order with adaptations in relation to habitat of the specimen. Preserved Specimen and or colored projection slide and or CD ROM projection of computer must be used.

1. Study of Euglena, Amoeba, Entameba, Plasmodium, Trypanosome, Paramecium as representative of animal like Protists.
2. Study of prepared slides of sponges, spicules of sponges, and their various body forms. Study of representatives of classes of Phylum Porifera.
3. Study of principal representatives of classes of Phylum Coelenterate.
4. Study of principal representatives of classes of Phylum Platyhelminthes.
5. Study of representatives of phylum Rotifer, Phylum Nematode.
6. Study of principal representatives of classes of Phylum Mollusca.
7. Study of principal representatives of classes of Phylum Annelida.
8. Study of principal representatives of classes of groups of Phylum Arthropoda
9. Study of representatives of classes of phylum Echinodermta.
10. Preparation of permanent mount of Leucosolenia, Obelia, Hydra, Proglottid of Tapeworm, Parapodia of Nereis and Daphnia. Drawing and labeling.
11. Preparation of permanent slide of mouthpart of insects (after dissection). Drawing and labeling.
12. How to make grade-wise series for preparation of temporary and permanent slides.
13. Field study tour to Insectary, Insect museum, Invertebrates aquaria etc

Recommended Principal Reference Book:

1. Miller, A.S. and Harley, J.B. ; Latest Edition (International), Singapore : McGraw Hill. Additional Readings:
2. Hickman, C.P., Roberts, L.C/, AND Larson, A., 2018. INTEGRATED PRINCIPLES OF ZOOLOGY, 15th Edition (International), Singapore: McGRAW-Hill.
3. Hickman, C.P., Roberts, L.C/, AND Larson, A., 2007. INTEGRATED PRINCIPLES OF ZOOLOGY, 12th & 13th Edition (International). Singapore: McGraw-Hill.
4. Pechenik, J.A., 2015. BIOLOGY OF INVERTEBRATES, 7th Edition, (International), Singapore: McGraw-Hill.
5. Kent, G. C. and Miller, S., 2001. COMPARATIVE ANATOMY OF VERTEBRATES New York: McGraw-Hill.
6. Campbell, N.A., 2002; BIOLOGY 6th Edition, Menlo Park, California; Benjamin ummings Publishing Company, Inc.

BOOKS FOR PRACTICAL

7. Miller, S.A., 2002. GENERAL ZOOLOGY LABORATORY MANUAL. 5th Edition International), Singapore: McGraw-Hill.
8. Hickman, C.P. and Kats, H.L., 2000. Laboratory Studies in integrated principal of zoology. Singapore: McGraw-Hill

Semester-II			
Course Category	Course Code	Course Title	Credits
General Edu.	ENG- 321	Expository writing	03
General Edu.	PS-322	Ideology and Constitution of Pakistan	02
General Edu.	QRZ-321	Quantitative reasoning-II (Tools for quantitative reasoning)	03
Allied	CHEM-324	Organic Chemistry	3(2+1)
Major	ZOO-325	Cell Biology	3(2+1)
Major	ZOO-326	Animal Diversity-II (Chordates)	4(3+1)
Total Credits			18

General Edu.	ENG- 321	Expository writing	03
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1. COURSE

CONTENTS Unit 1: Self

Reflection

- Introduction to the basics of the writing process
- Introduction to the steps of essay writing
- Students practice prewriting activities like brainstorming, listing, clustering and free writing
- Students practice outlining of the essay

Unit 2: Personalized Learning

- Students reflect on their learning process
- Group discussion about learning styles based on the reading material provided to students
- Introduction to personalized learning
- Students practice goal setting
- And create a learning plan
- Introduction to the structure and significance of oral presentations
- Class discussion about content selection and slide preparation for oral presentations
- Peer review through a gallery walk

Unit 3: Critical Reading Skills

- Introduce authentic reading (DAWN newspaper and non-specialist academic books/texts)
- Conduct classroom reading activities (using strategies skimming, scanning, SQW3R, previewing, annotating, detailed reading and note-taking) using standard tests (TOEFL and IELTS) Assign books/articles/reports for their individual home assignments.
- Share model review reports and annotated bibliographies

Unit 4: Community Engagement

- Showing short documentaries to students on global environmental issues
- Student-led brainstorming on local versus global issues
- Teacher-led introduction to the unit assignment (using assignment sheet)
- Readings (or other input sources - video, social media) from local news on possible community issues, letters to editor and op-eds
- Identify research problems
- Begin drafting research questions based on the problems identified
- Facilitating students on developing research questions in groups
- Draft interview or survey questions for community research (in English or L1)
- In-class role-plays of interviews with community members
- Engaging students in critical reading and reflection on the issues found in different communities
- In-class work on understanding interview information, how to present interview or survey information
- Refining the research questions, designing a detailed research plan in groups, dividing the tasks and deciding the timeline for the completion of the project
- Exposure to interview questions and interviewing techniques to develop an in-depth understanding of the issues
- Continued group work on report outline
- In-class lecture and group work on analyzing information
- Discussion based on translating the data from the source language to the target language (English)
- Sharing the experience of field work in class orally

- Teacher feedback on outline of report (globally to entire class and individually to groups as needed)
- Revisions to oral report in groups Engaging students in individual structured reflective writing based on their experience of working on the project
- Sharing their reflective writing to learn about each other's points of view
- Think-pair-share the findings (group similar issues)
- Individual writing of reflection on the community engagement project and their role in the group
- Brainstorm using creativity for dissemination - cartoons, advertisements for university magazine or beyond, creating posts for FB
- Summarizing/ converting the report to a letter to the editor to highlight the problems explored and their possible solutions (homework - connecting activity for week 11 - Unit 5)

Unit 5: Letter to the Editor

- Teacher-directed instruction on genres (types) of writing focusing on letter-writing
- Model-practice-reflect: Introduce types of letters comparing the use of formal and informal vocabulary and phrases in each type
- Introduce the format and purpose of the letter-to-editor explaining with the help of an actual letter from a local newspaper
- Group reading of sample letters-to-editor selecting ones that deal with issues familiar to the students
- Invite a guest lecturer (local newspaper editor or faculty from journalism) to talk about what issues are currently raised in letters-to-editors and what are editors' criteria to accept letters for publication
- Work in groups to continue reviewing letter samples, analyzing the structure of letters
- Each group identifies an issue they want to write about and give a brief oral presentation to the class
- Submit the first draft of letters (to the teacher and peer-review group)
- In-class peer review of drafts using a checklist focusing on content and structure DUE:
- First draft of letter (to teacher and peer review group)
- Groups revise first draft of letter
- Differentiate among revision, proofreading and evaluation (as sub stages of finalizing documents)
- Discuss critically the draft-letter and implement the 'revision' phase of writing Reading of (DAWN) newspaper and sharing important letters (to editors) on local issues
- Groups revise second draft of letter Explicit instruction (paragraph structure, syntax, diction, grammar, and mechanics)
- Classroom discussion/debrief of activity Discuss critically and finalize the draft-letter as the last phase of writing

Teacher Manual & Suggested Reading

[Expository Writing Course Outline - Sept 2021 - HEC.pdf Detailed](#)

[Courses - Expository Writing - Sept 2021 - HEC.pdf](#)

[Expository Writing Teachers Manual - Sept 2021 - HEC.pdf](#)

General Edu.	PS-322	Ideology and Constitution of Pakistan	02
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I. CREATION OF PAKISTAN

a) Ideology: Conservative and liberal perspectives

i) Significance before and after independence

ii) Quaid-e-Azam's vision about Pakistan

b) POLITICAL DYNAMICS

i) Democracy and authoritarianism

1. **Political Culture:** Parties and pressure groups

iii) **National integration:** Resources and distribution

iv) Governance and civil rights

II. ECONOMY

i) Agro-industrial growth

ii) Irrigation projects

iii) Economic development and poverty alleviation

iv) Foreign aid and economic stability

v) Characteristics of developing countries

III. FOREIGN POLICY

Determination of foreign policy, national interests, post-cold war environments of Pakistan: new world, order and nuclear non-proliferation

IV. ENVIRONMENT: definition and dimensions, management and natural resources environmental pollutions: industrial; agricultural; land; water; air and space environmental protection

V. POPULATION: Characteristics: Rural; urban; gender; age groups; and population growth, economic indicators: employment; education health and poverty, migration

VI. SOCIETY: Definitions, characteristics: multilingual, multi-ethnic and parochial, social stratification and social mobility, social problems

VII. CULTURE: Definitions, social organization; kinships; family; clan and tribe, material and non-material cultures, cultural institutions

Books Recommended

1. Shahid Javed Burki, State and Society in Pakistan, The Macmillan Press Ltd.1980 (Reprint, 1997)
2. Wayne Wilcox The Emergencies of Bangladesh, Washington AmericanEnterprise Institute of Public Policy Research 1972
3. Safdar Mehmood Pakistan Kayyum Tooda Idara-Saqafat-e-Islamia, ClubRoad Lahore
4. Tahir Amin National Movement of Pakistan Institute of Policy studiesIslamabad.
5. Lawrence Ziring, Enigma of Political Development, WmDawson and son Ltd.Cannon House Falkstone. Kent England 1980
6. Waseem Ahmad Pakistan under Marshal Law, Lahore 2002
7. Ansar Zahid, History and culture of Sindh, Karachi Royal Book Company1980
8. G.A Allana culture of Pakistan
9. Enamery Shamil The Pearls of Sindh
10. M Rafique Afzal Political Parties in Pakistan Vol I, II, and III IslamabadNational of Historical and culture Research 1998
11. Inyatullah Bureaucracy, Development in Pakistan Peshawar 1996
12. M Ikram Rabbani Pakistan Affairs Lahore Carwan Book House 1997
13. M Ikran Rabbani and Munawar Ali Sayyid An introduction to Pakistanstudies Karwan Book House 1999
14. Crompton.S.W. Pakistan (Modern World Nations) (2nd Edition).2006. ChelseaHouse Publications

General Edu.	QRZ-321	Quantitative reasoning-II (Tools for quantitative reasoning)	03
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WEEKLY BREAKDOWN

MODULE-1 Exploring Graphical Information

1. Investigating relationships between variables.
2. Exploring tools to find relationship between variables, Resources, and population growth: dealing with economic, environmental, and social issues.

MODULE-2 Building blocks of a plane

1. Graphical and analytical approaches to solve a problem.
2. Applications of graphical & analytical approaches to solve social & economic problems.

MODULE-3 Exploring inequalities

1. Understanding inequalities around us
2. Dealing with practical problems involving inequalities in different disciplines

MODULE-4 Comparing quantities

1. Golden ratio in sculptures
2. Comparison of statements and their use in social and economic problems,
3. Sequence

MODULE-5 Thinking Logically

1. Survival in the modern World,
2. Propositions and truth values,
3. Categorical proposition, and its applications

MODULE-6 Understanding Data

1. Methods to explore and summarize data, drawing graphs and identifying misleading graphs,
2. Methods to discuss the basic characteristics of any datasets, like finding a most representative value in a data, and methods to measure the amount of spread of a data,
3. Methods to measure degree of relationship among variables, finally this module includes methods to Count the odds.

TEACHER MANUAL

[Quantitative Reasoning Courses\Quantitative Reasoning Teacher Manual - Sept 2021 - HEC.pdf](#)

RECOMMENDED RESOURCES

1. Using and understanding mathematics, 6th edition by Jeffrey Bennet and William Briggs, published by Pearson USA.
2. Mathematical thinking and reasoning 2008 by Aufmann, Lockwood, Nation & Clegg published by Houghton Mifflin company USA.
3. Pre-calculus by Robert Blitzer 5th edition published by Pearson USA.
4. Pre-calculus Graphical, Numerical, Algebraic 8th edition by Franklin D. Demana, Bert K. Waits, Gregory D. Foley & Daniel Kennedy published by Addison Wesley USA.
5. Pre-calculus Mathematics for Calculus, 6th edition by James Stewart, Lothar Redlin and Saleem Watson published by Brooks/Cole Cengage Learning USA.
6. https://www.ets.org/s/gre/pdf/gre_math_review.pdf
7. Open Algebra. Com A free math study guide with notes and YouTube video tutorials.

Allied	161	Organic Chemistry	3(2+1)
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Basic Concepts of Organic Chemistry:

Bonding and hybridization, localized and delocalized bonding, structure aromaticity, inductive effect, dipole moment, resonance and its rules, hyperconjugation, classification and nomenclature of organic compounds including IUPAC system, 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.

Practicals:

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, organic syntheses may include preparation of benzanilide from benzoyl chloride, succinic anhydride from succinic acid, phthalimide from phthalic anhydride, oximes and hydrazones from carbonyl compounds, and an ester from a carboxylic acid and alcohol etc.

Books recommended:

1. Organic chemistry for B. Sc by M. Younas
2. Organic chemistry by B. S. Bhal
3. Clayden.J, Greeves N, Warren.S and Wothers.P.Organic Chemistry.2008. OxfordUniversity Press
Klein.D.R.Organic Chemistry as a Second Language.2009. Wiley

Major		Cell Biology	
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Course Outline:

1. Introduction cell structure and function

- a. Cell theory
- b. Comparison of plant and animal cells
- c. Comparison of prokaryotic and eukaryotic cells

2. Cell membranes

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

3. Cell Organelles (structure and function)

- a. Endoplasmic reticulum
- b. Golgi Bodies
- c. Mitochondria
- d. Lysosomes
- e. Peroxisomes
- f. Ribosome

4. Nucleus

- a. Structure and function
- b. Nuclear membrane
- c. Chromatin

5. Cytoskeleton

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

6. Cellular transport

- a. Diffusion and osmosis
- b. Facilitated and active transport
- c. Endocytosis and exocytosis

7. Cellular reproduction

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

Practical:

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

Books Recommended:

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

Major	ZOO-326	Animal Diversity-II (Chordates)	3+1
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Course Outline:

1. Protochordates

- Classification of protochordates.
- Structure, anatomy and organ systems of Acorn worms, Urochordates and Cephalochordates
- Reproduction; life histories and metamorphosis of protochordates.

2. Fishes:

- Vertebrate Success in Water.
- Classification of Chondrichthyes, Osteichthyes, Dipnoi and Holocephalli
- Locomotory adaptations, nutrition and the digestive system, circulation, gas exchange, nervous and sensory functions, excretion and osmoregulation, reproduction and development of Chondrichthyes (Scoliodon) and Osteichthyes (Cyprinus carpio and Wallago attu).

3. Amphibians:

- The first terrestrial vertebrates.
- Characteristics of amphibians
- Classification of amphibians and characteristics of order 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 of caudate, anura and Gymnophiona.

4. Reptiles:

- The First Amniotes and cladistic interpretation of the amniotic lineage. General characteristics of reptiles.
- Characteristics of Order 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 of chelonia, squamata, Rhynchocephalia and crocodylian.

5. Birds:

- Classification, 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.

6. Mammals:

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

Practicals:

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

Text and Reference Books:

- Campbell, N.A. Biology. Latest Edition. Menlo Park, California Benjamin/Cummings Publishing Company, Inc.
- Miller, S.A. and Harley, J.B.. Zoology, Latest Edition (International) Singapore: McGraw Hill.
- Miller, S.A. 2002. General Zoology Laboratory Manual. 5th Ed. (International), Singapore: McGraw Hill.
- Hickman, C.P., Roberts, L.S. and Larson, A. Integrated Principles of Zoology, 14th Edition (International), 2009. Singapore: McGraw-Hill.
- Pechenik, J.A. Biology of Invertebrates, 4th Edition (International), 2000. Singapore: McGraw Hill.

Semester 3rd			
Course Category	Course Code	Course Title	Credits
General Edu.		Natural Sciences (Physics)	3(2+1)
General Edu.		Civics and Community Engagement	02
General Edu.		Arts	02
Allied	BOT-434	Botany-II (Plant Physiology and ecology)	4(3+1)
Major	ZOO- 435	Animal Behavior	03
Major	ZOO-436	Animal Form and Function-I	4(3+1)
Total Credits			18

General Edu.		Natural Sciences (Physics)	3(2+1)
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Newton's Laws of Motion, Momentum, conservation of momentum, Problems

Gravitation Newton's law of gravitation, acceleration due to gravity, mass of earthmass of sun, variation of g with altitude and depth, satellites, problems

Current electricity; electric current, ohm's law, resistance and resistivity, combination of resistors, power dissipated in resistors, problems

Practicals

1. To study the damping features of an oscillating, system using simple pendulum of variable mass.
2. To determine the value of g , by compound pendulum /kater, s Pendulum
3. The dependence of centripetal force on mass, radius, and angular momentum
4. Velocity of a body in circular motion
5. Determination of moment of inertia of a solid /hollow cylinder and, Sphere.etc
6. Measurement of resistance using a Neon flash bulb and condenser
7. Conversion of Galvanometer into Voltmeter and an Ammeter
8. Study of electric circuits by black box

Books recommended

1. Principles of physics by Hodedayr Resnick
2. Biophysics by Adelman
3. Concepts of Modern Physics by A.Beiser
4. College Physics by Sears, Zamansky, and Young
5. Fundamental of Physics by Halliday. Resnick, and Krane
6. Jue. T. Fundamental Concepts in Biophysics: Volume1.2009. Humana Press

General Edu.		Civics and Community Engagement	02
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Contents

1. Introduction to citizenship education and Community Engagement
2. Identity, Culture, and Social Harmony
3. Multi-cultural society and inter-cultural dialogue
4. Active Citizen: Locally Active, Globally Connected
5. Human rights, constitutionalism and citizens' responsibilities
6. Social issues in Pakistan
7. Social Action Project
8. Assignment (Formative/Summative)

Recommended Books

1. John J. Macionis, Linda Marie Gerber, Sociology (New York: Pearson Education, 2010)
2. Community Development, Social Action and Social Planning by Alan Twelvetrees 12May 2017
3. The Constitution of the Islamic Republic of Pakistan (Pakistan: The National Assembly of Pakistan,2012),also available online at the official website of National Assembly of Pakistan: http://na.gov.pk/uploads/documents/13333523681_951.pdf(Accessed on April 25, 2017)

Suggested Books

1. Anne Karin Larsen, Participation in Community Work: International Perspectives(Vishanthie Sewpaul, Grete Oline Hole,2013)
2. British Council, Active Citizen's Social Action Projects Guide (Scotland: BritishCouncil,2017)

General Edu.		Arts/Urdu	02
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Allied		Botany-II (Plant Physiology and Ecology)	3(2+1)
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Course Contents

a) *Plant Physiology*

1. Water relations (water potential, osmotic potential, pressure potential, matric potential). Absorption and translocation of water. Stomatal regulation.
2. Mineral nutrition: Soil as a source of minerals. Passive and active transport of nutrients. Essential mineral elements, role and deficiency symptoms of macronutrients.
3. Photosynthesis: Introduction, Oxygenic and non-oxygenic photosynthesis Mechanism: light reactions (electron transport and photophosphorylation) and dark reactions (Calvin cycle). Differences between C₃ and C₄ plants. Factors affecting this process, Products of photosynthesis.

- b) Respiration: Definition and respiratory substrates. Mechanism-Glycolysis, Krebs cycle. Electron transport and oxidative phosphorylation. Anaerobic respiration. Energy balance in aerobic and anaerobic respiration, Respiratory quotients.

c) **Ecology**

1. Introduction, aims and applications of ecology.
2. Soil: Physical and Chemical properties of soil (soil formation, texture. pH, EC, organism and organic matter etc) and their relationships to plants.
3. Light and Temperature. Quality of light, diurnal and seasonal variations. Ecophysiological responses.
4. Water: Field capacity and soil water holding capacity. Characteristics of xerophytes and hydrophytes. Effect of precipitation on distribution of plants.
5. Wind: Wind as an ecological factor and its importance.
6. Population Ecology: Introduction. A brief description of seed dispersal and seed bank.
7. Community Ecology
 - i. Ecological characteristics of plant community
 - ii. Methods of sampling vegetation (Quadrat and line intercept)
 - iii. Major vegetation types of the local area.
8. Ecosystem Ecology
 - i. Definition, types and components of ecosystem.
 - ii. Food chain and Food web.
9. Applied Ecology: Causes, effects and control of water logging and salinity with respect to Pakistan

Lab Outline:

a) *Plant Physiology*

1. Preparation of solutions of specific normality of acids/bases, salts, sugars, molal and molar solutions and their standardization.
2. Determination of uptake of water by swelling seeds when placed in sodium chloride solution of different concentrations.
3. Measurement of leaf water potential by the dye method.
4. Determination of the temperature at which beet root cells lose their permeability.
5. Determination of the effects of environmental factors on the rate of transpiration of a leafy shoot by means of a potometer/cobalt chloride paper method.

b) **Ecology**

- o Determination of physical and chemical characteristics of soil.
- o Measurements of various population variables
- o Measurement of vegetation by Quadrat and line intercept methods.
- o Field trips to ecologically diverse habitats.

- Measurements of wind velocity.

Recommended Books:

1. Ihsan, I. Latest Edi.. Plant Physiology, Biochemical Processes in Plants, UGC Press.
2. Witham and Devlin. Latest Edi. Exercises in Plant Physiology, AWS Publishers, Boston.
3. Taiz, L. and Zeiger, E. Latest Edi.. Plant Physiology. 4th. Ed. Sinauers Publ. Co. Inc. Calif.
4. Salisbury F. B. and Ross C. B. 1992. Plant Physiology. 5th Edition. Wadsworth Publishing Co. Belmont CA.
5. Hopkins, W. B. Latest Edi.. Introduction to Plant Physiology. 2nd Ed. John Wiley and Sons. New York
6. Schultz, J. C. Latest Edi. Plant Ecology. Springer-Verlag, Berlin.
7. Ricklefs, R. E. Latest Edi. Ecology. W. H. Freeman and Co., UK.
8. Ricklefs, R. E. Latest Edi.. The Economy of Nature. W. H. Freeman and Co., UK.
9. Barbour, M. G., J. H. Burke and W. D. Pitts. Latest Edi.. Terrestrial Plant Ecology, The Benjamin, Cumming Publishing Co. Palo Alto, California, USA.
10. Hussain F. Latest Edi.. Field and Laboratory Manual of Plant Ecology. National Academy of Higher Education, Islamabad.
11. Larcher, W. Latest Edi. Physiological Plant Ecology: Ecophysiology and Stress Physiology of Functions Groups – Springer Verlag.

Journals / Periodicals:

Plant Physiology, Journal of Ecology

Major	ZOO-435	Animal Behavior	04 (3+1)
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Course Outline (Contents)

1. Introduction

- Behaviour and its types
- Proximate and ultimate causes of behaviour.
- Development of behavior and impact of neural and physiological mechanisms; role of external and internal stimuli and animal responses. Physiology of behavior in changed environments.
- Hormones and behavior in animals.
- Innate behavior and innate releasing mechanisms; built in programmed performance by offspring to that of parents. Innate behavior of three spined stickle back fish.
- Learned behavior and its mechanisms; quick learners' vs slow learners. Concept of animal cognition; key to understand and develop multiple behavioural choices. Ecological and genetics to maintain animal behavior. Concept of territoriality and defense in animals.
- Circadian rhythms and concept of bio-rhythmicity in animals. Maintenance of internal biological clock to perform various diurnal and nocturnal periodicities.
- Costs and benefit ratios in behavior; successful foragers and winners of predator-prey relationships. Altruism and parental sacrifice to nurture the young.
- Competition for resources; survival of the most suitable individuals; evolutionary arms races in behavior.
- Social organization in animals and concept of group living; benefits and losses. Aggression, appeasement and selfish individuals. Social organization in insects and mammals.
- Communication in animals: Visual, Bioacoustic, electrical, chemical and tactile.
- Various types of chemical signals in animals' behavior and their importance in ecosystems.

Practicals

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

TEXT AND REFERENCE BOOKS:

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

Major	ZOO-436	Animal Form and Function-I	4(3+1)
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Course Outline:

1. Protection, Support, and Movement:

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

2. Communication I:

- a. Nerves: Neurons: structure and function.

3. Communication II:

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

4. Communication III:

- a. The Endocrine System and Chemical Messengers: Chemical messengers: hormones chemistry; and their feedback systems; mechanisms of hormone action
- b. Hormones with principal function each of porifera, cnidarians, platyhelminthes, nemerteans, nematodes, molluscs, annelids, arthropods, and echinoderms invertebrates; an overview of the vertebrate endocrine system; endocrine systems of vertebrates, endocrine systems of birds and mammals

5. Circulation and Immunity:

- a. Internal transport and circulatory systems in invertebrates
- b. Characteristics of invertebrate coelomic fluid, hemolymph, and blood cells
- c. transport systems in vertebrates; characteristics of vertebrate blood, blood cells and vessels; the hearts and circulatory systems of bony fishes, amphibians, reptiles, birds and mammals; the human heart: blood pressure and the lymphatic system; immunity: nonspecific defenses, the immune response

Practicals:

1. Study of insect chitin, fish scale, amphibian skin, reptilian scales, feathers and mammalian skin.
 2. Study and notes of skeleton of Labeo (Labeo rohita), Frog (Hoplobatrachus tigerinus), Varanus (Varanus bengalensis), fowl (Gallus gallus domesticus) and rabbit (Oryctolagus cuniculus).
- Note: *Exercises of notes on the adaptations of skeletons to their function must be done.*
3. Earthworm or leech; cockroach, freshwater mussel, Channa or Catlacatla or Labeo or any other local fish, frog, pigeon and rat or mouse and rabbits dissections as per availability.
 4. Study of heart, principal arteries and veins in a representative vertebrate (dissection of representative fish/mammals).

Books Recommended:

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

Semester-IV			
Course Category	Course Code	Course Title	Credits
General Edu.	BSC-323	ICT	3(2+1)
General Edu.		Entrepreneurship	02
General Edu.		Social Anthropology	02
Major	ZOO- 444	Biological Techniques	4(2+2)
Major	ZOO- 445	Biochemistry-I	3(2+1)
Major	ZOO- 446	Animal Form & Function-II	4(3+1)
Total Credits			18

General Edu.	BSC-323	ICT	3(2+1)
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Course Contents

Basic Definitions & Concepts, Hardware: Computer Systems & Components. Storage Devices, Number Systems, Software: Operating Systems, Programming and Application Software, Introduction to Programming, Databases and Information Systems, Networks, Data Communication, The Internet, Browsers and Search Engines, The Internet: Email, Collaborative Computing and Social Networking, The Internet: E-Commerce, IT Security and other issues, IT Project.

1. Basic Knowledge of Computers

- Understand basic computer hardware components and terminology
- Understand the concepts and basic functions of a common computer operating system
- Start up, log on, and shut down a computer system properly
- Use a mouse pointing device and keyboard
- Use Help and know how to troubleshoot routine problems
- Identify and use icons (folders, files, applications, and shortcuts/aliases)
- Minimize, maximize and move windows
- Identify common types of file extensions (e.g. doc, docx, pdf, html, jpg, gif, xls, ppt, pptx, rtf, txt, exe)
- Check how much space is left on a drive or other storage device
- Backup files
- Download and install software on a hard disk
- Understand and manage the file structure of a computer
- Check for and install operating system updates

2. Proficiency in Using Productivity Software

- Create documents of various types and save in a desired location
- Retrieve an existing document from the saved location
- Select, copy, and paste text in a document or desired location
- Print a document
- Name, rename, copy and delete files
- Understand and know how to use the following types of software programs:
- Word processing (example: MS Word, Google Doc, Writer)
- Presentation (example: PowerPoint, Impress)
- Spreadsheet (example: Excel, Calc)
- PDF reader (example: Acrobat Reader, Preview)
- Compression software (example: WinZip, StuffIt, 7-Zip)

3. Electronic Communication Skills

- Email, using a common email program (example: MS Outlook, Gmail, Apple Mail)
- Compose, Send, Reply, Forward messages
- Add attachments to a message
- Retrieve attachments from an email message
- Copy, paste and print message content
- Organize email folders
- Understand what an electronic discussion list is and how to sign up and leave one (example: Listserv, Listproc)

4. Internet Skills

- Set up an Internet connection and connect to the Internet

- Have a working knowledge of the World Wide Web and its functions, including basic site navigation, searching, and installing and upgrading a Web browser
- Use a browser effectively, including bookmarks, history, toolbar, forward and back buttons
- Use search engines and directories to find information on the Web
- Download files and images from a Web page
- Understand and effectively navigate the hyperlink structure of the Web
- Understand how keep your information safe while using the Internet

5. Moving Files

- Transfer files by uploading or downloading
- View and change folder/document security settings
- Copy files from hard disk to storage devices and vice versa

Recommended Readings

- Bruce J. McLaren, Understanding and Using the Internet, West Publishing Company, 610 Opperman Drive, P. O. Box 64526, St. Paul, MN 55164.
- Computer Applications for Business, 2nd Edition, DDC Publishing, 275 Madison Avenue, New York,
- Nita Hewitt Rutkosky, Microsoft Office Professional, Paradigm Publishing Company, 875 Montreal Way, St Paul, MN 55102.42
- Robert D. Shepherd, Introduction to Computers and Technology, Paradigm Publishing Inc., 875 Montreal Way, St. Paul, MN 55102.
- Shelly Cashman Waggoner, Discovering Computers 98, International Thomson Publishing Company, One Main Street, Cambridge, MA 02142.
- V. Wayne Klemin and Ken Harsha, Microcomputers, A Practical Approach to Software Applications, McGraw-Hill Book Company, New York, NY 10016.

	Entrepreneurship	02
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Course Description

This course is designed for the students to understand that Starting & operating a new business which involves considerable risk & an effort to overcome the inertia against something new. In creating and growing a new venture, the entrepreneur assumes the responsibility and risks for its development & survival and enjoys the corresponding rewards. In the end the students will be able to develop business plans to start and initiate their own ventures.

Chapter-01

Introduction

Entrepreneurship and the Entrepreneurial Mind-Set Entrepreneurial Intentions and Corporate Entrepreneurship Entrepreneurial Strategy: Generating and Exploiting New Entries

Chapter-02

From Idea to Opportunity
Creativity and the Business Idea
Identifying and Analyzing Domestic and International Opportunities
Intellectual Property and Other Legal Issues for the Entrepreneur

Chapter-03

From the Opportunity to the Business Plan
The Business Plan: (Creating and Starting the Venture)
The Marketing Plan
The Organizational Plan
The Financial Plan

Chapter-04

From the Business Plan to Funding the Venture Sources of Capital
Informal Risk Capital, Venture Capital, and Going Public Strategies for Growth and Managing the Implication of Growth Accessing Resources for Growth from External Sources
Succession Planning and Strategies for Harvesting and Ending the Venture

Suggested Readings

Entrepreneurship by Robert d Hisrich 10th edition McGra Hill publications Entrepreneurship by Donald F. Kuratko and Richard M Hodgetts

Course Outline**1. Introduction**

- a. Definition, Concept and Branches: physical, social, archaeology, linguistics
- b. Relationship of anthropology with other social sciences,
- c. Relation between sociology and anthropology
- d. Anthropological research techniques
- e. Growth of anthropological theories

2. Evolution

- a. Evolution of Evolution
- b. Mendel's Law of Segregation
- c. Mitosis & Meiosis

3. How we discover Past

- a. Kinds of evidence
- b. Analyze & dating the evidence

c. Site creation**4. The Living Primates**

- a. Common features of primates
- b. Classification of primates

c. Hominoids**5. Primates Evolution: From Early Primates to Hominoids**

- a. Eon, Eras & Epochs
 - b. Cenozoic Era In detail
- 6. The first Hominoids**
- a. Australopithecus Anamensis
 - b. Australopithecus afarensis & africanus
 - c. Australopithecus Robustus
 - d. Homo *heidelbergensis/neanderthalensis*.
 - e. Homo habilis
 - f. Homo erectus
 - g. Homo Sapiens

7. The Stone Age

- a. Paleolithic
 - b. Mesolithic
 - c. Neolithic
- 8. Culture**
- a. The nature of culture
 - b. Definition, Properties and Taxonomy
 - c. the evolution and growth of culture
 - d. universal aspects of culture
 - e. Material and Non-Material aspects
 - f. Cultural Diversity and Integration
 - g. Globalization and culture

9. Origin of Cities & States**10. Origin of Food Production & Settled Life****11. Language and Communication**

- a. Origin of language
- b. Structure of language
- c. Socio-linguistics
- d. Nonverbal communication

12. Marriage

- a. Kinship
- b. Types of Marriage
- c. Concept of Incest Taboo
- d. Kinship systems,
- e. Rule of decent
- f. Types of decent system

13. Political System

- a. Kind of political systems
- b. Political system and economic system

14. Religion

- a. Origin, functions of religion
- b. Religion and cultural ecology
- c. Religion and social control
- d. Kinds of religion
- e. Witchcraft and Sorcery

Recommended Books:-

1. Ahmad, Akbar S. 1990. Pakistani Society, Karachi, Royal Books Co.
2. Bernard, H. Russel. 1994. Research Methods in Anthropology, Qualitative and Quantitative Approaches. London: Sage Publications
3. Bodley, John H. 1994. Cultural Anthropology, California: Mayfield Publishing Co.
4. Brogger, Jan. 1993. Social Anthropology and the Lonely Crowd. New Delhi: Reliance Publishing
5. Ember, Carol R. & Ember Melvin. 1990. Anthropology, 6th ed. Englewood Cliffs: Prentice Hall, Ince. Harper and Row
6. Harris Marvin. 1987. Cultural Anthropology. New York: Harper and Row
7. Harris Marvin. 1985. Culture, People, nature; An Introduction to General Anthropology London: Harper and Row
8. Hertzler J. O. 1981. The Social Structure of Islam. Cambridge: Cambridge University Press
9. Kennedy, Charles H. 1992. Pakistan London: Westview Press, Oxford
10. David Pocock, (1998) "Understanding Social Anthropology". The athlone press London;
11. Eliotd Chapple & Carletons S. coon (2004) Principles of Anthropology cosmo publications, India;
12. Fellmann/Getis/ Fellmann (1985) Human Geography (Land scope of human activates). wmbrown publishers;

Major	ZOO- 444	Biological Techniques	4(2+2)
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Course Contents:

1. Microscopy:

- a. Principles of light microscopy. Magnification, Resolution,
- b. Types of microscopy (Bright field, Dark field, Phase Contrast)
- c. Confocal Microscopy
- d. Electron microscope: Scanning electron microscope and Transmission electron microscope (SEM and TEM).

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

- a. Different Measurement systems (length; surface; weight, volume, temperature), Calculations and related conversions
- b. Concentrations- percent volume; ppt; ppm - molarity, normality, molality
- c. Preparation of stock solutions of various strengths
- d. Use of stage and ocular micrometers
- e. Calibration of ocular micrometer and measurement of size animal and plant cell and nuclei

3. Specimen preparation for optical microscopy:

- a. Introduction to Microtomy and its types
- b. Tissue Fixation, dehydration, clearing, embedding, Section cutting (transverse, longitudinal section)
- c. Tissue mounting (dry mount, wet mount)
- d. Staining: Hematoxylin and Eosin staining

4. Separation and purification techniques:

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

5. Chromatography:

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

6. Spectrophotometry:

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

7. Basic principles of Sampling and Preservation:

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

8. DNA sequencing

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

Practicals:

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

Books Recommended:

1. Dean, J. R. 1999. Extraction Methods for Environmental Analysis. John Wiley and Sons Ltd. UK.
2. Cheesbrough, M.1998. District Laboratory Practice in Tropical Countries. Part I. Cambridge University Press, UK.
3. Cheesbrough, M. 1998. District Laboratory Practice in Tropical Countries. Part II. Cambridge University Press, UK.
4. Curos, M. 1997.Environmental Sampling and Analysis: Lab Manual. CRC Press LLC. USA.

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

Major	ZOO- 445	Biochemistry-I	3(2+1)
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Course Contents

1. Introduction to Macromolecules

- Structure, types and role of various building blocks their respective macromolecules.
- Carbohydrates: Introduction; Classification Stereoisomerism in carbohydrate, Structure, types and role of monosaccharides, oligosaccharides and polysaccharides; Glycosaminoglycans and glycoconjugates;
- Carbohydrates as an information carrier molecule.

2. Amino acids, peptides & proteins:

- Types of amino acids & their classification;
- Uncommon amino acids; Acid/base behavior of amino acids.
- Titration curves in amino acids and their importance:
- Peptides & proteins;
- Biologically active peptides & polypeptides;
- Amino acid sequence in proteins & their importance; Conjugated proteins;

2.1. Purification Techniques for Proteins

- An outline of purification techniques for proteins; column chromatography, electrophoresis; Isoelectric focusing;

2.2. Organization of proteins:

- Structural levels of proteins; Covalent structure of proteins;
- function of some structural & functional proteins; Hemoglobin, Cytochrome-c: Chymotrypsin, alpha Keratin and Collagen;
- Proteins, their examples and role;

3. Enzymes

- Enzymes, their importance, classification & nomenclature, Function & inhibition.

4. Lipids:

- Introduction & classification of lipids; Fatty acids, their types; Storage lipids;

4.1. Classification and important characteristics;

- Triacylglycerols; waxes Structural/membrane lipids; Glycerophospholipids with Ether and Ester linkages Galactolipids & Sulfolipids: Sphingolipids their types & importance: Sterols, their structure, types & functions. Examples of Functional diversity of Lipids as Signaling molecules, Cofactors, Electron carrier, antioxidants, pigments etc.

5. Nucleic acids

- Nucleic acids and their types; Structure and role of various Bases in nucleic acids,
- Nucleoside & Nucleotides;
- Structure of DNA and RNA molecules;
- Organization and Chemistry of Double helical structure of DNA with their details.

Practical:

- Preparation of standard curve for glucose by ortho-Toluidine method.
- Estimation of glucose from blood serum or any other fluid using ortho Toluidine technique.
- Tests for detection of carbohydrates in alkaline medium.
- Tests for detection of carbohydrates in acidic medium.
- Tests for detection of Disaccharides.
- Tests to demonstrate relative instability of glycosidic linkage in carbohydrates.
- Detection of Non-Reducing sugars in the presence of reducing sugars.
- Demonstration of Acid Hydrolysis of Polysaccharide.
- Determination of pKa values of an amino acid by preparation of titration curves.
- Preparation of standard curve of proteins by Biuret method.
- Estimation of blood serum proteins or any unknown concentration of protein using Biuret technique.

Books Recommended:

- Lehninger principle of biochemistry by David L.Nelson and Michael M.Cox , 7th latest edition,ISBN-10:1-4641-2611-9,ISBN-13:978-14641-2611-6
- Biochemistry by Jeremy M. Berg, John L. Tymoczko; Lubert Stryer ,ISBN-10:1429229365,ISBN-13:97814229229364
- Berg, J. M.,Tymoczko,J. L., Lubert Stryer. 2010. Biochemistry. 7th Ed.
- Lodish, H., Berk, A., Zipursky, S. L., Paul. M., Baltimore D, Darnell, J. 2012. Molecular Cell Biology.
- David L. Nelson, and Michael M. Cox, 2000. Lehninger Principles of Biochemistry, 3rd Ed., Macmillan Worth Publishers, New York.
- Murray, R.K., Granner, D.K., Mayer, P.A. and Rodwells, V.W., 2000. Voet. D., Voet, J.G., and Pratt, C.W., 1999. Fundamentals of Biochemistry, John Wiley and Sons, Inc., New York.
- Zubay, G.,1995. Biochemistry, 4th Ed., Wm. C. Brown Publishers, Inc., Oxford, England.

8. Stryer, L., 1995. Biochemistry, 6th Ed., W.H. Freeman and Company, New York.
9. Nelson, D. L., Cox, M. M. 2012. Lehninger Principles of Biochemistry. McMillan Worth Publishers, New York.
10. McKee, T., McKee, J.R. 2003. Biochemistry:
11. The Molecular Basis of Life. 3rd Edition, McGraw-Hill
12. Lodish, H., Berk, A., Zipursky, S. L., Paul.M., Baltimore D, Darnell, J. 2012. Molecular Cell Biology.
13. McKee, T., McKee, J.R. 2003. Biochemistry:
14. The Molecular Basis of Life. 3rd Edition, McGraw-Hill
15. Molecular cell biology W.H Freeman by Lodish, Berk, Krieger, Scott, Bretscher, Ploegh and Matsudaira 8th edition/latest edition, ISBN:1464183392, ISBN-13:97814641183393

Text book for Practical:

1. Plummer, David T., 1990. An Introduction to Practical Biochemistry, 4th Ed. McGraw-Hill Book Company, London.
2. Wilson, K and Walker, J., 1994. Practical Biochemistry: Principles and Techniques, 4th Ed., Cambridge University Press.
3. Sawhney, S.K and Singh, R., 2008. Introductory Practical Biochemistry, Narosa Publishing House, New Delhi, India.

Major	ZOO- 446	Animal Form & Function-II	4(3+1)
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Course Outline:

1. Nutrition and Digestion:

- a. Evolution of nutrition; the metabolic fates of nutrients in heterotrophs; digestion
- b. Animal strategies for getting and using food, diversity in digestive structures of invertebrates.
- c. The mammalian digestive system: gastrointestinal motility and its control
- d. Oral cavity, pharynx and esophagus, stomach, small intestine: main site of digestion; large intestine; role of the pancreas in digestion; and role of the liver and gall bladder in digestion.

2. Temperature and Body Fluid Regulation:

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

3. Reproduction:

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

Practicals:

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

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

Books Recommended

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

Semester-I			
Category	Course Code	Course Title	Credits
General Edu.	ENG- 311	Functional English	03
General Edu.	ISL-312	Islamic Studies / Ethics (only for Non-Muslims)	02
General Edu.	QRZ-311	Quantitative reasoning-I (Exploring Quantitative Skills)	03
Allied	BOT-314	Botany-I (Morphology of vascular plants)	3(2+1)
Allied		Inorganic Chemistry	3(2+1)
Major	ZOO-316	Animal Diversity-I (Invertebrates)	4(3+1)
Total Credits			18

General Edu.	ENG- 311	Functional English	03
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Course Outline:

Basics of Grammar: Parts of speech and use of articles, Sentence structure, Active and passive voice, Practice in unified sentence, Analysis of phrase, clause and sentence structure, Transitive and intransitive verb, Punctuation and spelling Comprehension: Answers to questions on a giventext

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

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

Translation skills: Urdu to English

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

skills: Introduction to presentations and deliberations **Note: Extensive reading is required for vocabulary building**

Reference Materials

4. Thomson, A.J., Martinet, A.V. Practical English Grammar and Exercises Latest Ed. Oxford University Press
5. Boutin, M-C., Brinand, S., Grellet, F. Writing. Intermediate and Supplementary Skills. Oxford Fourth Impression Latest Edi.
6. Tomlinson, B., Ellis, R. Latest Edition. Reading. Upper Intermediate. Oxford Supplementary Skills. Third impression

General Edu.	ISL-312	Islamic Studies/Ethics (Only for Non-Muslims)	02
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Course Contents

Introduction to Quranic Studies: Basic Concepts of Quran: History of Quran; Uloom-ul -Quran

Study of Selected Text of Holy Quran: Verses of Surah Al-Baqra Related to Faith (Verse No-284-286), Verses of Surah Al-Hujrat Related to Adab AlNabi (Verse No-1-18), Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11), Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77), Verses of Surah Al-Inam Related to Ihkam(Verse No-152-154)

Study of Selected Text of Holy Quran: Verses of Surah Al-Ihزاب Related to Adab al-Nabi (Verse No.6,21,40,56,57,58.), Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment, Verses of Surah Al-Saf Related to Tafakar,Tadabar (Verse No-1,14)

Seerat of Holy Prophet (S.A.W) I: Life of Muhammad Bin Abdullah (Before Prophet Hood); Life of Holy Prophet (S.A.W) in Makkah; Important Lessons Derived from the life of Holy Prophet in Makkah

Seerat of Holy Prophet (S.A.W) II: Life of Holy Prophet (S.A.W) in Madina: Important Events of Life Holy Prophet in Madina; Important Lessons Derived from the life of Holy Prophet in Madina

Introduction to Sunnah: Basic Concepts of Hadith; History of Hadith; Kinds of Hadith; Uloom –ul-Hadith; Sunnah & Hadith; Legal Position of Sunnah

Selected Study from Text of Hadith

Introduction to Islamic Law & Jurisprudence: Basic Concepts of Islamic Law & Jurisprudence; History & Importance of Islamic Law & Jurisprudence; Sources of Islamic Law & Jurisprudence; Nature of Differences in Islamic Law; Islam and Sectarianism

Islamic Culture & Civilization: Basic Concepts of Islamic Culture & Civilization; Historical Development of Islamic Culture & Civilization; Characteristics of Islamic Culture & Civilization; Islamic Culture & Civilization and Contemporary Issues

Islam & Science: Basic Concepts of Islam & Science; Contributions of Muslims in the Development of Science; Quran & Science

Islamic Economic System: Basic Concepts of Islamic Economic System; Means of Distribution of wealth in Islamic Economics; Islamic Concept of Riba; Islamic Ways of Trade & Commerce

Political System of Islam; Basic Concepts of Islamic Political System; Islamic Concept of Sovereignty; Basic Institutions of Govt. in Islam

Social System of Islam; Basic Concepts of Social System of Islam; Elements of Family; Ethical Values of Islam.

General Edu.		Ethics (Only for Non-Muslims)	02
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Ethics (for Non-Muslims only)

Course Outlines

- Defining Ethics; and its relation to Philosophy
- Morality as Compared with other Normative Subjects
- Characteristics of Moral Principle
- The Purposes of Morality
- Cultural Relativism
- Cultural Relativism as a theory of Morality
- Judging a Cultural Practice to be Undesirable
- Ethical Subjectivism
- The First Stage: Emotivism
- Emotivism, Reason and Moral Facts
- The Presumed Connection between Morality and Religion
- The Natural Law Theory
- The Utilitarian Approach: a Revolution in Ethics:
- Mill's Utilitarianism: a modified version
- Implications of Utilitarianism
- Is Happiness the Only Thing That Matters? Are Consequences All That Matters?
- Defense of Utilitarianism
- Kant and the Categorical Imperative
- Absolute Rules and the Duty Not to Lie
- Kant and the Respect for Person
- Retribution and Utility in the Theory of Punishment
- The Ethics of Virtue and the Ethics of Right Action
- Some Advantages of Virtue Ethics
- Business Ethics
- The Nature of Business Ethics
- The Ethics of Advertising and Green Issues in Business
- Environmental Ethics
- Arguments for and against the Use and Exploitation of the Natural Environment
- Bioethics---Ethical Issues in Medicine
- Confidentiality, Guilt and Innocence in Treating Patients, Euthanasia, Ethics and Behavior Control, Genetics

Recommended Books

6. Rachels, J., & Rachels, S. (2012). *The Elements of Moral Philosophy* 7e. McGrawHill. ISBN: 0-07-247690-7
7. Loue, S. (2007). *Textbook of research ethics: Theory and practice*. Springer Science & Business Media.
8. Hendin, J. (1999). *The Right Thing to Do*. Feminist Press at CUNY.
9. Pojman, L. P., & Fieser, J. (2016). *Cengage advantage ethics: Discovering right and wrong*. Cengage Learning.
10. Vaughn, L. (2015). *Doing ethics: Moral reasoning and contemporary issues*. WW Norton & Company

General Edu.	QRZ-311	Quantitative reasoning-I (Exploring Quantitative Skills)	03
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WEEKLY BREAKDOWN

MODULE-I Exploring Importance of Quantitative Reasoning Skills (1 WEEK):

4. What is quantitative reasoning?
5. Overview of Contributions of Mathematicians especially Muslim scholars.
6. Different types of Standard numbers and their role in practical life scenarios.

MODULE-II Problem Solving Techniques (2.5 WEEKS):

4. Understanding relationship between parts and whole
5. Practical life scenarios involving units and rate

6. Unit Analysis as a problem-solving tool.

MODULE-III Number and the Universe (2.5 WEEKS)

4. Understanding our World through numbers.
5. Dealing with very big and small numbers & their applications.

6. Understanding uncertainty and its applications.

MODULE- IV Financial Issues (3 WEEKS)

3. Money management (profit, loss, discount, taxation, and other scenarios involving percentage)

4. Money management in practical life scenarios like investments and federal budget, simple and compound interest, Saving plans, and economy.
- MODULE-V Exploring Expressions (2 WEEKS)**

3. Practical scenarios involving expressions.

4. Equating two expressions in one variable & using it to solve practical problems.

MODULE-VI Exploring Beauty in Architecture and Landscape (2 WEEKS)

3. Introduce geometrical objects through architecture and landscape.
4. Dealing with social and economic issues involving geometrical objects.

MODULE-VII Venn Diagrams (1 WEEK)

Venn diagrams and their applications.

TEACHER MANUAL

[Quantitative Reasoning Courses\Quantitative Reasoning Teacher Manual - Sept 2021 - HEC.pdf](#)

RECOMMENDED RESOURCES:

8. Using and understanding mathematics, 6th edition by Jeffrey Bennet and William Briggs, published by Pearson USA.
9. Mathematical thinking and reasoning 2008 by Aufmann, Lockwood, Nation & Clegg published by Houghton Mifflin Company USA.
10. Precalculus by Robert Blitzer, 5th edition published by Pearson USA.
11. Precalculus Graphical, Numerical, Algebraic 8th edition by Franklin D. Demana, Bert K. Waits, Gregory D. Foley & Daniel Kennedy published by Addison Wesley USA.
12. Precalculus Mathematics for Calculus, 6th edition by James Stewart, Lothar Redlin and Saleem Watson published by Brooks/Cole Cengage Learning USA.
13. GRE Math Review https://www.ets.org/s/gre/pdf/gre_math_review.pdf
14. OpenAlgebra.com A free math study guide with notes and YouTube video tutorials

Allied	BOT-314	Botany – I (Diversity of Plants)	3(2+1)
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Course Contents

Comparative study of life form, structure, reproduction and economic significance of:

8. Viruses (RNA and DNA types) with special reference to TMV
 9. Bacteria and Cyanobacteria (Nostoc, Anabaena, Oscillatoria) with specific reference to biofertilizers, pathogenicity and industrial importance;
 10. Algae (Chlamydomonas, Spirogyra, Chara, Vaucheria, Pinnularia, Ectocarpus, Polysiphonia)
 11. Fungi (Mucor, Penicillium, Phyllactinia, Ustilago, Puccinia, Agaricus), their implication on crop production and industrial applications.
 12. Lichens (Physcia)
 13. Bryophytes
 - i. Riccia
 - ii. Anthoceros
 - iii. Funaria
 14. Pteridophytes.
 - i. Fossils and fossilization ii. Psilopsida (Psilotum)
 - iii. Lycopsidea (Selaginella)
 - iv. Sphenopsida (Equisetum)
 - v. Pteropsida (Marsilea)
 - vi. Seed Habit h) 8.
- Gymnosperms
- iii. Cycas
 - iv. Pinus
 - iii. Ephedra

Practicals:

Culturing, maintenance, preservation and staining of microorganisms. Study of morphology and reproductive structures of the types mentioned in theory.

Identification of various types mentioned from prepared slides and fresh collections.

Allied		Inorganic Chemistry	3(2+1)
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Course Contents:

Chemical Bonding: Types of chemical bonding, ionic and covalent bonding, localized bond approach, theories of chemical bonding, valence bond theory (VBT), hybridization and resonance, prediction of molecular shapes using Valence Shell Electron Pair Repulsion (VSEPR) model, molecular orbital theory (MOT) applied to diatomic molecules, delocalized approach to bonding, bonding in electron deficient compounds, hydrogen 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.

Practicals:

Lab safety and good laboratory practices, knowledge about material safety data sheets (MSD), disposal of chemical waste and first-aid practices, qualitative analysis of salt mixtures, quantitative analysis, acid- base titrations, preparation and standardization of acid and alkali solutions, redox titrations, preparation and standardization of potassium permanganate solution and its use for the determination of purity of commercial potassium oxalate or oxalic acid, preparation and standardization of sodium thiosulfate solution and its use in determination of copper in a given sample, gravimetric analysis, determination of barium in a given sample, determination of chloride in a given solution.

Recommended Books:

5. Inorganic chemistry, principles of structure and Reactivity 4th Ed. By J.EHuheey, E.A. Keiter and R.L Keiter, Harper international.
6. Basic inorganic chemistry by F.A Cotton and G.Willinson, Advanced chemistry 5th Ed. F.A cotton john wiley and sonsn New York.
7. Housecroft.C. Sharpe. A.G. Inorganic Chemistry (2nd Edition).2004. PrenticeHall

8. House.J.E. Inorganic Chemistry.2008. Academic Press

Major	ZOO-316	Animal Diversity-I (Invertebrates)	4(3+1)
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Course Contents:

Note: The minimum details of the titles in the content must be of the principal book Zoology by Miller and Harley. This must be kept in view in teaching and assessments.

1. INTRODUCTION

a. Classification of Organisms:

2. ANIMAL-LIKE PROTISTS: THE PROTOZOA

a. Characteristics. b. Classification up to class c. Symbiotic Life-styles. d. Locomotion in protozoa, e. Nutrition and Reproduction; f. Economic importance of protozoa. g. Parasitism in protozoa, h. Protozoa and human diseases

3. MULTICELLULAR AND TISSUE LEVELS OF ORGANIZATION

Phylum Porifera

a. Characteristics and classification. Cell Types, Body Wall, and Skeletons; b. types of canal system; c. Reproduction.

Phylum Cnidaria (Coelenterate)

a. Characteristics. b. Classification up to Class. c. The body Wall and Nematocysts, d. Reproduction: Alteration of generations. f. Corals and coral reefs

Phylum Ctenophore;

a. Characteristics, body organization

4. THE TRIPLOBLASTIC ORGANIZATION

PHYLUM PLATYHELMINTHES (ACOELOMATE)

a. Characteristics. b. Classification up to class, c. The Free-Living Flatworms and the Tapeworms, parasitic adaptations in platyhelminths

5. PHYLUM ASCHELMINTHS (PSEUDOCOELOMATE)

a. General Characteristics, b. Classification up to class, c. Helminths and human diseases,

COELOMATIC ORGANIZATION

6. PHYLUM ANNELIDA

a. General Characteristics, b. Metamerism and Tagmatization, c. Classification up to Class. d. Locomotion, Feeding and the Digestive system, Gas Exchange and Circulation, e. Nervous and Sensory Functions, Excretion, f. Reproduction; Regeneration,

7. PHYLUM MOLLUSCA

a. General Characteristics, b. Classification up to class. c. Shell, Feeding, Digestion, Gas Exchange, Locomotion, d. Reproduction and Development, e. Economic importance

8. PHYLUM ARTHROPODA

a. General Characteristics, b. Classification up to class. c. Biological success; d. Insects mouth parts, e. Economic importance of insects, f. Reproduction: Development, Metamorphosis; g. Economic importance of crustaceans.

9. PHYLUM ECHINODERMS

a. General Characteristics, b. Classification up to class. c. Reproduction; Regeneration, Larval forms.

Practical:

Note: Classification of each members of each phylum up to order with adaptations in relation to habitat of the specimen. Preserved Specimen and or colored projection slide and or CD ROM projection of computer must be used.

1. Study of Euglena, Amoeba, Entameba, Plasmodium, Trypanosome, Paramecium as representative of animal like Protists.
2. Study of prepared slides of sponges, spicules of sponges, and their various body forms. Study of representatives of classes of Phylum Porifera.
3. Study of principal representatives of classes of Phylum Coelenterate.
4. Study of principal representatives of classes of Phylum Platyhelminthes.
5. Study of representatives of phylum Rotifer, Phylum Nematode.
6. Study of principal representatives of classes of Phylum Mollusca.
7. Study of principal representatives of classes of Phylum Annelida.
8. Study of principal representatives of classes of groups of Phylum Arthropoda
9. Study of representatives of classes of phylum Echinodermta.

10. Preparation of permanent mount of Leucosolenia, Obelia, Hydra, Proglottid of Tapeworm, Parapodia of Nereis and Daphnia. Drawing and labeling.
11. Preparation of permanent slide of mouthpart of insects (after dissection). Drawing and labeling.
12. How to make grade-wise series for preparation of temporary and permanent slides.
13. Field study tour to Insectary, Insect museum, Invertebrates aquaria etc

Recommended Principal Reference Book:

1. Miller, A.S. and Harley, J.B. ; Latest Edition (International), Singapore : McGraw Hill. Additional Readings:
 2. Hickman, C.P., Roberts, L.C/ AND Larson, A., 2018. INTEGRATED PRINCIPLES OF ZOOLOGY, 15th Edition (International), Singapore: McGRAW-Hill.
 3. Hickman, C.P., Roberts, L.C/ AND Larson, A., 2007. INTEGRATED PRINCIPLES OF ZOOLOGY, 12th & 13th Edition (International). Singapore: McGraw-Hill.
 4. Pechenik, J.A., 2015. BIOLOGY OF INVERTEBRATES, 7th Edition, (International), Singapore: McGraw-Hill.
 5. Kent, G. C. and Miller, S., 2001. COMPARATIVE ANATOMY OF VERTEBRATES New York: McGraw-Hill.
 6. Campbell, N.A., 2002; BIOLOGY 6th Edition, Menlo Park, California; Benjamin ummings Publishing Company, Inc.
- BOOKS FOR PRACTICAL**
7. Miller, S.A., 2002. GENERAL ZOOLOGY LABORATORY MANUAL. 5th Edition International), Singapore: McGraw-Hill.
 8. Hickman, C.P. and Kats, H.L., 2000. Laboratory Studies in integrated principal of zoology. Singapore: McGraw-Hill

Semester-II			
Course Category	Course Code	Course Title	Credits
General Edu.	ENG- 321	Expository writing	03
General Edu.	PS-322	Ideology and Constitution of Pakistan	02
General Edu.	QRZ-321	Quantitative reasoning-II (Tools for quantitative reasoning)	03
Allied	CHEM-324	Organic Chemistry	3(2+1)
Major	ZOO-325	Cell Biology	3(2+1)
Major	ZOO-326	Animal Diversity-II (Chordates)	4(3+1)
Total Credits			18

General Edu.	ENG- 321	Expository writing	03
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2. COURSE

CONTENTS Unit 1: Self

Reflection

- Introduction to the basics of the writing process
- Introduction to the steps of essay writing
- Students practice prewriting activities like brainstorming, listing, clustering and free writing
- Students practice outlining of the essay

Unit 2: Personalized Learning

- Students reflect on their learning process
- Group discussion about learning styles based on the reading material provided to students
- Introduction to personalized learning
- Students practice goal setting
- And create a learning plan
- Introduction to the structure and significance of oral presentations
- Class discussion about content selection and slide preparation for oral presentations
- Peer review through a gallery walk

Unit 3: Critical Reading Skills

- Introduce authentic reading (DAWN newspaper and non-specialist academic books/texts)
- Conduct classroom reading activities (using strategies skimming, scanning, SQW3R, previewing, annotating, detailed reading and note-taking) using standard tests (TOEFL and IELTS) Assign books/articles/reports for their individual home assignments.
- Share model review reports and annotated bibliographies

Unit 4: Community Engagement

- Showing short documentaries to students on global environmental issues
- Student-led brainstorming on local versus global issues
- Teacher-led introduction to the unit assignment (using assignment sheet)
- Readings (or other input sources - video, social media) from local news on possible community issues, letters to editor and op-eds
- Identify research problems
- Begin drafting research questions based on the problems identified
- Facilitating students on developing research questions in groups
- Draft interview or survey questions for community research (in English or L1)
- In-class role-plays of interviews with community members
- Engaging students in critical reading and reflection on the issues found in different communities
- In-class work on understanding interview information, how to present interview or survey information
- Refining the research questions, designing a detailed research plan in groups, dividing the tasks and deciding the timeline for the completion of the project
- Exposure to interview questions and interviewing techniques to develop an in-depth understanding of the issues
- Continued group work on report outline
- In-class lecture and group work on analyzing information

- Discussion based on translating the data from the source language to the target language (English)
- Sharing the experience of field work in class orally
- Teacher feedback on outline of report (globally to entire class and individually to groups as needed)
- Revisions to oral report in groups Engaging students in individual structured reflective writing based on their experience of working on the project
- Sharing their reflective writing to learn about each other's points of view
- Think-pair-share the findings (group similar issues)
- Individual writing of reflection on the community engagement project and their role in the group
- Brainstorm using creativity for dissemination - cartoons, advertisements for university magazine or beyond, creating posts for FB
- Summarizing/ converting the report to a letter to the editor to highlight the problems explored and their possible solutions (homework - connecting activity for week 11 - Unit 5)

Unit 5: Letter to the Editor

- Teacher-directed instruction on genres (types) of writing focusing on letter-writing
- Model-practice-reflect: Introduce types of letters comparing the use of formal and informal vocabulary and phrases in each type
- Introduce the format and purpose of the letter-to-editor explaining with the help of an actual letter from a local newspaper
- Group reading of sample letters-to-editor selecting ones that deal with issues familiar to the students
- Invite a guest lecturer (local newspaper editor or faculty from journalism) to talk about what issues are currently raised in letters-to-editors and what are editors' criteria to accept letters for publication
- Work in groups to continue reviewing letter samples, analyzing the structure of letters

- Each group identifies an issue they want to write about and give a brief oral presentation to the class
- Submit the first draft of letters (to the teacher and peer-review group)
- In-class peer review of drafts using a checklist focusing on content and structure DUE:
- First draft of letter (to teacher and peer review group)
- Groups revise first draft of letter
- Differentiate among revision, proofreading and evaluation (as sub stages of finalizing documents)
- Discuss critically the draft-letter and implement the 'revision' phase of writing Reading of (DAWN) newspaper and sharing important letters (to editors) on local issues
- Groups revise second draft of letter Explicit instruction (paragraph structure, syntax, diction, grammar, and mechanics)
- Classroom discussion/debrief of activity Discuss critically and finalize the draft-letter as the last phase of writing

Teacher Manual & Suggested Reading

Expository Writing Course Outline - Sept 2021 - HEC.pdf
Detailed Courses - Expository Writing - Sept 2021 - HEC.pdf

Expository Writing Teachers Manual - Sept 2021 - HEC.pdf

General Edu.	PS-322	Ideology and Constitution of Pakistan	02
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VIII. CREATION OF PAKISTAN

c) Ideology: Conservative and liberal perspectives

- i) Significance before and after independence
- ii) Quaid-e-Azam's vision about Pakistan

d) POLITICAL DYNAMICS

ii) Democracy and authoritarianism

1. **Political Culture:** Parties and pressure groups

v) **National integration:** Resources and distribution

vi) Governance and civil rights

IX. ECONOMY

vi) Agro-industrial growth

vii) Irrigation projects

viii) Economic development and poverty alleviation

ix) Foreign aid and economic stability

x) Characteristics of developing countries

X. FOREIGN POLICY

Determination of foreign policy, national interests, post-cold war environments of Pakistan: new world, order and nuclear non-proliferation

XI. ENVIRONMENT; definition and dimensions, management and natural resources environmental pollutions: industrial; agricultural; land; water; air and space environmental protection

XII. POPULATION: Characteristics: Rural; urban; gender; age groups; and population growth, economic indicators: employment; education health and poverty, migration

XIII. SOCIETY: Definitions, characteristics: multilingual, multi-ethnic and parochial, social stratification and social mobility, social problems

XIV. CULTURE: Definitions, social organization; kinships; family; clan and tribe, material and non-material cultures, cultural institutions

Books Recommended

1. Shahid Javed Burki, State and Society in Pakistan, The Macmillan Press Ltd. 1980 (Reprint, 1997)
2. Wayne Wilcox The Emergencies of Bangladesh, Washington American Enterprise Institute of Public Policy Research 1972
3. Safdar Mehmood Pakistan Kayyum Tooda Idara-Saqafat-e-Islamia, Club Road Lahore
4. Tahir Amin National Movement of Pakistan Institute of Policy studies Islamabad.
5. Lawrence Ziring, Enigma of Political Development, Wm Dawson and son Ltd. Cannon House Falkstone. Kent England 1980
6. Waseem Ahmad Pakistan under Marshal Law, Lahore 2002
7. Ansar Zahid, History and culture of Sindh, Karachi Royal Book Company 1980
8. G.A Allana culture of Pakistan
9. Enamery Shamil The Pearls of Sindh
10. M Rafique Afzal Political Parties in Pakistan Vol I, II, and III Islamabad National of Historical and culture Research 1998
11. Inyatullah Bureaucracy, Development in Pakistan Peshawar 1996
12. M Ikram Rabbani Pakistan Affairs Lahore Carwan Book House 1997
13. M Ikran Rabbani and Munawar Ali Sayyid An introduction to Pakistan studies Karwan Book House 1999
14. Crompton.S.W. Pakistan (Modern World Nations) (2nd Edition).2006. Chelsea House Publications

General Edu.	QRZ-321	Quantitative reasoning-II (Tools for quantitative reasoning)	03
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WEEKLY BREAKDOWN

MODULE-1 Exploring Graphical Information

3. Investigating relationships between variables.
4. Exploring tools to find relationship between variables, Resources, and population growth: dealing with economic, environmental, and social issues.

MODULE-2 Building blocks of a plane

3. Graphical and analytical approaches to solve a problem.
4. Applications of graphical & analytical approaches to solve social & economic problems.

MODULE-3 Exploring inequalities

3. Understanding inequalities around us
4. Dealing with practical problems involving inequalities in different disciplines

MODULE-4 Comparing quantities

4. Golden ratio in sculptures
5. Comparison of statements and their use in social and economic problems,
6. Sequence

MODULE-5 Thinking Logically

4. Survival in the modern World,
5. Propositions and truth values,
6. Categorical proposition, and its applications

MODULE-6 Understanding Data

4. Methods to explore and summarize data, drawing graphs and identifying misleading graphs,
5. Methods to discuss the basic characteristics of any datasets, like finding a most representative value in a data, and methods to measure the amount of spread of a data,
6. Methods to measure degree of relationship among variables, finally this module includes methods to Count the odds.

TEACHER MANUAL

[Quantitative Reasoning Courses\Quantitative Reasoning Teacher Manual - Sept 2021 - HEC.pdf](#)

RECOMMENDED RESOURCES

8. Using and understanding mathematics, 6th edition by Jeffrey Bennet and William Briggs, published by Pearson USA.
9. Mathematical thinking and reasoning 2008 by Aufmann, Lockwood, Nation & Clegg published by Houghton Mifflin company USA.
10. Pre-calculus by Robert Blitzer 5th edition published by Pearson USA.
11. Pre-calculus Graphical, Numerical, Algebraic 8th edition by Franklin D. Demana, Bert K. Waits, Gregory D. Foley & Daniel Kennedy published by Addison Wesley USA.
12. Pre-calculus Mathematics for Calculus, 6th edition by James Stewart, Lothar Redlin and Saleem Watson published by Brooks/Cole Cengage Learning USA.
13. https://www.ets.org/s/gre/pdf/gre_math_review.pdf
14. Open Algebra. Com A free math study guide with notes and YouTube video tutorials.

Allied		Organic Chemistry	3(2+1)
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Basic Concepts of Organic Chemistry:

Bonding and hybridization, localized and delocalized bonding, structure aromaticity, inductive effect, dipole moment, resonance and its rules, hyperconjugation, classification and nomenclature of organic compounds including IUPAC system, 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.

Practicals:

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, organic syntheses may include preparation of benzanilide from benzoyl chloride, succinic anhydride from succinic acid, phthalimide from phthalic anhydride, oximes and hydrazones from carbonyl compounds, and an ester from a carboxylic acid and alcohol etc.

Books recommended:

- Organic chemistry for B. Sc by M. Younas
- Organic chemistry by B. S. Bhal
- Clayden.J, Greeves N, Warren.S and Wothers.P.Organic Chemistry.2008. OxfordUniversity Press
- Klein.D.R.Organic Chemistry as a Second Language.2009. Wiley

Major	ZOO-325	Cell Biology	3(2+1)
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Course Outline:

1. Introduction cell structure and function

- Cell theory
- Comparison of plant and animal cells
- Comparison of prokaryotic and eukaryotic cells

2. Cell membranes

- Structural models
- Chemical composition and function

3. Cell Organelles (structure and function)

- Endoplasmic reticulum
- Golgi Bodies
- Mitochondria
- Lysosomes
- Peroxisomes
- Ribosome

4. Nucleus

- Structure and function
- Nuclear membrane
- Chromatin

5. Cytoskeleton

- Structure and types
- Function of cytoskeleton

6. Cellular transport

- Diffusion and osmosis
- Facilitated and active transport
- Endocytosis and exocytosis

7. Cellular reproduction

- Cell cycle
- Mitosis

c. Meiosis

Practical:

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

Books Recommended:

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

Major	ZOO-326	Animal Diversity-II (Chordates)	4(3+1)
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Course Outline:

1. Protochordates

- a. Classification of protochordates.
- b. Structure, anatomy and organ systems of Acorn worms, Urochordates and Cephalochordates
- c. Reproduction; life histories and metamorphosis of protochordates.

2. Fishes:

- a. Vertebrate Success in Water.
- b. Classification of Chondrichthyes, Osteichthyes, Dipnoi and Holocephalli
- c. Locomotory adaptations, nutrition and the digestive system, circulation, gas exchange, nervous and sensory functions, excretion and osmoregulation, reproduction and development of Chondrichthyes (Scoliodon) and Osteichthyes (Cyprinus carpio and Wallago attu).

3. Amphibians:

- a. The first terrestrial vertebrates.
- b. Characteristics of amphibians
- c. Classification of amphibians and characteristics of order Caudata, Gymnophiona, and Anura.
- d. Structure and locomotory adaptations, nutrition and the digestive system, circulation, gas exchange, temperature regulation, nervous and sensory functions, excretion and
- e. Osmoregulation, reproduction, development and metamorphosis of caudate, anura and Gymnophiona.

4. Reptiles:

- a. The First Amniotes and cladistic interpretation of the amniotic lineage. General characteristics of reptiles.
- b. Characteristics of Order Testudines or Chelonia, Rhynchocephalia, Squamata, and Crocodilia
- c. Adaptations in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange and temperature regulation, nervous and sensory functions, excretion and osmoregulation, reproduction and development of chelonia, squamata, Rhynchocephalia and crocodilian.

5. Birds:

- a. Classification, Feathers, flight and endothermy.
- b. Phylogenetic relationships; ancient birds and the evolution of flight.
- c. Diversity of modern birds.
- d. Adaptation in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, and regulation, nervous and sensory systems, excretion and osmoregulation, reproduction and development.
- e. Migration and navigation.

6. Mammals:

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

Practicals:

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

Text and Reference Books:

1. Campbell, N.A. Biology. Latest Edition. Menlo Park, California Benjamin/Cummings Publishing Company, Inc.
2. Miller, S.A. and Harley, J.B.. Zoology, Latest Edition (International) Singapore: McGraw Hill.
3. Miller, S.A. 2002. General Zoology Laboratory Manual. 5th Ed. (International), Singapore: McGraw Hill.
4. Hickman, C.P., Roberts, L.S. and Larson, A. Integrated Principles of Zoology, 14th Edition (International), 2009. Singapore: McGraw-Hill.
5. Pechenik, J.A. Biology of Invertebrates, 4th Edition (International), 2000. Singapore: McGraw Hill.

Semester 3rd			
Course Category	Course Code	Course Title	Credits
General Edu.		Natural Sciences (Physics)	3(2+1)
General Edu.		Civics and Community Engagement	02
General Edu.		Arts	02
Allied	BOT-434	Botany-II (Plant Physiology and ecology)	4(3+1)
Major	ZOO- 435	Animal Behavior	03
Major	ZOO-436	Animal Form and Function-I	4(3+1)
Total Credits			18

General Edu.		Natural Sciences (Physics)	3(2+1)
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Newton's Laws of Motion, Momentum, conservation of momentum, Problems

Gravitation Newton's law of gravitation, acceleration due to gravity, mass of earth mass of sun, variation of g with altitude and depth, satellites, problems

Current electricity; electric current, ohm's law, resistance and resistivity, combination of resistors, power dissipated in resistors, problems

Practicals

1. To study the damping features of an oscillating, system using simple pendulum of variable mass.
9. To determine the value of g , by compound pendulum /kater, s Pendulum
10. The dependence of centripetal force on mass, radius, and angular momentum
11. Velocity of a body in circular motion
12. Determination of moment of inertia of a solid /hollow cylinder and, Sphere.etc
13. Measurement of resistance using a Neon flash bulb and condenser
14. Conversion of Galvanometer into Voltmeter and an Ammeter
15. Study of electric circuits by black box

Books recommended

1. Principles of physics by Hodedayr Resnick
2. Biophysics by Adelman
3. Concepts of Modern Physics by A.Beiser
4. College Physics by Sears, Zamansky, and Young
5. Fundamental of Physics by Halliday. Resnick, and Krane
6. Jue. T. Fundamental Concepts in Biophysics: Volume1.2009. Humana Press

General Edu.		Civics and Community Engagement	02
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Contents

1. Introduction to citizenship education and Community Engagement
2. Identity, Culture, and Social Harmony
3. Multi-cultural society and inter-cultural dialogue
4. Active Citizen: Locally Active, Globally Connected
5. Human rights, constitutionalism and citizens' responsibilities
6. Social issues in Pakistan
7. Social Action Project
8. Assignment (Formative/Summative)

Recommended Books

4. John J. Macionis, Linda Marie Gerber, Sociology (New York: Pearson Education, 2010)
5. Community Development, Social Action and Social Planning by Alan Twelvetrees 12May 2017
6. The Constitution of the Islamic Republic of Pakistan (Pakistan: The National Assembly of Pakistan,2012),also available online at the official website of National Assembly of Pakistan: <http://na.gov.pk/uploads/documents/13333523681951.pdf>(Accessed on April 25, 2017)

Suggested Books

3. Anne Karin Larsen, Participation in Community Work: International Perspectives(Vishanthie Sewpaul, Grete Oline Hole,2013)
4. British Council, Active Citizen's Social Action Projects Guide (Scotland: British Council,2017)

General Edu.		Arts/Urdu	02
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Allied		Botany-II (Plant Physiology and Ecology)	3(2+1)
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Course Contents

b) Plant Physiology

1. Water relations (water potential, osmotic potential, pressure potential, matric potential). Absorption and translocation of water. Stomatal regulation.
2. Mineral nutrition: Soil as a source of minerals. Passive and active transport of nutrients. Essential mineral elements, role and deficiency symptoms of macronutrients.
3. Photosynthesis: Introduction, Oxygenic and non-oxygenic photosynthesis Mechanism: light reactions (electron transport and photophosphorylation) and dark reactions (Calvin cycle). Differences between C₃ and C₄ plants. Factors affecting this process, Products of photosynthesis.

- d)** Respiration: Definition and respiratory substrates. Mechanism-Glycolysis, Krebs cycle. Electron transport and oxidative phosphorylation. Anaerobic respiration. Energy balance in aerobic and anaerobic respiration, Respiratory quotients.

e) Ecology

1. Introduction, aims and applications of ecology.
2. Soil: Physical and Chemical properties of soil (soil formation, texture, pH, EC, organism and organic matter etc) and their relationships to plants.
3. Light and Temperature. Quality of light, diurnal and seasonal variations. Ecophysiological responses.
4. Water: Field capacity and soil water holding capacity. Characteristics of xerophytes and hydrophytes. Effect of precipitation on distribution of plants.
5. Wind: Wind as an ecological factor and its importance.
6. Population Ecology: Introduction. A brief description of seed dispersal and seed bank.
7. Community Ecology
 - i. Ecological characteristics of plant community
 - ii. Methods of sampling vegetation (Quadrat and line intercept)
 - iii. Major vegetation types of the local area.
8. Ecosystem Ecology
 - i. Definition, types and components of ecosystem.
 - ii. Food chain and Food web.
9. Applied Ecology: Causes, effects and control of water logging and salinity with respect to Pakistan

Lab Outline:

b) Plant Physiology

1. Preparation of solutions of specific normality of acids/bases, salts, sugars, molal and molar solutions and their standardization.
2. Determination of uptake of water by swelling seeds when placed in sodium chloride solution of different concentrations.
6. Measurement of leaf water potential by the dye method.
7. Determination of the temperature at which beet root cells lose their permeability.
8. Determination of the effects of environmental factors on the rate of transpiration of a leafy shoot by means of a porometer/cobalt chloride paper method.

c) Ecology

- Determination of physical and chemical characteristics of soil.
- Measurements of various population variables
- Measurement of vegetation by Quadrat and line intercept methods.

- Field trips to ecologically diverse habitats.
- Measurements of wind velocity.

Recommended Books:

12. Ihsan, I. Latest Edi.. Plant Physiology, Biochemical Processes in Plants, UGC Press.
13. Witham and Devlin. Latest Edi. Exercises in Plant Physiology, AWS Publishers, Boston.
14. Taiz, L. and Zeiger, E. Latest Edi.. Plant Physiology. 4th. Ed. Sinauers Publ. Co. Inc. Calif.
15. Salisbury F. B. and Ross C. B. 1992. Plant Physiology. 5th Edition. Wadsworth Publishing Co. Belmont CA.
16. Hopkins, W. B. Latest Edi.. Introduction to Plant Physiology. 2nd Ed. John Wiley and Sons. New York
17. Schultz, J. C. Latest Edi. Plant Ecology. Springer-Verlag, Berlin.
18. Ricklefs, R. E. Latest Edi. Ecology. W. H. Freeman and Co., UK.
19. Ricklefs, R. E. Latest Edi.. The Economy of Nature. W. H. Freeman and Co., UK.
20. Barbour, M. G., J. H. Burke and W. D. Pitts. Latest Edi.. Terrestrial Plant Ecology, The Benjamin, Cumming Publishing Co. Palo Alto, California, USA.
21. Hussain F. Latest Edi.. Field and Laboratory Manual of Plant Ecology. National Academy of Higher Education, Islamabad.
22. Larcher, W. Latest Edi. Physiological Plant Ecology: Ecophysiology and Stress Physiology of Functions Groups – Springer Verlag.

Journals / Periodicals:

Plant Physiology, Journal of Ecology

Major	ZOO-435	Animal Behavior	04 (3+1)
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Course Outline (Contents)

1. Introduction

- Behaviour and its types
- Proximate and ultimate causes of behaviour.
- Development of behavior and impact of neural and physiological mechanisms; role of external and internal stimuli and animal responses. Physiology of behavior in changed environments.
- Hormones and behavior in animals.
- Innate behavior and innate releasing mechanisms; built in programmed performance by offspring to that of parents. Innate behavior of three spined stickle back fish.
- Learned behavior and its mechanisms; quick learners' vs slow learners. Concept of animal cognition; key to understand and develop multiple behavioural choices. Ecological and genetics to maintain animal behavior. Concept of territoriality and defense in animals.
- Circadian rhythms and concept of bio-rhythmicity in animals. Maintenance of internal biological clock to perform various diurnal and nocturnal periodicities.
- Costs and benefit ratios in behavior; successful foragers and winners of predator-prey relationships. Altruism and parental sacrifice to nurture the young.
- Competition for resources; survival of the most suitable individuals; evolutionary arms races in behavior.
- Social organization in animals and concept of group living; benefits and losses. Aggression, appeasement and selfish individuals. Social organization in insects and mammals.
- Communication in animals: Visual, Bioacoustic, electrical, chemical and tactile.
- Various types of chemical signals in animals' behavior and their importance in ecosystems.

Practicals

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

TEXT AND REFERENCE BOOKS:

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

Major	ZOO-436	Animal Form and Function-I	4(3+1)
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Course Outline:

1. Protection, Support, and Movement:

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

2. Communication I:

- a. Nerves: Neurons: structure and function.

3. Communication II:

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

4. Communication III:

- a. The Endocrine System and Chemical Messengers: Chemical messengers: hormones chemistry; and their feedback systems; mechanisms of hormone action
- b. Hormones with principal function each of porifera, cnidarians, platyhelminthes, nemertean, nematodes, molluscs, annelids, arthropods, and echinoderms invertebrates; an overview of the vertebrate endocrine system; endocrine systems of vertebrates, endocrine systems of birds and mammals

5. Circulation and Immunity:

- a. Internal transport and circulatory systems in invertebrates
- b. Characteristics of invertebrate coelomic fluid, hemolymph, and blood cells
- c. transport systems in vertebrates; characteristics of vertebrate blood, blood cells and vessels; the hearts and circulatory systems of bony fishes, amphibians, reptiles, birds and mammals; the human heart: blood pressure and the lymphatic system; immunity: nonspecific defenses, the immune response

Practicals:

1. Study of insect chitin, fish scale, amphibian skin, reptilian scales, feathers and mammalian skin.
2. Study and notes of skeleton of Labeo (Labeo rohita), Frog (Hoplobatrachus tigerinus), Varanus (Varanus bengalensis), fowl (Gallus gallus domesticus) and rabbit (Oryctolagus cuniculus).

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

3. Earthworm or leech; cockroach, freshwater mussel, Channa or Catlacatla or Labeo or any other local fish, frog, pigeon and rat or mouse and rabbits dissections as per availability.
4. Study of heart, principal arteries and veins in a representative vertebrate (dissection of representative fish/mammals).

Books Recommended:

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

Semester-IV			
Course Category	Course Code	Course Title	Credits
General Edu.	BSC-323	ICT	3(2+1)
General Edu.		Entrepreneurship	02
General Edu.		Social Anthropology	02
Major	ZOO- 444	Biological Techniques	4(2+2)
Major	ZOO- 445	Biochemistry-I	3(2+1)
Major	ZOO- 446	Animal Form & Function-II	4(3+1)
Total Credits			18

General Edu.	BSC-323	ICT	3(2+1)
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Course Contents

Basic Definitions & Concepts, Hardware: Computer Systems & Components. Storage Devices, Number Systems, Software: Operating Systems, Programming and Application Software, Introduction to Programming, Databases and Information Systems, Networks, Data Communication, The Internet, Browsers and Search Engines, The Internet: Email, Collaborative Computing and Social Networking, The Internet: E-Commerce, IT Security and other issues, IT Project.

6. Basic Knowledge of Computers

- Understand basic computer hardware components and terminology
- Understand the concepts and basic functions of a common computer operating system
- Start up, log on, and shut down a computer system properly
- Use a mouse pointing device and keyboard
- Use Help and know how to troubleshoot routine problems
- Identify and use icons (folders, files, applications, and shortcuts/aliases)
- Minimize, maximize and move windows
- Identify common types of file extensions (e.g. doc, docx, pdf, html, jpg, gif, xls,ppt, pptx, rtf, txt,exe)
- Check how much space is left on a drive or other storage device
- Backup files
- Download and install software on a hard disk
- Understand and manage the file structure of a computer
- Check for and install operating system updates

7. Proficiency in Using Productivity Software

- Create documents of various types and save in a desired location
- Retrieve an existing document from the saved location
- Select, copy, and paste text in a document or desired location
- Print a document
- Name, rename, copy and delete files
- Understand and know how to use the following types of software programs:
- Word processing (example: MS Word, Google Doc, Writer)
- Presentation (example: PowerPoint, Impress)
- Spreadsheet (example: Excel, Calc)
- PDF reader (example: Acrobat Reader, Preview)
- Compression software (example: WinZip, StuffIt, 7-Zip)

8. Electronic Communication

Skills

- Email, using a common email program (example: MS Outlook, Gmail, Apple Mail)
- Compose, Send, Reply, Forward messages
- Add attachments to a message
- Retrieve attachments from an email message
- Copy, paste and print message content
- Organize email folders
- Understand what an electronic discussion list is and how to sign up and leave one (example:

Listserv, Listproc)

9. Internet Skills

- Set up an Internet connection and connect to the Internet
- Have a working knowledge of the World Wide Web and its functions, including basic site navigation, searching, and installing and upgrading a Web browser
- Use a browser effectively, including bookmarks, history, toolbar, forward and back buttons
- Use search engines and directories to find information on the Web
- Download files and images from a Web page
- Understand and effectively navigate the hyperlink structure of the Web
- Understand how keep your information safe while using the Internet

10. Moving Files

- Transfer files by uploading or downloading
- View and change folder/document security settings
- Copy files from hard disk to storage devices and vice versa

Recommended Readings

- Bruce J. McLaren, Understanding and Using the Internet, West Publishing Company, 610 Opperman Drive, P. O. Box 64526, St. Paul, MN 55164.
- Computer Applications for Business, 2nd Edition, DDC Publishing, 275 Madison Avenue, New York,
- Nita Hewitt Rutkosky, Microsoft Office Professional, Paradigm Publishing Company, 875 Montreal Way, St Paul, MN 55102.42
- Robert D. Shepherd, Introduction to Computers and Technology, Paradigm Publishing Inc., 875 Montreal Way, St. Paul, MN 55102.
- Shelly Cashman Waggoner, Discovering Computers 98, International Thomson Publishing Company, One Main Street, Cambridge, MA 02142.
- V. Wayne Klemin and Ken Harsha, Microcomputers, A Practical Approach to Software Applications, McGraw-Hill Book Company, New York, NY 10016.

	Entrepreneurship	02
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Course Description

This course is designed for the students to understand that Starting & operating a new business which involves considerable risk & an effort to overcome the inertia against something new. In creating and growing a new venture, the entrepreneur assumes the responsibility and risks for its development & survival and enjoys the corresponding rewards. In the end the students will be able to develop business plans to start and initiate their own ventures.

Chapter-01

Introduction

Entrepreneurship and the Entrepreneurial Mind-Set Entrepreneurial Intentions and Corporate Entrepreneurship Entrepreneurial Strategy: Generating and Exploiting New Entries

Chapter-02

From Idea to Opportunity
Creativity and the Business Idea
Identifying and Analyzing Domestic and International Opportunities
Intellectual Property and Other Legal Issues for the Entrepreneur

Chapter-03

From the Opportunity to the Business Plan
The Business Plan: (Creating and Starting the Venture)
The Marketing Plan
The Organizational Plan
The Financial Plan

Chapter-04

From the Business Plan to Funding the Venture Sources of Capital
Informal Risk Capital, Venture Capital, and Going Public Strategies for Growth and Managing the Implication of Growth Accessing Resources for Growth from External Sources
Succession Planning and Strategies for Harvesting and Ending the Venture

Suggested Readings

Entrepreneurship by Robert d Hisrich 10th edition McGra Hill publications Entrepreneurship by Donald F. Kuratko and Richard M Hodgetts

Course Outline**15. Introduction**

- a. Definition, Concept and Branches: physical, social, archaeology, linguistics
- b. Relationship of anthropology with other social sciences,
- c. Relation between sociology and anthropology
- d. Anthropological research techniques
- e. Growth of anthropological theories

16. Evolution

- a. Evolution of Evolution
- b. Mendel's Law of Segregation
- c. Mitosis & Meiosis

17. How we discover Past

- a. Kinds of evidence
- b. Analyze & dating the evidence

c. Site creation**18. The Living Primates**

- a. Common features of primates
- b. Classification of primates

c. Hominoids**19. Primates Evolution: From Early Primates to Hominoids**

- a. Eon, Eras & Epochs
 - b. Cenozoic Era In detail
- 20. The first Hominoids**
- a. Australopithecus Anamensis
 - b. Australopithecus afarensis & africanus
 - c. Australopithecus Robustus
 - d. Homo *heidelbergensis/neanderthalensis*.
 - e. Homo habilis
 - f. Homo erectus
 - g. Homo Sapiens

21. The Stone Age

- a. Paleolithic
- b. Mesolithic
- c. Neolithic

22. Culture

- a. The nature of culture
- b. Definition, Properties and Taxonomy
- c. the evolution and growth of culture
- d. universal aspects of culture
- e. Material and Non-Material aspects
- f. Cultural Diversity and Integration
- g. Globalization and culture

23. Origin of Cities & States**24. Origin of Food Production & Settled Life****25. Language and Communication**

- a. Origin of language
- b. Structure of language

- c. Socio-linguistics
- d. Nonverbal communication

26. Marriage

- a. Kinship
- b. Types of Marriage
- c. Concept of Incest Taboo
- d. Kinship systems,
- e. Rule of decent
- f. Types of decent system

27. Political System

- a. Kind of political systems
- b. Political system and economic system

28. Religion

- a. Origin, functions of religion
- b. Religion and cultural ecology
- c. Religion and social control
- d. Kinds of religion
- e. Witchcraft and Sorcery

Recommended Books:-

1. Ahmad, Akbar S. 1990. Pakistani Society, Karachi, Royal Books Co.
13. Bernard, H. Russel. 1994. Research Methods in Anthropology, Qualitative and Quantitative Approaches. London: Sage Publications
14. Bodley, John H. 1994. Cultural Anthropology, California: Mayfield Publishing Co.
15. Brogger, Jan. 1993. Social Anthropology and the Lonely Crowd. New Delhi: Reliance Publishing
16. Ember, Carol R. & Ember Melvin. 1990. Anthropology, 6th ed. Englewood Cliffs: Prentice Hall, Ince. Harper and Row
17. Harris Marvin. 1987. Cultural Anthropology. New York: Harper and Row
18. Harris Marvin. 1985. Culture, People, nature; An Introduction to General Anthropology London: Harper and Row
19. Hertzler J. O. 1981. The Social Structure of Islam. Cambridge: Cambridge University Press
20. Kennedy, Charles H. 1992. Pakistan London: Westview Press, Oxford
21. David Pocock, (1998) "Understanding Social Anthropology". The athlone press London;
22. Eliotd Chapple & Carletons S. coon (2004) Principles of Anthropology cosmo publications, India;
23. Fellmann/Getis/ Fellmann (1985) Human Geography (Land scope of human activates). wmbrown publishers;

Major	ZOO- 444	Biological Techniques	4(2+2)
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Course Contents:

1. Microscopy:

- a. Principles of light microscopy. Magnification, Resolution,
- b. Types of microscopy (Bright field, Dark field, Phase Contrast)
- c. Confocal Microscopy
- d. Electron microscope: Scanning electron microscope and Transmission electron microscope (SEM and TEM).

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

- a. Different Measurement systems (length; surface; weight, volume, temperature), Calculations and related conversions
- b. Concentrations- percent volume; ppt; ppm - molarity, normality, molality
- c. Preparation of stock solutions of various strengths
- d. Use of stage and ocular micrometers
- e. Calibration of ocular micrometer and measurement of size animal and plant cell and nuclei

3. Specimen preparation for optical microscopy:

- a. Introduction to Microtomy and its types
- b. Tissue Fixation, dehydration, clearing, embedding, Section cutting (transverse, longitudinal section)
- c. Tissue mounting (dry mount, wet mount)
- d. Staining: Hematoxylin and Eosin staining

4. Separation and purification techniques:

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

5. Chromatography:

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

6. Spectrophotometry:

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

7. Basic principles of Sampling and Preservation:

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

8. DNA sequencing

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

Practicals:

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

Books Recommended:

1. Dean, J. R. 1999. Extraction Methods for Environmental Analysis. John Wiley and Sons Ltd. UK.

2. Cheesbrough, M.1998. District Laboratory Practice in Tropical Countries. Part I. Cambridge University Press, UK.
3. Cheesbrough, M. 1998. District Laboratory Practice in Tropical Countries. Part II. Cambridge University Press, UK.
4. Curo, M. 1997.Environmental Sampling and Analysis: Lab Manual. CRC Press LLC. USA.
5. Curo, M. 1997. Environmental Sampling and Analysis: For Technician. CRC Press LLC. USA.
6. Slingsby, D., Cock, C.1986. Practical ecology. McMillan Education Ltd. London.
7. Rob Reed/ David HOLMES, Jonathan Weyers/ Allan Jones Pearson, Practical skill in bio-molecular sciences.
8. Gallagher, S.R. and Wiley E.A. 2008. Current protocols essential laboratory Techniques. John Wiley & Sons Inc, USA.
9. Jones, A. Reed, R and Weyers, J. 1994. Practical skills in Biology. Longman Singapore Publishers (Pte) Ltd.

Major	ZOO- 445	Biochemistry-I	3(2+1)
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Course Contents

1. Introduction to Macromolecules

- Structure, types and role of various building blocks their respective macromolecules.
- Carbohydrates: Introduction; Classification Stereoisomerism in carbohydrate, Structure, types and role of monosaccharides, oligosaccharides and polysaccharides; Glycosaminoglycans and glycoconjugates;
- Carbohydrates as an information carrier molecule.

2. Amino acids, peptides & proteins:

- Types of amino acids & their classification;
- Uncommon amino acids; Acid/base behavior of amino acids.
- Titration curves in amino acids and their importance;
- Peptides & proteins;
- Biologically active peptides & polypeptides;
- Amino acid sequence in proteins & their importance; Conjugated proteins;

2.1. Purification Techniques for Proteins

- An outline of purification techniques for proteins; column chromatography, electrophoresis; Isoelectric focusing;

2.2. Organization of proteins:

- Structural levels of proteins; Covalent structure of proteins;
- function of some structural & functional proteins; Hemoglobin, Cytochrome-c: Chymotrypsin, alpha Keratin and Collagen;
- Proteins, their examples and role;

3. Enzymes

- Enzymes, their importance, classification & nomenclature, Function & inhibition.

4. Lipids:

- Introduction & classification of lipids; Fatty acids, their types; Storage lipids;

4.1. Classification and important characteristics;

- Triacylglycerols; waxes Structural/membrane lipids; Glycerophospholipids with Ether and Ester linkages Galactolipids & Sulfolipids: Sphingolipids their types & importance: Sterols, their structure, types & functions. Examples of Functional diversity of Lipids as Signaling molecules, Cofactors, Electron carrier, antioxidants, pigments etc.

5. Nucleic acids

- Nucleic acids and their types; Structure and role of various Bases in nucleic acids,
- Nucleoside & Nucleotides;
- Structure of DNA and RNA molecules;
- Organization and Chemistry of Double helical structure of DNA with their details.

Practical:

- Preparation of standard curve for glucose by ortho-Toluidine method.
- Estimation of glucose from blood serum or any other fluid using ortho Toluidine technique.
- Tests for detection of carbohydrates in alkaline medium.
- Tests for detection of carbohydrates in acidic medium.
- Tests for detection of Disaccharides.
- Tests to demonstrate relative instability of glycosidic linkage in carbohydrates.
- Detection of Non-Reducing sugars in the presence of reducing sugars.
- Demonstration of Acid Hydrolysis of Polysaccharide.
- Determination of pKa values of an amino acid by preparation of titration curves.
- Preparation of standard curve of proteins by Biuret method.
- Estimation of blood serum proteins or any unknown concentration of protein using Biuret technique.

Books Recommended:

- Lehninger principle of biochemistry by David L.Nelson and Michael M.Cox , 7th latest edition,ISBN-10:1-4641-2611-9,ISBN-13:978-14641-2611-6
- Biochemistry by Jeremy M. Berg, John L. Tymoczko; Lubert Stryer ,ISBN-10:1429229365,ISBN-13:97814229229364
- Berg, J. M.,Tymoczko,J. L., Lubert Stryer. 2010. Biochemistry. 7th Ed.
- Lodish, H., Berk, A., Zipursky, S. L., Paul. M., Baltimore D, Darnell, J. 2012. Molecular Cell Biology.

5. David L. Nelson, and Michael M. Cox, 2000. Lehninger Principles of Biochemistry, 3rd Ed., Macmillan Worth Publishers, New York.
6. Murray, R.K., Granner, D.K., Mayer, P.A. and Rodwells, V.W., 2000. Voet. D., Voet, J.G., and Pratt, C.W., 1999. Fundamentals of Biochemistry, John Wiley and Sons, Inc., New York.
7. Zubay, G., 1995. Biochemistry, 4th Ed., Wm. C. Brown Publishers, Inc., Oxford, England.
8. Stryer, L., 1995. Biochemistry, 6th Ed., W.H. Freeman and Company, New York.
9. Nelson, D. L., Cox, M. M. 2012. Lehninger Principles of Biochemistry. McMillan Worth Publishers, New York.
10. McKee, T., McKee, J.R. 2003. Biochemistry:
11. The Molecular Basis of Life. 3rd Edition, McGraw-Hill
12. Lodish, H., Berk, A., Zipursky, S. L., Paul.M., Baltimore D, Darnell, J. 2012. Molecular Cell Biology.
13. McKee, T., McKee, J.R. 2003. Biochemistry:
14. The Molecular Basis of Life. 3rd Edition, McGraw-Hill
15. Molecular cell biology W.H Freeman by Lodish, Berk, Krieger, Scott, Bretscher, Ploegh and Matsudaira 8th edition/latest edition, ISBN: 1464183392, ISBN-13: 97814641183393

Text book for Practical:

1. Plummer, David T., 1990. An Introduction to Practical Biochemistry, 4th Ed. McGraw-Hill Book Company, London.
2. Wilson, K and Walker, J., 1994. Practical Biochemistry: Principles and Techniques, 4th Ed., Cambridge University Press.
3. Sawhney, S.K and Singh, R., 2008. Introductory Practical Biochemistry, Narosa Publishing House, New Delhi, India.

Major	ZOO- 446	Animal Form & Function-II	4(3+1)
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Course Outline:

1. Nutrition and Digestion:

- a. Evolution of nutrition; the metabolic fates of nutrients in heterotrophs; digestion
- b. Animal strategies for getting and using food, diversity in digestive structures of invertebrates.
- c. The mammalian digestive system: gastrointestinal motility and its control
- d. Oral cavity, pharynx and esophagus, stomach, small intestine: main site of digestion; large intestine; role of the pancreas in digestion; and role of the liver and gall bladder in digestion.

2. Temperature and Body Fluid Regulation:

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

3. Reproduction:

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

Practicals:

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

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

Books Recommended

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