University of Chitral
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یونیورسٹی آف چترال

Scheme of Studies Bachelor of Studies in Botany

Fall 2023

Additional Director Academics
University of Chitral

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Curriculum of Undergraduate Program in Botany

BACHELOR OF STUDIES IN BOTANY

General Requirements of the Program

Nomenclature: Bachelor of Studies in Botany

Eligibility Criteria: The minimum requirements for admission are at least 45% marks in F. Sc. (Pre-Medical)

Duration: The minimum duration for completion of BS degree is four years. The HEC allows maximum period of seven years to complete BS degree requirements.

Pathway for the Associate Degree Holders in Botany:

- The candidates with AD Botany are eligible for admission in 5th Semester of BS Botany Programs. Such students shall complete the deficiency courses of General Education (if any) during 5th to 8th Semester.
- The candidates who acquired AD in Botany prior to the admission criteria (as stated above) are also eligible for admission in 5th Semester of BS Botany Programs. Such students shall also complete the deficiency courses of General Education (if any) during 5th to 8th Semester.
- The minimum eligibility for admission in the fifth semester in this case is 2.5 CGPA out of 4 in the prior qualification i.e., conventional two-year BSc degree programs.
- Admission in 5th Semester is subject to the availability of seats.

Pathway for Conventional Two-Year BSc Degree Holders

- Students having completed conventional two-year BSc are allowed to be admitted in the fifth semester of the BS program, in which case students shall be required to complete deficiency courses through a bridging semester before commencement of the fifth semester as determined by the department.
- The minimum eligibility for admission in the fifth semester in this case is 45% cumulative score in the prior qualification i.e., conventional two-year BSc degree programs.
- Admission in the 5th Semester is subject to the availability of seats.

Exit with associate degree.

The students after successful completion of 04 semesters in BS Botany Programs may exit with Associate Degree in Botany subject to completion of all requirements for the award of associate degree, i.e., Credit Hours (60-70) and CGPA (2.5).

Degree Completion Requirements

To become eligible for award of BS degree, a student must satisfy the following requirements:

a) Must have studied and passed the prescribed courses, totaling at least 130 credit hours.

b) Must have earned CGPA (Cumulative Grade Point Average) of at least 2.5 on a scale of 4.0.

The students after successful completion of 04 semesters in BS Botany Program may exit with **AD in Botany** subject to completion of all requirements for the award of associate degree, i.e., Credit Hours (60-70) and CGPA (2.5).

Coding Scheme of Courses

• Coding Scheme is based on the following principles: –

Letter Code consists of two to four characters to represent the title of the degree • Such as Bot for Botany

Numerical code consists of three digits.

• 1st digit represents year

• 2nd digit represents semester

• 3rd digit represents the sequence of the subject in the semester

Example: Bot-111 (Botany, 1st year, 1st semester, and 1st in sequence)

Admission Committee and Admission Procedure: as per guidelines provided by the Admission Office.

Assessment Criteria

Each subject carries 100 marks and will be examined and assessed as under:

Midterm: Total Marks	30
Final-Term: Total Marks	50
Internal marks	20 **(As designed by the concerned teacher)**
Total: 30+50+20 =	100

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PROGRAME-WISE SCHEME OF STUDIES

Domain	Credit Hours	General Education Courses	Major Courses	Interdisciplinary Courses	Internship/Field Experience/Capstone Project/ Research
Total Cr. Hr.	136	30	91	15	6

SEMESTER-WISE SCHEME OF STUDIES

Semester	**General Education Courses Cr. Hr.**	**Major Cr. Hr.**	**Interdisciplinary Courses Cr. Hr.**	**Internship/Field Experience/Capstone Project Cr. Hr.**	**Total Cr.Hr**
1st	9	4	3		16
2nd	8	4	6		18
3rd	5	8	3		16
4th	8	6	3		17
5th		18			18
6th		18			18
7th		18		03	18
8th		15		03	15
8 Semesters	**30**	**91**	**15**	**06**	**136**

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SEMESTER-WISE BREAKDOWN

SEMESTER I			
Course Code	Subject	Course Type	Credit Hour
Bot-111	Diversity of Plants	Major	4(3+1)
Bot-112	Organic Chemistry	AC	3(2+1)
Bot-113	Civics and Community Engagement	GE	2 (2+0)
Bot-114	Exploring Quantitative Skills	GE	3(3+0)
Bot-115	Ideology and Constitution of Pakistan	GE	2 (2+0)
	Any one subject from the following (Social Sciences)		
Bot-116	Introduction to Economics	GE	2 (2+0)
Bot-117	Introduction to Political Science	GE	2 (2+0)
Bot-118	Introduction to Human Resource Management	GE	2 (2+0)
Bot-119	Science of Society	GE	2(2+0)
Total	06		16
SEMESTER II			
Course Code	Subject	Course Type	Credit Hour
Bot-121	Plant Systematics, Anatomy & Development	Major	4 (3+1)
Bot-122	Principles in Animal Life-I	AC	3 (2+1)
Bot-123	Environmental Chemistry	AC	3(2+1)
Bot-124	Islamic Studies OR	GE	2(2+0)
Bot-125	Ethics	GE	2(2+0)
Bot-126	Functional English	GE	3 (3+0)
	Any one subject from the following (Natural Sciences)		
Bot-127	Introduction to Geography	GE	3 (2+1)
Bot-128	Animal Diversity I: Invertebrates	GE	3 (2+1)
Bot-129	Physical Chemistry	GE	3 (2+1)
Bot-130	What is Science?	GE	3(2+1)
Total	06		18

SEMESTER III			
Course Code	Subject	Course Type	Credit Hour
Bot-231	Biodiversity and Conservation	Major	4 (3+1)
Bot-232	Cell Biology, Genetics and Evolution	Major	4 (3+1)
Bot-233	Inorganic Chemistry	AC	3 (2+1)
Bot-234	Tools for Quantitative Reasoning	GE	3 (3+0)
	Any one subject from the following (Arts and Humanities)		
Bot-235	Technical Report Writing & Presentation Skill	GE	2(2+0)
Bot-236	Introduction to History	GE	2 (2+0)
Bot-237	Introduction to Philosophy	GE	2 (2+0)
Bot-238	Fables, Wisdom Literature, and Epic	GE	2(2+0)
Total	05		16

SEMESTER IV			
Course Code	Subject	Course Type	Credit Hour
Bot-241	Edaphology	Major	3 (2+1)
Bot-242	General Biochemistry	Major	3 (2+1)
Bot-243	Animal Diversity II: Chordates	AC	3 (2+1)
Bot-244	Introduction to Expository Writing	GE	3 (3+0)
Bot-245	Information and Communication Technologies	GE	3 (2+1)
Bot-246	Entrepreneurship	GE	2 (2+0)
Total	06		17

SEMESTER V			
Course Code	Subject	Course Type	Credit Hour
Bot-351	Economic Botany	Major	3 (2+1)
Bot-352	Bacteriology and Virology	Major	3 (2+1)
Bot-353	Phycology and Bryology	Major	3 (2+1)
Bot-354	Mycology and Plant Pathology	Major	3 (2+1)
Bot-355	Diversity of Vascular Plants	Major	3 (2+1)
Bot-356	Plant Systematics	Major	3 (2+1)
Total	06		18

SEMESTER VI			
Course Code	Subject	Course Type	Credit Hour
Bot-361	Plant Anatomy	Major	3 (2+1)
Bot-362	Genetics-I	Major	3 (2+1)
Bot-363	Plant Biochemistry-I	Major	3 (2+1)
Bot-364	Plant Ecology-I	Major	3 (2+1)
Bot-365	Plant Physiology-I	Major	3 (2+1)
Bot-366	Plant Pathology	Major	3 (2+1)
Total	06		18
SEMESTER VII			
Course Code	Subject	Course Type	Credit Hour
Bot-471	Molecular Biology	Major	3 (2+1)
Bot-472	Plant Biochemistry-II	Major	3 (2+1)
Bot-473	Plant Ecology-II	Major	3 (2+1)
Bot-474	Plant Physiology-II	Major	3 (2+1)
Bot-475	Genetics-II	Major	3 (2+1)
Bot-476	Field Experience	Major	3
Total	06		18
SEMESTER VIII			
Course Code	Subject	Course Type	Credit Hour
Bot-481	Pharmacognosy	Major	3 (2+1)
Bot-482	Environmental Biology	Major	3 (2+1)
Bot-483	Plant Tissue Culture	Major	3 (2+1)
Bot-484	Introduction to Horticulture	Major	3 (2+1)
Bot-485	Research	Major	3
Total	05		15

SEMESTER-I

Course Name: Diversity of Plants

Course Code: Bot-111

Cr. Hr. 04(3+1)
Domain: Major

Specific Objectives of course:

To introduce the students to the diversity of plants and their structures and significance.

Course Outline:

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

a) Viruses (RNA and DNA types) with special reference to TMV;
b) Bacteria and Cyanobacteria
c) Algae (Chlamydomonas, Chara)
d) Fungi (Penicillium, Puccinia, Agaricus)
e) Lichens
f) Bryophytes
i. Funaria
g) Pteridophytes.
h) Gymnosperms

i) Angiosperms
i. Monocot
ii. Dicot

Lab Outline:

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.

Recommended Books:

1. Lee, R. E. 1999. Phycology. Cambridge University Press, UK
2. Prescott, L. M., Harley, J. P. and Klein, A. D. 2004. Microbiology, 3rd Ed. WM. C. Brown Publishers.
3. Alexopoulos, C. J., Mims, C. W. and Blackwell, M. 1996. Introductory Mycology. 4th Ed. John Wiley and Sons Publishers.
4. Agrios, G. N. 2004. Plant pathology. 8th Ed. Academic Press London.
5. Vashishta, B. R. 1991. Botany for degree students (all volumes). S. Chand and Company. Ltd. New Delhi.
6. Andrew, H. N. 1961. Studies in Paleobotany. John Willey and Sons.
7. Ingrouille , M. 1992. Diversity and Evolution of Land Plants. Chapman & Hall.

8. Mauseth, J. D. 2003. Botany: An Introduction to Plant Biology 3rd Ed., Jones and Bartlett Pub. UK
9. Marti. J. Ingrouille & Plant: Diversity and Evolution. 2006 CUP
10. Taylor, T. N. & Taylor, E. D. 2000. Biology and Evolution of Fossil Plants. Prentice Hall. N. Y.
11. Hussain, F. 2012. A Text Book of Botany and Biodiversity. Pak Book Empire.

Journals / Periodicals:

Pakistan Journal of Botany, American Journal of Botany, Canadian Journal of Botany, Annals of Botany.

Course Name: Organic Chemistry
Course Code: Bot –112
Cr. Hr. 03 (2+1)
Domain: Allied

Introduction to Organic Chemistry

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

Chemical Bonding and Properties of Organic Molecules:

Localized and delocalized chemical bonding; concept of hybridization leading to bond angles, bond lengths, bond energies and shape of organic molecules; inductive and field effects; resonance; aromaticity; tautomerism; hyperconjugation.

Classes and Nomenclature of Organic Compounds:

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

Functional Group Chemistry:

A brief introduction to the chemistry of hydrocarbons (Alkane, alkene and alkyne), alkyl halides, aldehydes, ketones and their derivatives.

Recommended Books

1. Clayden, J., Greeves, N., Warren, S. and Wothers, P., Organic Chemistry, Oxford University Press, New York.
2. Loudon, G. M., Organic Chemistry, Oxford University Press, New York
3. Sorrell, T. N., Organic Chemistry, Viva Books Private Ltd., New Delhi.
4. Finar, I. L., Organic Chemistry, Vol. 1, Pearson Education, Delhi.
5. Carey, F. A., Organic Chemistry, McGraw-Hill, New York.
6. Ahluwalia, V. K. and Goyal, M., A Text Book of Organic Chemistry, Narosa Publishing House, New Delhi
7. March, J., Advanced Organic Chemistry, John Wiley & Sons, New York.
8. Bansal, R. K., Organic Reaction Mechanisms, Tata McGrawHill Publishing Company Ltd., New Delhi.

9. Pine, S. H., Organic Chemistry, National Book Foundation, Islamabad.
10. Bailey Jr., P. S. and Bailey, C. A., Organic Chemistry-A Brief Survey of Concepts and Applications, Prentice-Hall, New Jersey.

Course Name: Civics and Community Engagement
Course Code: Bot-113
Cr.Hrs: 2(2+0)
Domain: GE

Description

Teach students the importance and role of active citizenship in promoting a productive, harmonious and development society/ world. Educate students about the importance of concepts, skills and philosophy of community linkages in developing a sustainable society. Inculcate the importance of community involvement for ensuring an improved, tolerant and generative society/ world. Provide an opportunity to the students to develop their relationship with the community

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, Lindaa Marie Gerber, Sociology (New York: Pearson Education, 2010)
2. Community Development, Social Action and Social Planning by Alan Twelvetrees 12 May 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: British Council,2017)

Course Name: Exploring Quantitative Skills
Course Code: Bot – 114
Cr. Hr. 03(3+0)
Domain: GE

COURSE DESCRIPTION: This course aims to develop the basic mathematical skills which ultimately enhance problem solving skills using inductive and deductive reasoning and sets. The basic concepts will be developed with applications from the real world such as algebraic models with equations, rates, ratios, and percentages will be discussed. Students will also explore linear models, including rectangular-coordinates, functions, empowering them to analyze real-world problems with logical precision. By the end of course, students will have practiced problem-solving, logical reasoning, and mathematical modeling abilities to tackle diverse challenges confidently as follows:

- Students will be introduced to the above concepts, and they will be prepared to apply these concepts to analyze and interpret information in different walks of life.
- Students will get familiarized with the importance of quantitative reasoning skills in the modern age.
- This course will improve their ability to deal with scenarios involving numbers related issues in a logical manner.
- It will provide students an opportunity to appreciate the intellectual beauty of quantitative reasoning skills.
- It will prepare students to apply the quantitative reasoning skills in solving quantitative problems which they will experience in their practical lives.

COURSE CONTENTS

Exploring Importance of Quantitative Reasoning Skills

What is quantitative reasoning, Overview of contributions of mathematicians especially Muslim scholars.

Problem Solving Techniques

Understanding relationship between parts and whole, Practical life scenarios involving units and rate, Unit analysis as a problem-solving tool, Inductive and deductive reasoning, Problem solving strategies.

Numbers & the Universe

Understanding our World through numbers, Dealing with very big and small numbers & their applications, Understanding uncertainty and its applications, Introduction to number systems and different types of standard numbers and their role in practical life scenarios, square roots, cube roots, highest common factors, lowest common multiples, visualizing fractions, decimals, systems of measurements, an overview of contributions of mathematicians, unit analysis as a problem-solving tool.

Financial Issues

Money management (profit, loss, discount, taxation, and other scenarios involving percentage), money management in practical life scenarios like investments and federal budget, simple and compound interest, Saving plans and economy, percentage, profit, loss, discount, taxation, and other scenarios involving percentage, simple and compound interest with applications.

Exploring Expressions

Practical scenarios involving expressions, equating two expressions in one variable & using it to solve practical problems, linear equations, quadratic equations and their applications in social and economic problems.

Exploring Beauty in Architecture & Landscape

Introduce geometrical objects through architecture and landscape, dealing with social and economic issues involving geometrical objects, fundamentals of geometry, applications of Pythagorean theorem, introduction to unit circles, trigonometric functions and inverse trigonometric functions, problem solving with geometry.

Venn Diagrams

Venn diagrams and their applications

TEACHER MANUAL

Quantitative Reasoning Courses\Quantitative Reasoning Teacher Manual - Sept 2021 - HEC.pdf

RECOMMENDED RESOURCES

1. R. N. Aufmann, 1. S. Lockwood, R. D. Natio and D. K. Clegg, Mathematical Thinking and Quantitative Reasoning (2008), Houghton Mifflin Company (New York).
2. Bennett,1. & Briggs, W. (2015). Using and understanding mathematics (6th Edition). Pearson Education, Limited.
3. Blitzer, R. (2014). Precalculus. (5th Edition). Pearson Education, Limited.
4. Using and understanding mathematics, 6th edition by Jeffrey Bennet and William Briggs, published by Pearson USA.
5. Mathematical thinking and reasoning 2008 by Aufmann, Lockwood, Nation & Clegg published by Houghton Mifflin Company USA.
6. Precalculus by Robert Blitzer 5th edition published by Pearson USA.
7. Precalculus Graphical, Numerical, Algebraic 8th edition by Franklin D. Demana, Bert K. Waits, Gregory D. Foley & Daniel Kennedy published by Addison Wesley USA.
8. Precalculus Mathematics for Calculus, 6th edition by James Stewart, Lothar Redlin and Saleem Watson published by Brooks/Cole Cengage Learning USA.
9. GRE Math Review https://www.ets.org/s/gre/pdf/gre_math_review.pdf OpenAlgebra.com
10. A free math study guide with notes and YouTube video tutorials.

Course Name: Ideology and Constitution of Pakistan
Course Code: Bot-115
Cr. Hr. 02 (2+0)
Domain: GE

Course Introduction

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

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

Course Outline

Introduction to Ideology

Defining the Term Ideology, Role of Ideas, Contours of Ideology, Ideology, Truth and Power

Types of Ideologies, Left, Right and Center Debate, Old and New Ideologies, Views about Ideologies

Ideology of Pakistan

Aims and Objects of Pakistan's Formation

Ideology of Pakistan – its Importance

Basics of Pakistan's Ideology

Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Iqbal's and M. A. Jinnah's Notions on Ideology of Pakistan

Constitution, Government and Politics

Definitions, Features, and Functions

Constitutional Development in Pakistan 1947-1973: Constitution of 1956, 1962

Salient Features of Constitution of Pakistan 1973

Fundamental Rights in Constitution of Pakistan 1973

Martial Law 1977-88,

Civilian Rule 1988-99

Martial Law 1999 Onward

Pakistan – Land and Peoples

Geography and its Importance

Natural resources and Their use

Agriculture and Industry

Population, Manpower, and Education

Contemporary Pakistan

Economic Institutions and Issues

Society and Social Structure

Foreign Policy of Pakistan and Challenges

Reference Materials:

1) The Emergence of Pakistan, Chaudary M., 1967
2) The making of Pakistan, Aziz. 1976
3) A Short History of Pakistan, I. H. Qureshi, ed., Karachi, 1988
4) Perspectives on Contemporary Pakistan Governance, Development and Environment Edited By Ghulam Ali, Ejaz Hussain, 2020
5) Any other standard and latest books covering the subject.

List of General Education: Social Sciences

Course Name: Introduction to Economics

Course Code: Bot-116

Cr. Hr.: 2(2+0)

Domain: GE(Social Sciences)

Course Contents:

1. **Introduction**

- Introduction to Economics,
- Definition of Economics By Adam Smith, Marshal &Robbins
- Human Wants, Utility & Scarcity
- Scope of Economics.
- Microeconomics vs Macroeconomics

- Micro & Macro Economics
- Positive & Normative Economics,
- Economic Problem

2. Consumer Behavior:

- Utility,
- Meaning and Definition of Utility,
- Characteristics of utility,
- Value and Price
- Income, Goods and Services
- Law of Diminishing Marginal Utility,
- Law of Equi Marginal Utility
- Laws of demand and supply • Indifference Curve Analysis,
- Budget line.
- Consumer Equilibrium through Indifference Curve approach

3. Demand:

- Demand, Law of demand, Shift in Demand Curve, Rise and Fall in Demand Curve
- Individual and Market demand,
- Price elasticity of demand
- Price Elasticity of Demand,
- Measurement of elasticity of demand i.e.
- Point Elasticity, Arc Elasticity of demand, Income Elasticity

4. Supply:

- Supply:
- Supply vs Stock,
- Law of Supply,
- Change in Supply
- Movement and Shift in supply Preferences, Elasticity of Supply

5. Market:

- Market,
- Types of market; Determination of Price, Effect of Changes in demand or Supply on Price

- Perfect competition,
- Monopoly,
- Oligopoly monopolistic competition Total,
- Average and marginal products.

6. Economic System:

- Economic System:
- Capitalism,
- Socialism.
- Mixed Economic System,
- Islamic Economic System,
- Importance of Islamic Economic System
- Assumptions and Price/Output determination

7. Concepts of National Income:

- National Income,
- Gross Domestic Product,
- Gross National Product,
- Net National Product,
- Per capital income.

8. Money:

- Definition of money, Barter and Its Difficulties
- Kinds of money, Instruments of Money
- Functions of money and Evaluation of money.

9. Bank:

- Bank,
- Types of Bank.
- Commercial Banks and its functions,
- Central Bank and functions.

10. Public Finance:

- Government revenue,
- Sources of government revenue

- Govt expenditure and Head of government expenditure ,
- Fiscal policy and Monetary Policy
- Instruments of fiscal and Monetary Policy
- Budget:
- Types of budget i.e.
- Balance budget,
- Budget deficit and surplus budget.

11. International Trade:

- Trade, Background of Trade,
- Difference between domestic and international trade
- Importance of International trade,

Recommended Books:

1. Michel Parkin. 2004. Economics, 5th Ed.
2. Paul A. Samualson and W.D. Nordhaus. 2004. Economics, 18th Ed.
3. John Sloman, Economics (Latest edition).
4. Miller. Microeconomic Theory (Latest edition).
5. Lipsey and Crystal. Economics (Latest edition).
6. Habibullah Vaseer "Fundamentals of Economics" Latest Edition.

Course Name: Introduction to Political Science

Course Code: Bot-117

Cr. Hr. 02 (2+0)

Domain: GE (Social Science)

Course Title: Introduction to Political Science-I

Cr Hrs. 3

Course Objectives:

In "Introduction to Political Science-I," the primary objective is to provide students with a comprehensive introduction to the foundational principles and theories of political science. Students will delve into the fundamental concepts of politics, governance, and statecraft, gaining an understanding of different political systems, government structures, and the role of institutions. By exploring topics such as the origin and evolution of the state, the concept of nationhood, and forms of government, students will develop critical thinking skills and the ability to analyze and evaluate complex political phenomena. Regardless of their academic background, students will emerge from this course with a solid grounding in political science, enabling them to engage in informed discussions about politics, governance, and societal issues, as well as fostering interdisciplinary perspectives on political matters.

Learning Outcomes:

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

- Define and explain the nature of political science and its significance in understanding political phenomena.
- Identify and compare traditional and behavioral approaches in Political Science.
- Recognize and describe the various sub-fields of Political Science and their relationships with other social sciences.
- Analyze the origin of the state through theories like Divine Origin, Force, and Social Contract, and understand the elements of a state.
- Differentiate between state, society, and government, and discuss the Islamic concept of the state.
- Evaluate the functions of a state and describe the characteristics of a welfare state, as well as identify the concept of a failed state.
- Define and distinguish between Nation, Nationality, and Muslim Ummah, and identify the characteristics of a nation.
- Compare and contrast different forms of state, including Unitary, Federation, and Confederation.
- Analyze various forms of government, including Authoritarian, Democracy, Parliamentary Democracy, and Presidential Democracy.
- Explain the basic concepts of Political Science, including Power, Authority, and Legitimacy.

- Identify and describe the roles and functions of the major organs of government, such as the Legislature, Executive, Judiciary, and Media (considered as the fourth pillar of the state).

Course Outline:

1. Introduction: What is Political?
2. What is Political Science? Theories or Approaches in Political Science
   Traditional and behavioral approach.
3. Sub-fields of Political Science and Relationship of Political Science with other social sciences.
   Sub-fields of Political Science include Political Philosophy/Theory; Comparative Politics; International Relations; Public Administration/ Public Policy; Local Government, etc.

4. Origin, Evolution and Elements of State

- The origin of state with reference to the theories of Divine Origin, Force and Social Contract (Hobbs, Lock, Rousseau);
- The elements of a state (sovereignty, population, territory, government);
- Compare and distinguish the role of state, society and government;
- Islamic concept of state: Basis of an Islamic State, Difference between an Islamic and Secular state,
- Functions of a state: Characteristics of a welfare state.
- The concept of a failed state

5. Nation and Nationalism
   Define Nation, Nationality and Muslim Ummah; differentiate between nation and nationality, distinguish between nation and Ummah, characteristics of a nation.
6. **Forms of State:**
   Unitary, Federation, Confederation.

7. **Forms of Government**: Authoritarian, Democracy, Parliamentary Democracy, Presidential Democracy

8. **Basic concepts of Political Science**:

   Power, Authority, Legitimacy

9. **Organs of Government:**

legislature, Executive, Judiciary and Media (Considered as fourth pillar of the state).

Recommended Books:

1. Haq, Mazherul, Theory and Practice in Political Science, Lahore Bookland, 1996.
2. Ian Mackenzi (Ed.), Political Concepts: A Reader and Guide, Edinburgh, University Press, 2005.
3. Michael G. Roskin et al, Political Science: An Introduction, 14th edition , 2019, Pearson.
4. Robert Jackson and Dorreen Jackson, A Comparative Introduction to Political Science, New Jersey, Prentice – Hall, 1997.
5. C. Agarwal, Political Theory (Principles of Pol. Science), New Delhi, S. Chand & Co., 2006.
6. Grigsby, Ellen, Analyzing Politics: An Introduction to Political Science, fifth edition, 2012, Wadsworth, Cengage Learning.
7. Mohammad Sarwar, Introduction to Political Science, Lahore Ilmi Kutub Khana, 1996.
8. Shafi, Choudhry Ahmad, Usul-e-Siyasiat (Urdu), Lahore Standard Book Depot, 1996.
9. V. D. Mahajan, Political Theory- Principles of Pol. Science, New Delhi, S. Chand & Co., 2006.
10. Andrew Heywood , Key Concepts in Politics, (2000), Palgrave Macmillan.
11. Choudhry Ahmad Shafi, Usul-e-Siyasiat (Urdu), Lahore Standard Book Depot, 1996.
12. R. C. Agarwal, Political Theory (Principles of Pol. Science), New Delhi, S. Chand & Co., 2006.
13. Rodee Anderson etc. Introduction to Political Science, Islamabad, National Book Foundation, Latest Edition.
14. Sheikh Bashir Ahmad, Riyasat Jo Ilm (Sindhi meaning Science of State), Jamshoro, Institute of Sindhalogy, University of Sindh, 1985.

Course Name: INTRODUCTION TO HUMAN RESOURCE MANAGEMENT

Course Code: Bot-118

Cr. Hrs. 02 (2+0)

Domain: GE (Social Science)

Learning Objectives:

The purpose of this course is to prepare the students for management of people at work. There is a great demand of the modern business and not-for profit organizations for high caliber of human resource. Theorists and planners equipped with sound knowledge for personnel polices and procedures to motivate the workforce for higher efficiency and maximum productivity. In considering the demand, this course is designed to give an overview of current ideas and issues in Human Resource Development. The core objective if the course is to provide students with clear thinking and understanding of how to plan, recruit, train, develop, appraise, compensate and lead human resource.

Learning Outcomes:

• After the Studying these topics, Students are well familiar with the application of all these techniques to get the maximum of productivity as well as the technique of developing & management People in organization.

Course Contents:

Concept of Human Resource Management; Human Resource Challenges; Human Resource Functions; Philosophical approaches to Human Resource Management; Job design and analysis; Human resources planning & recruitment; Career Planning & Development; Training and Development; Motivation and reward system; Performance appraisal; Compensation and Services

Text Books and Software: 1. Human Resource Management, (11th Edition). By Gary Dessler, (2008).

Reference Book: Fundamentals of Human Resource Management (8th Edition). By David A. Decenzo, Stephen P. Robbins

Course Name: Science of Society
Course Code: Bot-119
Cr.Hr.: 2(2+1)
Domain: GE (Social Science)

Course Description

Systematic study of social behaviour and human groups. It focuses on the influence of social relationships upon people's attitudes and behaviour and on how societies are established and changed. This course provides students with both methodologies and knowledge of the study of critical social issues ranging in scope from family to global.

Objectives

By the end of the course, students will be able to:

1. Correctly identify causes of critical social issues through a systematic study of social behaviour and social change;

2. Demonstrate comprehension of roles and functions of various social institutions and relationships among them;

3. Demonstrate understanding of several sociological theories and apply them to explain social phenomena or situations;

4. Demonstrate interest in taking part in social activities;

5. Use sociological imagination to explain their life experience in a broader social context.

Course Contents

1. The Nature of society
2. Basic Concepts
3. Culture
4. Socialization
5. Social interaction and social structure
6. Groups and organizations
7. Deviance and social control
8. Stratification and social mobility
9. Social inequality
10. Race and ethnicity, class, caste, nation
11. Stratification by gender
12. Stratification by age
13. Family
14. Religion
15. Government and the economy
16. Education
17. Health and medicine
18. Communities
19. Population
20. Collective behaviour and social change

Suggested Reading

1. Sociology (Richard T. Schaefer and Robert P. Lamm, MacGraw-Hill, N.O., 2002)
2. Social Problems (LeRoy W. Barnes, The Dushkin Publishing Group, Guilford, CT, 2000)

SEMESTER-II

Course Name: Plant Systematics, Anatomy and Development/Embryology
Course Code: Bot –121
Cr. Hr. 04(3+1)
Domain: Major

Specific Objectives of course:

To understand: 1. various systems of classification, identification and nomenclature of Angiosperms, 2- Structures and functions of tissues and organs at embryonic level.

Course Outline:

a) Plant systematics

1. Introduction to Plant Systematics: aims, objectives and importance.
2. Classification: brief history of various systems of classification.
3. Brief introduction to nomenclature.
4. Morphology: a detailed account of various morphological characters root, stem, leaf, inflorescence, flower, placentation and fruit types.
5. Diagnostic characters, economic importance and distribution pattern of the following families:
   i) Ranunculaceae
   ii) Rosaceae
   iii) Euphorbiaceae
   iv) Lamiaceae (Labiatae)
   v) Apiaceae (Umbelliferae)

b) Anatomy

1. Cell wall: structure and chemical composition
2. Concept, structure and function of various tissues like:
   i. Parenchyma
   ii. Collenchyma
   iii. Sclerenchyma
   iv. Phloem
   v. Xylem
3. Meristem
4. Vascular cambium
5. Structure of root, stem and leaf.
6. Characteristics of wood: diffuse porous and ring porous, sap and heart wood, soft and hard wood, annual rings.

c) Development/Embryology

1. Early development of plant body:
2. Structure and development of Anther Microsporogenesis, Microgametophyte
3. Structure of Ovule Megasporogenesis Megagametophyte
4. Endosperm formation
5. Parthenocarpy
6. Polyembryony

Lab Outline:

Plant Systematics

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

Anatomy and Embryology

1. Study of stomata and epidermis.
2. Tissues of primary body of plant.
3. Study of xylem 3-dimensional plane of wood.
4. T. S of angiosperm stem and leaf.
5. Anatomy of germinating seeds
6. Study of pollens

Recommended Books:

1. 1 Mauseth, J. D. 1998. An Introduction to Plant Biology: Multimedia Enhanced. Jones and Bartlett Pub. UK
2. Moore, R. C., W. D. Clarke and Vodopich, D. S. 1998. Botany. McGraw Hill Company, U.S.A.
3. Raven, P. H., Evert, R. E. and Eichhorn, S. E. 1999. Biology of Plants. W. H. Freeman and Company Worth Publishers.
4. Stuessy, T. F. 1990. Plant Taxonomy. Columbia University Press, USA.
5. Lawrence, G. H. M. 1951 Taxonomy of Vascular Plants. MacMillan & Co. New York.
6. Panday, B. P. 2004. A textbook of Botany (Angiosperms). S. Chand and Co. New Delhi.
7. Raymond E, S. E. Eichhorn. 2005. Esau's Plant Anatomy. Meristems cells and tissues of the plant body, 3rd Ed. John Wiley & Sons. Inc.
8. Fahn, A. 1990. Plant Anatomy. Pergamon Press, Oxford.
9. Esau, K. 1960. Anatomy of Seed Plants. John Wiley, New York.
10. Maheshwari, P. 1971. Embryology of Angiosperms, McGraw-Hill. New York.
11. Eames A. J. and L. H Mac Daniels. 2002. An Introduction to Plant Anatomy. Tata-Mac Graw-Hill Publishing Company, Limited, New Delhi.
12. Pullaiah, T. 2007. Taxonomy of Angiosperms. 3rd Edition, Regency Publications, New Delhi.

13. Naik, V. N. 2005 Taxonomy of Angiosperms. 20th Reprint. TataMacGraw-Hill Publishing Company, Limited New Delhi.
14. Rajput, M. T., S. S. Hassney and K. M. Khan. 1996. Plant Taxonomy. New Trends Computer Service, Hyderabad, Sindh, Pakistan.

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

Course Name: Principles in Animal Life – I
Course Code: Bot -122
Cr. Hr. 03(2+1)
Domain: Allied

Objectives

The course aims to impart knowledge and understanding of:

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

Course Contents

Scope of Zoology: Introduction; significance and applications of zoology; animal diversity; the scientific method; environment and world resources.

The Chemical Basis of Animal Life: Brief introduction to biomolecules; carbohydrates, lipids, proteins, and nucleic acids.

Cellular Organization: Structure of animal cells, cell membrane, cytoplasm and its organelles: ribosomes, endoplasmic reticulum, Golgi apparatus, lysosomes, mitochondria, cytoskeleton, cilia and flagella, centrioles and microtubules, vacuoles;the nucleus: nuclear envelope, chromosomes and nucleolus.

Animal tissues: Types: epithelial, connective, muscle and nervous tissue; organs and organ systems.

Enzymes: Structure, types; function and factors affecting their activity; cofactors and coenzymes.

Energy Harvesting: Aerobic and anaerobic respiration: glycolysis, citric acid cycle and electron transport chain; fermentation, the major source of ATP.

Reproduction and Development: Types; asexual and sexual, gametogenesis, fertilization, metamorphosis, zygote and early development.

Ecological Concepts: Ecosystem, types, homeostasis, biomes, food chain, food web, energy flow and thermodynamics; biogeochemical cycles, and limiting factors, populations and communities, human population growth, pollution, resource depletion and biodiversity.

Practicals

1. Tests for different carbohydrates, proteins and lipids.

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

2. Study of the prepared slides of epithelial tissue (squamous, cuboidal, columnar), connective tissue (adipose, cartilage, bone, blood), nervous tissue and muscle tissue (skeletal, smooth and cardiac). Note: Prepared microscopic and/or projection slides and/or CD ROM computer projections must be used.

3. Plasmolysis and deplasmolysis in blood. Preparation of blood smears.

4. Protein digestion by pepsin.

5. Ecological notes on animals of a few model habitats.

6. Field observation and report writing on animals in their ecosystem (a terrestrial and an aquatic ecosystem study).

Books Recommended

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

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

3. Hickman, C.P., Roberts, L.S. and Larson, A. 2004. Integrated Principles of Zoology, 12th Ed. (International), Singapore: McGraw Hill.

4. Campbell, N.A. 2002. Biology. 6th Ed. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.

5. Miller, S.A. 2002. General Zoology Laboratory Manual. 5th Ed. (International), Singapore: McGraw Hill.

6. Hickman, C.P. and Kats, H.L. 2000. Laboratory Studies in Integrated Principles of Zoology. Singapore: McGraw Hill.

7. Odum, E. P. 1994. Fundamentals of Ecology. 3rd Ed. W.B. Saunders. Philadelphia

Course Name: Environmental Chemistry
Course Code: Bot- 123
Cr. Hr. 03(2+1)
Domain: Allied

Objectives of the Course:

From this course, the students should be able to:

- Understand the fundamental principles of environmental chemistry.

• Apply these principles in pollution related subjects.

• Demonstrate the understanding of environmental chemistry principles via experimental exercises in the laboratory.

Course Outlines:

Atmospheric Chemistry

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

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

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

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

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

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

Recommended Books

1. Collin Baird, Environmental Chemistry, W. H. Freeman and company, New York, 1995.

2. John W. Moore and Elizabeth A. Moore, Environmental Chemistry, Academic Press Inc., New York, 1976.

3. Anil Kumar De, Environmental Chemistry, Wiley Eastern Ltd. New Delhi, 1989.

4. R. W. Raiswell, P. Brimblecombe, D. L. Dent and P. S. Liss, Edward Arnold Ltd., London, 1980.

5. Staneley E. Manahan, Environmental Chemistry, Brooks, California.

Course Name: Islamic Studies
Course Code: Bot –124
Cr. Hr. 02 (2+0)
Domain: GE

Note: May be taught in Urdu.

Course Contents (English & Urdu)

English	Urdu
1. Introduction to Quranic Studies • Basic Concepts of Quran • History of Quran • Uloom-ul -Quran	**1. قرآنی علوم کا تعارف** • قرآن مجید کے بنیادی اصطلاحات • تاریخ تدوین وجمع قرآن • علوم القرآن
2. Study of Selected Text of Holy Quran • Verses of Surah al-Furqan Related to Social Ethics (Verse No.6377) • Verses of Surah Al-Hashr (18,19, 20) Related to thinking, Day of Judgment • Verses of Surah Al-Saff Related to Tafakur, Tadabbur (Verse No-1,14)	**2. منتخب آیات کریمہ کا مطالعہ** • معاشرتی آداب سے متعلق سورہ الفرقان کی آیات نمبر 63-77 • آخرت اور اسکی فکر سے متعلق سورہ الحشر کی آیات 18-20 • کائنات میں غور و فکر سے متعلق سورہ الصف کی آیات 1-14
3. Seerat of Holy Prophet (PBUH) • Life of Holy Prophet (PBUH) in Makkah (After Prophethood) and its Important Events • Life of Holy Prophet (PBUH) in Madinah and its Important Events	**3. سیرت طیبہ ﷺ کا مطالعہ** • مکہ مکرمہ میں بعد از نبوت حضور ﷺکی زندگی اور اہم واقعات • مدینہ منورہ میں حضور ﷺکی زندگی اور اہم واقعات
4. Introduction to Sunnah • Basic Concepts of Hadith • History of Hadith • Kinds of Hadith • Legal Position of Sunnah	**4. تعارف حدیث و سنت** • سنت و حدیث کا تعارف و اہمیت • تاریخ حدیث • حدیث کی اقسام • سنت کا شرعی مقام
5. Selected Study from Text of Hadith • عن انس بن مالک رضی اللہ عنہ قال قال رسول اللہ ﷺ:"من خرج فی طلب العلم فھو فی سبیل اللہ حتّیٰ یرجع"۔ • عن ابی امامۃ رضی اللہ عنہ قال قیل یارسول اللہ!الرجلان یلتقیان ایھما یبدا بالسلام فقال اولاھما باللہ"۔ • عن ابی سعید الخدری رضی اللہ عنہ قال سمعت رسول اللہ ﷺ یقول:" من رأیٰ منکم منکراً فلیغیرہ بیدہ فان لم یستطع فبلسانہ فان لم یستطع فبقلبہ و ذٰالک اضعف الایمان" • عن ابی ھریرۃ رضی اللہ عنہ قال قال رسول اللہ ﷺ:" آیۃ المنافق ثلاث اذا حدث کذب واذا وعد اخلف واذا ائتمن خان" • عن ابی ھریرۃ رضی اللہ عنہ قال قال رسول اللہ ﷺ:" ایاکم و الحسد فان الحسد یأکل الحسنات کما تأکل النار الحطب"۔ • عن ابی ھریرۃ رضی اللہ عنہ ان رسول اللہ ﷺ قال:" من کان یؤمن باللہ والیوم الآخر فلیقل خیرا او لیصمت ومن کان یؤمن باللہ والیوم الآخر فلیکرم جارہ ومن کا ن یؤمن باللہ والیوم الآخر فلیکرم ضیفہ"۔ • عن عبداللہ ابن عمربن الخطاب رضی اللہ عنھما قال سمعت رسول اللہ ﷺیقول:بنی الاسلام علیٰ خمس شھادۃ ان لا الٰہ الا اللہ وان محمدا عبدہٗ ورسولہ واقام الصلوٰۃ وایتاء الزکوٰۃ وحج البیت وصوم رمضان • عن ابی ھریرۃ رضی اللہ عنہ ان رسول اللہ ﷺ قال:" من حسن اسلام المرء ترکہ مالایعنیہ"۔	

6. Introduction to Islamic law and jurisprudence • History and Importance of Islamic Law and Jurisprudence • Sources of Islamic law and jurisprudence • Nature of differences in Islamic law • Islam and sectarianism	**6. اسلامی قانون اور فقہ کا تعارف** • اسلامی قانون اور فقہ کی تاریخ اور اہمیت • اسلامی قانون اور فقہ کے ذرائع • اسلامی قانون میں اختلافات کی نوعیت • اسلام اور فرقہ واریت
7. Political System of Islam • Basic Concepts of Islamic Political System • Islamic Concept of Sovereignty • Basic Institutions of government in Islam	**7. اسلام کا سیاسی نظام** • اسلامی سیاسی نظام کے بنیادی تصورات • اسلامی تصور حاکمیت • اسلام میں حکومت کے بنیادی ادارے
8. Social System of Islam • Basic concepts of social system of Islam • Elements of Family • Ethical Values of Islam	**8. اسلام کا معاشرتی نظام** • اسلام کے معاشرتی نظام کے بنیادی تصورات • خاندان کے عناصر • اسلام کی اخلاقی اقدار

Recommended Readings

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

Course Name: Ethics

Course Code: Bot-125

Cr.Hr.: 2(2+0)

Domain: GE

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. McGraw Hill. 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

Course Name: Functional English
Course Code: Bot –126
Cr. Hr. 03(3+0)
Domain: GE

COURSE DISCRIPTION

The purpose of this course is to develop the English-language proficiency of students and to help them become confident in reading, writing, speaking, and listening to the English language. Instead of teaching grammar in isolation and only at sentence level, this course is based on developing the language abilities of students through an integrated approach that provides opportunities to develop their listening, speaking, reading, and writing skills. With a focus on social interaction, the course draws specific attention to the accurate use of structures, improvement of pronunciation, and development of active vocabulary in descriptive, narrative, and instructional texts.

COURSE OUTCOMES

After completing this course, students will:

- have improved their listening and reading skills in English
- be able to communicate in written and oral English with peers and teachers
- rely less on their first languages and increase their use of English in formal and informal situations
- have a deeper understanding of correct English structures in descriptive, narrative, and instructional texts.

COURSE CONTENTS

Basics of Grammar

- Parts of Speech and their Usage
- Sentence and Its Structure
- Phrase, usage of phrases
- Clause, usage of clauses

Introductions

This first unit will provide students with an opportunity to interact with one another in oral and written forms. It will serve to introduce them and help them develop conversations through suggesting simple words and phrases to describe people, preferences, and other conversation topics in a logical sequence.

Making Introductions

• Making effective self and peer introductions
• Taking useful introductory notes

Expressing Requests and Enquiries

• Forming appropriate requests and enquiries
• Responding to enquiries
• Requests versus commands

Social Interaction

This unit is aimed at developing students' social interaction in English and expanding their interpersonal skills. Through class activities, they actively converse in formal and informal contexts to congratulate, express gratitude, make invitations, and respond to speakers in oral and written contexts.

Greetings

• Greeting friends and family on different occasions and for different reasons
• Responding to a positive event
• Using formal greeting expressions appropriately

Gratitude

• Using formal and informal expressions of gratitude appropriately
• Reading a story that uses expressions of gratitude
• Writing a formal letter to say thanks to a teacher, parent, or friend

Invitations

• Demonstrating the use of formal and informal expressions of invitation
• Developing verbal and written skills for invitations
• Responding to invitation requests by accepting or declining

Regrets

• Expressing regrets orally and in writing appropriately

- Saying sorry and accepting apologies

Giving and Following Directions

In this unit, students learn how to follow directions from a map as well as how to give directions to search for a location or specific information. They learn how to follow and provide clear instructions.

Following and Giving Directions

- Following directions from a map
- Giving directions to a location in oral and written forms
- Reaching a destination

Giving Clear Instructions

- Carrying out instructions
- Structuring instructions
- Writing clear instructions

Sharing experiences

In this unit, students will engage with different meanings in a variety of written and visual texts through shared, guided, and independent readings of narratives in various genres. Instructors will encourage them to respond to the narrative and imaginative texts by composing stories and sharing them in written and oral form.

Sharing narratives

- Reading short stories
- Reading excerpts, comic strips, interviews, and other common texts

Sharing unique experiences

- Summarizing and narrating true stories
- Solving word puzzles to develop language awareness
- Reading short stories and completing exercises to test comprehension
- Converting an event into a short story
- Using pictures as stimuli for narrative creation
- Using songs as examples of personal experience

Imaginative texts

- Developing imaginative texts by communicating engrossing stories and descriptions of scenes

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)

Composition and Comprehension

Writing Mechanics

- Sentences, sentence fragments, and run-on sentences
- Subject-predicate and pronoun-reference agreement
- Punctuation and structure

Paragraph Writing (practice)

Essay Writing (practice)

Précis writing (practice)

TEXTBOOKS AND REFERENCES

- T. K. Carver and S. Fortinos-Riggs, Conversation Book II – English in Everyday Life (New York: Pearson Education Limited, 2006).
- J. Eastwood, Oxford Practice Grammar (Karachi: Oxford University Press, 2005).
- J. Swan, Practical English Usage, 3rd ed. (New York: Oxford University Press, 2005).
- J. Thomson and A. V. Martinet, A Practical English Grammar (Intermediate) (New York: Oxford University Press, 1986)
- Allama Iqbal Open University, Compulsory English 1 (Code 1423) (Islamabad: AIOU Press).
- BBC. (2013) Learning English. http://www.bbc.co.uk/worldservice/learningenglish/
- British Council. Learn English. http://learnenglish.britishcouncil.org/en/
- British Council and BBC. Learn English. http://www.teachingenglish.org.uk/
- Grammar English. http://freesoftwarepc.biz/educational-software/ download-

List of General Education Course: Natural Sciences

Introduction to Geography

Course Code: Bot – 127
Cr. Hr. 03(2+1)
Domain: GE (Natural Science)

COURSE DISCRIPTION

The purpose of this course is to develop the English-language proficiency of students and to help them become confident in reading, writing, speaking, and listening to the English language. Instead of teaching grammar in isolation and only at sentence level, this course is based on developing the language abilities of students through an integrated approach that provides opportunities to develop their listening, speaking, reading, and writing skills. With a focus on social interaction, the course draws specific attention to the accurate use of structures, improvement of pronunciation, and development of active vocabulary in descriptive, narrative, and instructional texts.

COURSE OUTCOMES

After completing this course, students will:

- have improved their listening and reading skills in English
- be able to communicate in written and oral English with peers and teachers
- rely less on their first languages and increase their use of English in formal and informal situations
- have a deeper understanding of correct English structures in descriptive, narrative, and instructional texts.

COURSE CONTENTS

Basics of Grammar

- Parts of Speech and their Usage
- Sentence and Its Structure
- Phrase, usage of phrases
- Clause, usage of clauses

Introductions

This first unit will provide students with an opportunity to interact with one another in oral and written forms. It will serve to introduce them and help them develop conversations through suggesting simple words and phrases to describe people, preferences, and other conversation topics in a logical sequence.

Making Introductions
- Making effective self and peer introductions
- Taking useful introductory notes

Expressing Requests and Enquiries
- Forming appropriate requests and enquiries
- Responding to enquiries
- Requests versus commands

Social Interaction

This unit is aimed at developing students' social interaction in English and expanding their interpersonal skills. Through class activities, they actively converse in formal and informal contexts to congratulate, express gratitude, make invitations, and respond to speakers in oral and written contexts.

Greetings
- Greeting friends and family on different occasions and for different reasons
- Responding to a positive event
- Using formal greeting expressions appropriately

Gratitude
- Using formal and informal expressions of gratitude appropriately
- Reading a story that uses expressions of gratitude
- Writing a formal letter to say thanks to a teacher, parent, or friend

Invitations

- Demonstrating the use of formal and informal expressions of invitation
- Developing verbal and written skills for invitations
- Responding to invitation requests by accepting or declining

Regrets
- Expressing regrets orally and in writing appropriately
- Saying sorry and accepting apologies

Giving and Following Directions

In this unit, students learn how to follow directions from a map as well as how to give directions to search for a location or specific information. They learn how to follow and provide clear instructions.

Following and Giving Directions
- Following directions from a map
- Giving directions to a location in oral and written forms
- Reaching a destination

Giving Clear Instructions
- Carrying out instructions
- Structuring instructions
- Writing clear instructions

Sharing experiences

In this unit, students will engage with different meanings in a variety of written and visual texts through shared, guided, and independent readings of narratives in various genres. Instructors will encourage them to respond to the narrative and imaginative texts by composing stories and sharing them in written and oral form.

Sharing narratives
- Reading short stories
- Reading excerpts, comic strips, interviews, and other common texts

Sharing unique experiences
- Summarizing and narrating true stories
- Solving word puzzles to develop language awareness
- Reading short stories and completing exercises to test comprehension
- Converting an event into a short story
- Using pictures as stimuli for narrative creation
- Using songs as examples of personal experience

Imaginative texts
- Developing imaginative texts by communicating engrossing stories and descriptions of scenes

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)

Composition and Comprehension

Writing Mechanics
- Sentences, sentence fragments, and run-on sentences
- Subject-predicate and pronoun-reference agreement
- Punctuation and structure

Paragraph Writing (practice)

Essay Writing (practice)

Précis writing (practice)

TEXTBOOKS AND REFERENCES

- T. K. Carver and S. Fortinos-Riggs, Conversation Book II – English in Everyday Life (New York: Pearson Education Limited, 2006).
- J. Eastwood, Oxford Practice Grammar (Karachi: Oxford University Press, 2005).
- J. Swan, Practical English Usage, 3rd ed. (New York: Oxford University Press, 2005).
- J. Thomson and A. V. Martinet, A Practical English Grammar (Intermediate) (New York: Oxford University Press, 1986)
- Allama Iqbal Open University, Compulsory English 1 (Code 1423) (Islamabad: AIOU Press).
- BBC. (2013) Learning English. http://www.bbc.co.uk/worldservice/learningenglish/
- British Council. Learn English. http://learnenglish.britishcouncil.org/en/
- British Council and BBC. Learn English. http://www.teachingenglish.org.uk/
- Grammar English. http://freesoftwarepc.biz/educational-software/ download-

Course Name: Animal Diversity I: Invertebrates
Course Code: Bot –128
Cr. Hr. 03(2+1)
Domain: GE (Natural Science)

Objectives:

The course is designed to provide students with:

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

Course Contents

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

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

Multicellular and Tissue Levels of Organization: origins of multicellularity; animal origins. Phylum porifera: cell types, body wall, and skeletons; water currents and body forms; maintenance functions; reproduction.

Phylum Cnidaria (coelenterata) the body wall and nematocysts; alternation of generations; maintenance functions; reproduction and classification up to class. Phylum Ctenophora; further phylogenetic considerations.

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

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

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

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

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

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

Lesser Invertebrates: The lophophorates, entoprocts, cycliophores, and chaetognaths.

Practicals :

Museum study of representative Phyla,

Permanent slide preparations

1. Study of Euglena, Amoeba, Entamoeba, Plasmodium, Trypanosoma,
2. Paramecium as representative of animal like protists. (Prepared slides).
3. Study of sponges and their various body forms.
4. Study of principal representative classes of Phylum Cnidaria.
5. Study of principal representative classes of Phylum Platyhelminthes.
6. Study of representative of Phylum Rotifera, Phylum Nematoda.
7. Study of principal representative classes of Phylum Mollusca.
8. Study of principal representative classes of Phylum Annelida.
9. Study of principal representative classes of groups of Phylum Arthropoda.
10. Brief notes on medical/economic importance of the following:

11. Plasmodium, Entamoeba histolitica, Leishmania, Liverfluke, Tapeworm, Earthworm,
12. Silkworm, Citrus butterfly.

Books Recommended

1. Hickman, C.P., Roberts, L.S., Larson, A. 2011. Integrated Principles of Zoology, 15th Ed. (International). Singapore: McGraw Hill.

2. Miller, S.A., Harley, J.B. 2011. Zoology, 8th Ed. (International), Singapore: McGraw Hill.

3. Pechenik, J.A. 2010. Biology of Invertebrates, 4th Ed. (International), Singapore: McGraw Hill.

4. Campbell, N.A. 2002. Biology, 6th Ed. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.

5. Miller, S.A., 2002. General Zoology Laboratory Manual. 5th Ed. (International). Singapore: McGraw Hill.

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

Course Name: Physical Chemistry

Course Code: Bot-129

Cr. Hr.: 03(2+1)

Domain: GE (Natural Science)

Physical States of Matter

Ideal and real gases, equations of state, critical phenomenon and critical constants. Molecules in motion: collision diameter and mean free path. Physical properties of liquids: surface tension, viscosity, refractive index etc. and their applications. Brief account of interactions among the molecules in liquids. Packing of atoms in solids. Unit cells and crystal systems. Method of crystal structure analysis. Brief account of polymers and composite materials with special emphasis on superconductors, semi-conductors etc. Introduction to plasma.

Chemical Thermodynamics

Laws of thermodynamics and their applications. Thermodynamic functions: internal energy, enthalpy, entropy and free energy. Relation between thermodynamic functions. van't Hoff's equation. Heat capacities, concept of entropy and probability.

Chemical Kinetics Rate of reaction.

Rate law, order and molecularity of the reactions. Zero, first and second order reactions. Determination of reaction order and its rate constant. Effect of temperature on the reaction rate.

Concepts of chemical equilibrium. Le-Chatelier's principle and its applications. Elementary concepts underlying complex and fast reactions.

Solution Chemistry

Ideal and non-ideal solutions. Raoult's and Henery's laws and their applications. Molecular interactions in solutions. Colligative properties. Distillation and concept of azeotropic mixture.

Surface Chemistry

Concept of interfaces. Adsorption and adsorption isotherms: Freundlich and Langmuir adsorption isotherms. Catalysis, colloids emulsion and their industrial applications.

Electrochemistry

Basic concepts of electrochemistry. Ions in solution. Measurement of conductance and Kohlrausch's law. Debye-Hueckel theory and activity coefficient. Application of conductance measurement. Electrode potential. Electrochemical cell. Application of electrode potential

Practicals:

Determination of viscosity and parachor values of liquids.

Determination of percent composition of liquid solutions viscometrically.

Determination of refractive index and molar refractivity.

Determination of percent composition of liquid solutions by refractive index measurements.

Determination of molecular weight of a compound by elevation of boiling point (ebullioscopic method).

Determination of molecular weight of a compound by lowering of freezing point (cryoscopic method).

Determination of heat of solution by solubility method.

Determination of heat of neutralization of an acid with a base.

Kinetic study of acid catalyzed hydrolysis of ethyl acetate

. Determination of partition coefficient of a substance between two immiscible liquids.

Books Recommended (Theory)

1. Alberty R. "Physical Chemistry" 17th ed., John Wiley and Sons (1987).
2. Atkins, P.W. "Physical Chemistry" 6th ed., W.H. Freeman and Co. New York (1998).

3. Laidler K.J. "The World of Physical Chemistry" 1st ed., Oxford University Press (1993).
4. Laidler K.J., John H.M. and Bryan C.S. "Physical Chemistry" 4th ed., Houghton Mifflin Publishing Company Inc.(2003).
5. Peter P.A. "Chemical Thermodynamics" Oxford University Press (1983).
6. Brain S.E. "Basic Chemical Thermodynamics" 4th ed., E.L.B.S. Publishers (1990).
7. Barrow G.M. "Physical Chemistry" 5th ed., McGraw Hill (1992).

Recommended (Practicals)

1. Jaffar M. "Experimental Physical Chemistry" University Grants Commission (1989).
2. Levitt B.P. "Findlay's Practical Physical Chemistry" 9th ed., Longman Group Limited (1978).
3. Shoemaker D. "Experiments in Physical Chemistry" 5th ed., McGraw Hill Publishing Company Limited (1989).

Course Name: What is Science
Course Code: Bot 130
Cr.Hr. 3(2+1)
Domain: GE (Natural Science)

COURSE DESCRIPTION

Science and Technology have completely transformed the way we live. The development we have seen in the past few decades is unprecedented but very few understand the principles through which the scientific progress is achieved. This course, especially designed for first year students introduces various fields of natural science, how scientists operate within these fields, what methods they deploy to make new discoveries, and how they communicate the advances in their fields to the world.

The course starts with an introduction to the development of the scientific approach. It discusses the modern use of the scientific method and the tools and resources that scientists deploy to ensure that they produce authentic and reliable bodies of knowledge. Students are then introduced to three main branches of science (Physics, Chemistry and Biology), their core underlying principles, major developments in these fields and their applications in modern life. Students will work on case studies and lab experiments to understand how scientists discover various workings of nature and the missteps that they can take while conducting any scientific inquiry. The final part of the course focusses on the skills to separate valid science from fringe science. Students are also exposed to the fundamentals of scientific communication and strategies to identify reliable bodies of knowledge.

COURSE OUTCOMES

Through successful completion of this course, students will be able to:

- Clearly articulate the development of scientific thought through various parts of human history and compare it to the modern scientific method.
- Describe various branches of Science, their underlying core ideas, and compare their applications.
- Using case studies and demonstrations, practice application of the Scientific Method in the natural sciences.
- Determine whether a given claim or belief is scientifically valid or not and provide a clear rationale for doing so.

COURSE CONTENTS

Overview of Science and the Scientific Method

- What is science?
- What qualifies as science?
- Why does it matter?
- Who practices it?
- Introduction to important terminology: Fact, hypothesis, theory, law

Evolution of the Scientific Method across Civilizations

- Prehistory, Mesopotamia & Egypt, Greeks, China, South Asia, Arab/Islamic, European
- Examples of scientific contributions from different regions are used to show different forms of reasoning that were used to determine the nature of reality and develop science as a process, e.g. inductive, deductive, abductive, hypothetico-deductive, falsification.

The Modern Scientific Method

- What does modern science look like today?
- What are the advantages of using this method? What are the limitations?
- How did science become the dominant method of understanding the natural world?

Introduction to Areas/Branches of Science

1 week (Intro to areas/branches of science)

2 weeks (Physics) = Major themes in Physics, Applications, Experiments

2 weeks (Chemistry) = Major themes in Chemistry, Applications, Experiments

2 weeks (Biology) = Major themes in Biology, Applications, Experiments

For each of the branches:

• Introduction to core ideas and important theories (e.g. Physics: Gravity, Chemistry: Atomic theory, Biology: Evolution by Natural Selection).

• Introduction to possible majors: How do they relate to various professions/fields.

• Practical applications of ideas from each field

How to spot Fake Science!?

- Practices leading to pseudoscience
- Case-studies from popular discourse (e.g. Cold Fusion, Telepathy, N-rays etc.

Scientific communication

- Introduction to the Peer Review (advantages and misuse)
- Importance of controls and replication (link with the replication crisis in science)

Teacher's Manual

Natural Sciences Course Outline - Aug 2021.pdf

Natural Sciences Teacher Manual - Aug 2021.pdf

SEMESTER-III

Course Name: Biodiversity and Conservation
Course Code: Bot –231
Cr. Hr. 04 (3+1)
Domain: Major

Objectives:

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

Course Outline:

Biodiversity: Definition, types and threats

Threats to Biodiversity; deforestation, over grazing, erosion, desertification, ecosystem degradation, bio invasion, pollution and climate change
Biodiversity of Pakistan
Measuring biodiversity: Alpha, Beta and Gamma diversity; Systematic and functional diversity.
Ecological services, indirect value of ecosystem by virtue of their ecological functions, direct value of ecosystem (i.e. Utility of Bio resources)
Sustainable and unsustainable use of biological resources
Biodiversity Hot spots of Pakistan and the world.
International treaties/agreements regarding Biodiversity and conservation; CBD, CITES, Ramsar
Conservation strategies; in situ, ex situ, in vitro conservation
Conservation vs preservation
IUCN categorized protected areas in Pakistan; red listing
Environmental Impact Assessment.
Use of herbarium and Botanical Garden in biodiversity and conservation.
Concept of pastures and wild life management
Global Biodiversity Information Facility (GBIF)

Lab outline:

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

Recommended Books:

Abbasi, A. M., Khan, M. A., M. Ahmad and M. Zafar. 2012. Medicinal plant biodiversity of Lesser Himalaya Pakistan. Springer Publishers USA.

Hussain, F., 1991. Vegetation and ecology of lesser Himalaya. Department of Botany, Peshawar

Shinwari, M. I. and M. A. Khan. 1998. Ethnobotany of Margalla Hills. Department of Biological Sciences, Quaid-i-Azam University Islamabad Pakistan.

Shinwari, M. I., M. I. Shinwari and Shah, M. 2007. Medicinal Plants of Margalla Hills National Park Islamabad. Higher Education Commission Islamabad. Pp.218.

Provincial conservation strategies

Heywood, V. (ed.). 1995. Global Biodiversity Assessment. Published for the United Nations Environment Programme. Cambridge University Press, Cambridge, UK.

Falk, D. A. & Holsinger, K. E. 1991. Genetics and Conservation of Rare Plants. Center for Plant Conservation. Oxford University Press, Oxford, UK.

Frankel, O. H., Brown, A. H. D. & Burdon, J. J. 1995. The Conservation of Plant Biodiversity. Cambridge University Press, Cambridge, UK.

IUCN. 1994. IUCN Red List Categories. As Approved by the IUCN Council. IUCN.
Leadlay, E. and Jury, S. 2006 Taxonomy and Plant Conservation. CUP.

Bush, M. B. 1997 Ecology of a changing Planet. Prentice hall. New Jersy.

French, H. 2000 Vanishing Borders- protecting the Planet in the age of globalization. W. W. Norton & Co.

Swanson, T. 2005 Global Action for Biodiversity. Earth Scan Publication Ltd.

Taylor, P. 2005 Beyond Conservation. Earth Scan Publication Ltd.

Journals /Periodicals

Systematics and Biodiversity, Biological Conservation.

Course Name: Cell Biology, Genetics and Evolution
Course Code: Bot –232
Cr. Hr. 04 (3+1)
Domain: Major

Specific objectives:

To understand:

1. Structure and function of cell.
2. Nature of genetic material and hereditary process
3. Familiarization with evolutionary processes.

Course outline:

a) Cell Biology

1. Structure and Function of Bio-molecules
    i. Carbohydrates
    ii. Lipids
    iii. Proteins
    iv. Nucleic Acids
2. Cell: Cell theory, cell types (prokaryotes, eukaryotes), basic properties of cell.
3. Brief description of following cell organelles
    i) Cell wall
    ii) Cell membrane
    iii) Nucleus
    iv)Endoplasmic reticulum
    v) Plastids
    vi) Mitochondria
    vii) Ribosomes
    viii) Dictyosomes
    ix) Vacuoles
4. Reproduction in somatic and embryogenic cell, mitosis, meiosis and cell cycle

b) Genetics

1. Introduction, scope and brief history of genetics. Mendelian inheritance; Laws of segregation and independent assortment, back cross, test cross, dominance and incomplete dominance.

2. Molecular genetics; DNA replication. Nature of gene, genetic code, transcription, translation, protein synthesis, regulation of gene expression (e.g. lac operon).

3. Chromosomal aberrations; Changes in the number of chromosomes. Aneuploidy and Euploidy. Changes in the structure of chromosomes, deficiency, duplication, inversion and translocation.

c) Evolution: Introduction and theories.

Lab Outline:

Cell Biology

1. Study of cell structure using compound microscope and elucidation of ultrastructure from electron microphotographs
2. Measurement of cell size.
3. Study of mitosis and meiosis by smear/squash method and from prepared slides.
4. Study of chromosome morphology and variation in chromosome number.
5. Extraction and estimation of carbohydrate, protein, RNA and DNA from plant sources.

Genetics

1. Genetical problems related to transmission and distribution of genetic material.
2. Identification of chromosomes in plant material. Carmine/orcein staining.
3. Determination of blood groups

Recommended Books:

1. Hoelzel, A. R. 2001. Conservation Genetics. Kluwer Academic Publishers.
2. Dyonsager, V. R. (1986). Cytology and Genetics. Tata and McGraw-Hill Publication Co. Ltd,, New Delhi.
3. Lodish. H. 2001. Molecular Cell Biology. W. H. Freeman and Co.
4. Sinha, U. and Sinha, S. (1988). Cytogenesis Plant Breeding and Evolution, Vini Educational Books, New Delhi.
5. Strickberger, M. V. (1988), Genetics, MacMillan Press Ltd., London.
6. Carroll, S. B., Grenier, J. K. and Welnerbee, S. D. 2001. From DNA to Diversity - Molecular Genetics and the Evolution of Animal Design. Blackwell Science.
7. Lewin, R, 1997. Principles of Human Evolution. Blackwell Science.
8. Strickberger, M. W. 2000 Evolution. Jones & Bartlet Publishers Canada
9. Ingrouille M. J. & B. Eddie. 2006. Plant Diversity and Evolution. Cambridge University Press.
10. Bruce Albert et al. 2009. Essential cell biology. Garland Sciences Publishers. Journals/Periodicals:

Theoretical & Applied Genetics, the Cell, Heredity

Course Name: Inorganic Chemistry
Course Code: Bot –233

Cr. Hr. 03(2+1)
Domain: Allied

Objectives:

- The program is aimed that the student should learn:
- The Development of periodic law and properties of elements in a systematic way.
- The principal of chemical bonding
- Chemistry of acid and bases
- Chemistry of p-block Elements

Course Content

1. **The Periodic Law and Periodicity**

Development of Periodic Table; Classification of elements based on s, p, d and f orbitals, group trends and periodic properties in s, p, d and f block elements, i.e., atomic radii, ionic radii, ionization potential, electron affinities, electronagetivities.

2. Principles of Chemical Bonding Types of chemical bonding; ionic bonding; the localized bond approach: VB theory, hybridization and resonance; the delocalized approach to bonding: molecular orbital theory as applied to diatomic homouclear molecules, bonding theory of metals; conductors, insulators and semiconductors; bonding in electron deficient compounds; hydrogen bonding.

3. Acids and Bases Concepts of acids and bases including SHAB concept, relative strength of acids and bases, significance of pH, pKa, pKb and buffer solutions. Theory of Indicators, solubility, solubility product, common ion effect.

4. Chemistry of p-block Elements Chemistry and structure of noble gases and their compounds, chemistry and structure of interhalogens and pseudohalogens.

Practical

1. Laboratory Ethics and safety measures Awareness about the toxic nature of chemicals and their handling, cleaning of glassware, safe laboratory operations

2. Qualitative analysis Analysis of four ions (two anions and two cations) from mixture of salts

3. Quantitative analysis Laboratory work illustrating topics covered in the lecture of CHEM-151

Recommended Books

1. Huheey, J. E., Keiter, E. A. and Keiter, R. L., Inorganic Chemistry: Principles of Structure and Reactivity, 4th Ed., Harper and Row, New York, 2001

2. Cotton, F. A., Wilkinson, G. and Gaus, P. L., Basic Inorganic Chemistry, 3rd Ed., Wiley, New York, 1995.

3. Clyde Day, M. & Selbin, J., Theoretical Inorganic Chemistry, 2nd Ed., Van Nustrand Reinhold, 1969.

4. Lee, J.D., Concise Inorganic Chemistry, Chapman and Hall, 5th Edition,1996.

5. Shriver, D. F., Atkins, P. W. and Langford, C. H., Inorganic Chemistry, Oxford University Press, 2nd Edition, 1994.

6. Bassette, J., Denney, G. H. and Mendham, J., Vogel's Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis English Language Book Society, 4th Edition, 1981.

7. Vogel, A. I., A Textbook of Micro and Semi-micro Qualitative Inorganic Analysis. Longman Green & Co. 1995.

Course Name: Tools for Quantitative Reasoning
Course Code: Bot – 234
Cr. Hr. 03(2+1)
Domain: GE

COURSE DESCRIPTION

The primary objective of this course is to explore probability and statistics. The curriculum includes in-depth study of exponential and logarithmic functions, as well as problem-solving related to these mathematical concepts. Solving system of linear equations and matrix algebra is the part of this course which ultimately develops the necessary background for data analysis. Overall, the course aims to equip students with a comprehensive understanding of mathematical concepts relevant to probability and statistics enabling them to apply these skills in real-world problems. The following are the main objectives:

- Students will be introduced to the above listed concepts, and they will be prepared to apply these concepts to practical life scenarios.
- This course will enhance their ability to deal with scenarios involving quantitative reasoning skills in a logical manner which they can face in their practical lives.
- It will prepare students to deal with different forms of data occurring in professional, social and natural sciences.
- Students will be introduced to scenarios involving functions and probability in different disciplines.
- This course will prepare the students to apply the quantitative reasoning skills in other disciplines.
- This course will provide solid foundation for students to use the quantitative reasoning skills in solving practical life problems.

COURSE CONTENTS

Exploring Graphical Information

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

Building blocks of a plane

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

Exploring inequalities

Understanding inequalities around us, dealing with practical problems involving inequalities in different disciplines

Comparing quantities

Golden ratio in sculptures, Comparison of statements and their use in social and economic problems, Applications of ratio and proportion, Sequence, Arithmetic sequence, geometric sequence, counting principles and their applications.

Thinking Logically

Survival in the modern World, Propositions and truth values, Categorical proposition, and its applications

Understanding Data

Introduction to data, tabular and graphical presentation of data, descriptive analysis of data,
standard deviation, measure of the locations, Scatter plots, Pearson's correlation coefficient,
measure of dispersions, sampling distributions, levels of measurements, experimental design and basic rules of probability.

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. OpenAlgebra.com A free math study guide with notes and YouTube video tutorials.
7. R. N. Aufmann, J. S. Lockwood, R. D. Natio and D. K. Clegg, Mathematical Thinking and Quantitative Reasoning (2008), Houghton Mifflin Company (New York).
8. Blitzer, R. (2014). Precalculus. (5th Edition). Pearson Education, Limited.
9. R. Walpole, R. Myers, S. Myers and K. Ye, Probability and Statistics/or Engineers &
Scientists (9th Edition), Pearson.
10. Bennett, J. & Briggs, W. (2015). Using and understanding mathematics (6th Edition).
Pearson Education, Limited.
11. J. Yeo, T. K. Send, L. C. Yee I. Chow, N.C. Meng, J. Liew, O. C. Hong, New Syllabus Mathematics (7th edition 2019), Oxford University Press.

List of General Education: Arts and Humanities

Course Name: Technical Report Writing and Presentation Skills
Course Code: Bot –235
Cr. Hr. 02(2+0)
Domain: GE (Arts and Humanities)

Objectives:

To enable the students to write a research paper / technical report in a succinct manner according to a specified format.

Course Contents:

Presentation skills

Essay writing

Descriptive, narrative, discursive, argumentative

Academic writing

How to write a proposal for research paper/term paper

How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)

Technical Report writing

Note: Extensive reading is required for vocabulary building

Recommended Books:

Technical Writing and Presentation Skills

a) Essay Writing and Academic Writing

1. Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 435407 3 (particularly suitable for discursive, descriptive, argumentative and report writing). 59

2. College Writing Skills by John Langan. McGraw-Hill Higher Education. 2004.

3. Patterns of College Writing (4th edition) by Laurie G. Kirszner and Stephen R. Mandell. St. Martin's Press.

b) Presentation Skills

c) Reading

The Mercury Reader. A Custom Publication. Compiled by northern Illinois University. General Editors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharton. (A reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students)

Course Name: Introduction to History

Course Code: Bot-236

Cr. Hr. 2 (2+0)

Domain: GE (Arts and Humanities)

Course Description

This is an Introductory level course consist of a review of major concepts relevant to the understanding of history as discipline and as a Process. It focuses on the introduction of major concepts, terminologies and issues, understanding of those are essential for the study of history. It will aim at the clarification of basic notions or ideas about what is history and what history is for. It evolves around the idea of the place of history as a source of knowledge and how can we approach historical knowledge with a sense of evolution.

Course Objectives

The purpose of this course is:

- To make students aware of the nature of historical knowledge and research.
- To inculcate among the students a sense of historical evolution of human knowledge, development and progress
- To develop among the students an ability to understand the common themes of historical knowledge.
- To inculcate among the students of history a sense of critical thinking.
- The Course shall form the basis for the ensuing courses of History at different levels.

Course Outcomes

At the end of the course the students shall be able to:

- Have an understanding of the major concept of historical Knowledge.
- Have an ability to distinguish between 'historical' and 'Instinctual' aspects of human knowledge.
- Have an ability to understand the historical evolution.
- Have an ability to plan a role in the future development.

Course Contents

- What is History?
  - Literal, terminological and conceptual meaning of history
  - History as Fact
  - History as Process
  - History as Narrative
- Memory, Record and History
- Nature of History:
  - Being and Becoming;
  - Continuity and Change;
  - Evolution, Progress and Development
  - Macrocosm & Microcosm: Time, Space, Causation
  - Facts and opinion/ objectivity & Subjectivity
- Utility, Benefits & importance of History:
  - History as a corrective/cohesive force;
  - History as a repetitive force
  - Continuity of History from Past to Future
  - Lessons from Past Historical determinism, etc.

History as Mother of All Sciences/Knowledge

- Epistemological nature of History:
  Relationship of History with other forms of knowledge:
  Natural Sciences
  Social Sciences
  Literature and Arts
- Forms and Classification of History

Suggested Readings

1. Burke, Varieties of Cultural History, Cornell University Press, 1977

2. Carlo, Ginzburg. Clues. Myths, and the Historical Method, John Hopkins: University Press, 1992

3. Carr, E. H., What is History? Harmondsworth: Penguin, 1961

4. Cohn, Bernard. An Anthropologist among Historians and Other Essay, Oxford University Press, 1988

5. Collingwood, R. G. The Idea of History. Oxford: Oxford University Press, 1978.

6. Daniels, Studying History: How and Why, New Jersey, 1981.

7. Gertrude Himmalfarb. The New History and the Old, Cambridge: Harvard University Press, 1987

8. Govranski. History Meaning and Methods, USA, 1969

9. Hegel. Elements of the Philosophy of Right. Cambridge University Press, 1991

10. Qadir, Khurram, Tarikh Nigari Nazriyat-o-Irtiqa, Lahore: Palgrave, 1994.

11. Qureshi, Muhammad Aslam. A Study of Historiography. Lahore: Pakistan Book Centre, Latest Edition.

12. Steedman. Caroline, Dust: The Archive and Cultural History, Manchester University Press, 2002

13. Stern Fritz, .Varieties of History: from Voltaire to the Present, Vintage, 2nd Edition 1975

14. Tahir Kamran, The Idea of History Through Ages, Lahore: Progressive Publisher, 1993

15. Lemon, M. C., Philosophy of History, London: Routledge, 2003

16. Marwick, Arthur, The New Nature of History, London, 1989, pp.31-35.

17. Roberts, Geoffrey, ed., History and Narrative Reader, London: Routledge, 2001.

18. Shafique, Muhammad, British Historiography of South Asia: Aspects of Early Imperial Patterns and Perceptions, Islamabad, NIHCR, Quaid-iAzam University, 2016

Course name: Introduction to Philosophy
Course Code:Bot-237
Cr. Hr. 02 (2+0)
Domain: GE (Arts and Humanities)

Course Description

The course introduces undergraduate students to some of the main concerns in philosophy concentrating on the works of major thinkers such as Plato, Aristotle, Descartes, Hume, Kant, Hegel, Marx, Kierkegaard, Husserl, Sartre, Foucault, and Derrida, to name a few The class discussions will center on broad philosophical concerns: the nature of philosophy, the nature and limits of human knowledge, the scope and limits of human freedom, the differences between right and wrong conduct, the nature of good life, and the meaning and the value of human existence. The students will thus be given introductory overview of different areas of philosophy beginning with Plato. The topics for discussion will include: Morality, Free Will, Metaphysics and Knowledge. The basic principles and methods of logical reasoning will be introduced and students will be given opportunity to participate actively in class discussions.

Course Objectives

- Understanding basic concepts of philosophy in the fields of metaphysics, axiology, and epistemology.
- Understanding of philosophical terms.

Course Contents

1. A review of the history of philosophy
2. A discussion on the major problems and methods of philosophy
3. Studying the work of at least ONE philosopher from each of the following groups:

Week	Topics
1	Introduction Definition of philosophy

	Literal and general Subject Matter, Nature, and Scope of philosophy
2-.3`	Branches of philosophy Metaphysics Branches of Metaphysics (Ontology, Cosmology, and philosophical psychology
4-5	Epistemology Knowledge (Definition, Nature, Scope and condition of knowledge, Empiricism. Rationalism, institution theories of Truth
6-7	logic Basic Logical concepts Deductive Reasoning vs. inductive Reasoning
8-9	Ethics Definition, Nature, and Scope Branches of Ethics (Normative Ethics and Applied Ethics Normative theories of truth
10	Aesthetics Definition and Nature objectivity vs. subjectivity
11	Greek philosophical thought Schools of thought in philosophy.
12-13	Materialism (Mechanistic Materialism Dialectical Materialism and Naturalistic Humanism) b-Idealism (subjective idealism objective idealism and personal idealism
14	Realism (Naïve Realism Representative realism, critical Realism Dogmatic and agnostic realism
15-16	Pragmatism Existentialism Phenomenalism Analytic Tradition

Recommended Books

- Copi, leaving M.and Carl Cohen, introduction to logic,2009,An imprint of Pear bson Education.
- Durant,will.The story of philosophy,1985,services Book club, Rawalpindi ,Pakistan. National Book foundation, Islamabad, Pakistan.
- .Stewart ,David and Blocker, H.Gene. Fundamentals of philosophy ,2006,Pearson Education inc. Dorling Kindersley Pvt .Ltd, India
- .Stace, W.T.C critical History of Greek philosophy ,2008,5th Reprint, National Book foundation, Islamabad, Pakistan.

- Titus,Harold H.Living issues in philosophy (An introductory Text Book),1964,4th Edition, American Book company,USA

Course Name: Fables, Wisdom Literature, and Epic

Course Code: Bot-238

Cr.Hr. : 2(2+1)

Domain: GE (Arts and Huminities)

Course Description

This course has three components containing both readings and related activities: The first component is about fables—that is, stories with animal characters having human attributes. The second component concerns wisdom literature and looks specifically at some of the stories, both in prose and poetry, of the famous Persian literary figure Sa‘di. We shall introduce this author to you. The third component is on the world’s largest epic—the Shāhnāma (Book of Kings) of another literary giant, Firdausi.

Course Contents

I. FABLES

Kalīla wa Dimna is a collection of fables in Arabic dating back to the 8th century CE. The fables were originally written in Sanskrit and trace their origins to India prior to the 6th century. After being translated to Pahlavi, they were then translated into Arabic by Abdullah ibn Muqaffa during the Abbasid era and since then have been in circulation around the world in numerous languages including Greek and Latin. In these various translations, the book has not remained in a static form, but instead various additions and omissions have accompanied its long history of translation. The story of Kalīla and Dimna revolves around an ambitious jackal, Dimna, who navigates his way in the king’s court to win his favor and become his most trusted advisor. In the progression of this story, various sub-stories are recounted couched in elaborate idioms and metaphors that all eventually culminate in a moral lesson for its characters and the reader. The following excerpt is near the beginning of the story in which Dimna works himself into a complicated situation after attempting to help the king. The remainder of the story is an account of his efforts to undo his mistake and learn many crucial lessons in the process about friendship, betrayal and power.

Following chapters from Kalīla wa Dimna or The Fables of Bidpai are included:

Chapter V – The Lion and the Bull, or the emblem of two friends whom a liar contrives to disunite.

Chapter VI – Investigation of the conduct together with the defence of Dimna.

Chapter VII – The Ring-dove, or the emblem of sincere friends.

Chapter VIII – The Owls and the Crows, or the danger of being deceived by an enemy,

BĀNG-I DARĀ

Bāng-i Darā or The Call of the Marching Bell is the first and perhaps the most famous of Allama Muhammad Iqbal's works of Urdu poetry, published in 1924. It came after his initial three books of poetry which were all in Persian and were considered difficult to read. The lucid and relatively accessible style of Bāng-i Darā coupled with the fact that it was written in Urdu earned it much greater acclaim and acceptance among people than the earlier books.1 Bāng-i Darā is divided into three distinct parts based on differences that are chronological and also thematic. The first part comprises his poetry written from the start of his career until 1905. During this time, Iqbal was heavily influenced by nationalism; many of his poems such as Tasvīr -i Dard, Āftāb and Tarāna-i Hindī reflect his nationalist political fervor. The second part was written from 1905 to 1908 during his stay in Europe. Iqbal experienced a major revolution in his thinking during this time as he closely scrutinized the social and political makeup of Western societies and lost much of his earlier fervor for nationalism. His poems from this time period are critical of Western modernity and the materialism and godlessness lying at its heart. The last part was written from 1909 to 1923 after his return to India from Europe. Poems from this part feature a strong philosophical and mystical bent along with a great religious fervor especially at display in his abundant and heartfelt praise of the Prophet, peace and blessings be upon him. 2 The following eight poems from Bāng-i Darā have been chosen in accordance with the general theme of this component i.e. fables. They feature various animals, and at times inanimate beings, engaged in discussion about different facets of man's moral existence. They generally begin with an ethical dilemma and, by drawing on various natural and environmental sources of imagery, metaphor and religious idiom, culminate in a resolution of the dilemma leaving the reader with an accessible but profound moral lesson.

The selected poems are:

1. مکھی اور مکڑا ایک
2. گلہری اور پہاڑ ایک
3. بکری اور گائے ایک
4. یاد فر کی ندے پر

5. موج دریا

6. جگنو

7. جگنو اور پرندہ ایک

8. ہمدردی

II. WISDOM LITERATURE

GULISTĀN-E SA‘DĪ The author of the following ḥikāyāt, Sharf al-Din Sa‘dī Shirazi, was born in Shiraz, Iran, at the turn of the 12th century. Sa‘dī was raised in a family of religious scholars and received his initial education in his hometown and later in the illustrious city of Baghdad where he was under the tutelage of the famous scholar Ibn al-Jawzi. Alongside his traditional education in the Islamic sciences, Sa‘dī was also deeply influenced by Sufism and was a student of the great philosopher and Sufi mystic Shihab al-Din al-Suhrawardi. His deep commitment to Sufism and the moral project of purifying and elevating the self, permeate his works of poetry and especially his most famous work, for which he earned lasting acclaim throughout the Muslim world, namely, the Gulistān. His ḥikāyāt, or short stories, that are the subject of this component, are an extension of this moral project and offer the reader advice and guiding principles in various domains of life. The following selections from his collections of ḥikāyāt touch on a variety of themes and circumstances ranging from issues surrounding wealth, power, and injustice to those regarding the importance of knowledge and piety. The narratives are similar in style and content to the famous ḥikam of Ibn ‘Ataillah and are part of a tradition of offering pithy and often witty pieces of advice aimed at the moral development of the reader. Despite a diversity of themes, the stories can be tied together given their emphasis on the development of personal virtue and the subduing of the lower self; resonating through each of them is a deep Sufi ethic that follows the Divine law in both letter and spirit with an unwavering concern for the permanent and the ever-lasting over the fleeting and the ephemeral.

Ten ḥikāyāt from: John T. Platts, The Gulistan; or, Rose Garden of Shaikh Muslihu’d Dīn Sa’dī of Shīrāz (London: Wm. II. Allen, 1876).

The selected ten hikāyāt are given below:

1. **Story** (chapter 1): VI, Pg. 83. “Those who make an effort to display their virtues, do the same to conceal their vices”. A man purposefully eats less and prays more in court to appear pious, requesting more food within the walls of his home. His son asks him to offer his

prayers again as the one he performed in front of the sultan were meant to impress a mortal, not God.

2. **Story** (chapter 1): XX, Pg. 44. "The foundation of injustice in the world began with small unjust deeds." The Sassanian King Naushirwan3 and his retinue need salt to roast their hunt. Before his men leave to get it from a nearby village, he tells them to pay for. He explains that the smallest action of appropriations by the rich and powerful of the poor and weak lead to unending trails of confiscations that subsequently plagues the entire society.
3. **Story** (chapter 1): XXI, Pg. 45. "Burden bearing oxen and asses are better that oppressors." A royal revenue collector is unfair to the peasantry to fill the treasury and please the Sultan. Instead of being awarded, he is punished when the Sultan finds out. Misuse of authority as a right to oppress the weak and helpless eventually brings ruin to the oppressor. The humble ass and ox are much better than the mighty lion as they serve humanity and silently bear their burden. Similarly, humility and eagerness to serve others are qualities appreciated by God, not the ruthless lion-like pride that destroys the destitute.
4. **Story** (chapter 1): XXVII, Pg. 56. "The pain you give to others eventually finds its way back to you." A man oppressed the poor by forcibly purchasing cheap firewood from them and would sell it for large profits to the rich. One day his home burnt down from a fire with no apparent reason. A pious man told him that the sighs of helpless people suffering at his hands were the cause of this calamity. Contemporary equivalents: "What goes around, comes around" & the concept of "Karma."
5. **Story** (chapter 1): XXIX, Pg. 59. "Power and riches cannot exalt one in status." A king passes by a faqir and becomes angry when the poor man does not acknowledge him. Upon confrontation, he learns that it is the kings who serve their subjects, rather than subjects submitting to the rich, as power comes with responsibilities towards the masses.
6. **Story** (chapter 1): XXXI, Pg. 62. "The fleeting moment of an angry decision has everlasting consequences." A raging king orders an innocent man to be killed. The man cries that his punishment would end in a short while, but the king's guilt would last for as long as he lives.
7. **Story** (chapter 1): XXXVII, Pg. 67. "A pair of hands working at one's will are better than those clasped in obedience, waiting for orders" A poor laborer tells his rich brother (who serves the sultan) that he prefers poverty as although he is poor, his work and self-sufficiency sets him free from bowing down in front of others. Serving royalty, he says, is a burden as it causes dependency and ingratitude. Contemporary equivalent: "Less is more." (Known mostly as associated with Architect Ludwig Mies who used the phrase to encourage simplicity in style.

8. **Story** (chapter 1): XXXVIII, Pg. 68. "It is fruitless to celebrate the death of an enemy as one will never be spared from it either." A happy messenger gives the Sassanian King Naushirwan the news of the death of his enemy. He refusesto rejoice because he realizesthat death does not favor anyone and that he and his all friends will die one day too. Mian Muhammad Bakhsh (1830-1907): dushman mare te khushī nā karye, sajnāṇ vī mar jānā.
9. **Story** (chapter 1): XLII, Pg. 74. "Destruction of the good names of the departed cannot protect your own." Alexander the Greek conqueror tells how he won over kingdoms with armies and riches greater than his own by speaking kindly of their former leaders and kings. Fortune and power perish, but one's integrity remains behind if they keep others'.
10. **Story** (chapter 2): XXXVIII, Pg. 124. "Do not turn away from knowledge even if one has to get it from the teachings of the ignorant." A law professor refuses to listen to religious preachers as he believes they don't practice what they preach. His father tells him to never reject knowledge because of this alone, as it can be gained despite their ignorance if one makes his own effort to listen and think.

III. EPIC THE SHĀHNĀMA OF FIRDAUSI

The Shāhnāma is a Persian poem completed around the year 1010 by the poet Firdausi and later presented to Sultan Mahmud Ghazni, the famous Ghaznavid ruler. It is a kind of poem known as an 'epic,' which means a long poem that tells us stories of the adventures and deeds of heroic or legendary figures from the past of a nation. The Shāhnāma is one of the most popular works of poetry in Persian and is considered to be Iran's 'national' epic as well. It consists of a total of 60,000 verses and is divided roughly into two sections. The first section is taken mainly from Iran's ancient mythology, while the second is more historical and tells us about the history of the Sassanians (the last rulers of Iran before the coming of Islam) up to their defeat by the forces of Islam. The author of the Shāhnāma is Abu'l Qasim Firdausi Tusi, who was born in Tus in northeastern Iran in 940 AD. For composing the Shāhnāma, he is considered to be one of Iran's greatest poets.But his greatness was recognized only after his death, and it seems that he led a difficult life while he was alive. For various reasons, Sultan Mahmud also seems not to have recognized the greatness of the Shāhnāma, and rewarded Firdausi with an amount that the poet thought was humiliating. Unfortunately for Firdausi but fortunately for us, the Shāhnāma was later recognized for what it was-- one of the greatest long poems ever composed in Persian, and later to become Iran's nationalepic. One of the most famous stories of the Shāhnāma is the tale of Rustam and Sohrab. Rustam is a legendary warrior from ancient Iranian mythology, famous for his strength and fearlessness in battle. He has a son called Sohrab, who is also a champion warrior. The father and son have never met, and the first time they meet is on the battlefield. But they fight without knowing who the other

is. After a long battle, Sohrab receives a fatal wound from his father. As he lies on the battlefield dying, he utters his last words to Rustam, which reveal that he is actually Rustam's son, and Rustam has killed him accidentally. Rustam's horror on hearing this and his inconsolable grief is something that only a poet of Firdausi's ability could capture in verse. Read this tragic story for yourself, and experience what high tragedy looks like in the hands of a master craftsman.

Teacher's Manual

Arts and Humanities Teacher Manual - Sept 2021 - HEC.pdf

Bang e Dara - Selected Poems - Sept 2021 - HEC.pdf

Kalila wa Dimna or The Fables of Bidpai - Sept 2021 - HEC.pdf

The Gulistan or Rose Garden - Sept 2021 - HEC.pdf

SEMESTER-IV

Course Name: Edaphology
Course Code:Bot – 241
Cr.Hr.3(2+1)
Domain: Major

Objectives of course:

To understand: 1. scope of edaphology, soil fertility and their properties, 2- Importance of water, and various fertilizers and their effects, 3-seconday and micronutrients, soil salinity and waterlogging and conservation.

Outlines:

1. **Definition, scope and importance of edaphology**: soil, land and earth: Mineral and organic soils, topsoil, subsoil; Soil as a medium for plant growth.
2. **Soil fertility and productivity:** Plant nutrients, Liebgs Law of the minimum, soil solution, intensity and quantity factor in plant nutrition, dynamic equlibria in soils, evaluation of soil fertility: soil plant relation
3. **Soil Physical Properties:** Soil texture, soil structure, soil consistency, soil pores, soil density, soil color, soil temperature.
4. **Soil Chemical Properties:** Ion water interaction, soil constituents, soil pH, cation exchange equation, soil redox potential, biochemical properties of rhizosphere soil.

5. **Soil Water:** Soil water classification, measurement of soil water, water retention and curve, Hysteresis, soli water effective use and lose.
6. **Soil and Fertilizer Nitrogen:** Functions of nitrogen in plants, symptoms of deficiency and excess, nitrogen efficiency. Determination of available nitrogen in soil.
7. **Soil and Fertilizer Phosphorous:** role of phosphorus in plants, phosphorus content in soil, factors affecting phosphorus availability to plants.
8. **Soil and Fertilizer potassium:** Functions of potassium in plants, symptoms of deficiency and luxury consumption, potassium availability.
9. **Secondary and micronutrients:** Calcium, magnesium and sulfur effect on plants. Role of Boron, Manganese, Zinc in plant growth.
10. **Soil salinity, sodicity and waterlogging:** plant growth on salt affected soils, classification of salt affected soils, reclamation and management of salt affected soils, total dissolved salts, sources of waterlogging, effects on plant growth and control measure of waterlogging.
11. **Soil erosion and conservation:** water erosion effects on plants, prevention of water erosion.

Practical:

1. Testing of soils minerals of different locations
2. Determination of soil pH and soil temperature.
3. Classification of different soil of various locations.
4. Collection of plants affected with nitrogen deficiency.
5. Identification of Phosphorus deficient soils.
6. Identification of water logged soils of locations.
7. Classification of salt affected soils in different locations.

Books:

1. Soil science & management. 1985. Edward J. Plaster. 6th edition.Cengage Learning, Inc.
2. Physical Edaphology: The Physics of Irrigated and Nonirrigated Soils. 1972. Gaylen L. Ashcroft and Sterling A. Taylor. San Francisco, W.H. Freeman. 10th edition.
3. Principles of Soil and Plant Water Relations. 2004. Kirkham M.B. Academic Press. 2nd edition.
4. The Soil Resource: Origin and Behavior. 1980. Hans Jenny. Springer Velog. 2nd Edition.
5. Principles of Soil Physics. 2004. Rattan Lal. Taylor and Fancis Group. 1st edition.
6. Guidelines for analysis and description of soil and regolith thin sections. 2021. Georges Stoops. Wiley. 1st edition.
7. Edaphology. 2012. Jesse Russell, Ronald Cohn. 1st edition.
8. Handbook of Soil Sciences Properties and Processes. 2011. Pan Ming Huang , Yuncong Li , Malcolm E. Sumner. Roudlege Handbook Online. 3rd edition.
9. The Nature and Properties of Soils. 2017. Raymond R Weil and Nyle C Brady. Pearson Education. 15th edition

10. Soil Science for Gardeners: Working with Nature to Build Soil Health.2020.Robert Pavlis. Paperback. 1st edition.

Course Name: General Biochemistry
Course Code: Bot – 242
Cr. Hr. 03 (2+1)
Domain: Major

Objective of the Course:

This course provides fundamental concepts in biochemistry, which focuses upon the major macromolecules and chemical properties of living systems. Primary topics include the structures, properties and functions of amino acids, proteins, carbohydrates, lipids and nucleic acids.

Course Outline:

Introduction to Biochemistry

Brief introduction, to the scope and history of Biochemistry. Molecular logic of the living organism. Cell structures and their functions. Origin and nature of biomolecules

Carbohydrates

Definition and classification, Chemistry, physical and chemical properties of various classes of carbohydrates. Biological functions of starch, glycogen, cellulose and cell wall polysaccharides, acid mucopolysaccharides and proteoglycans.

Lipids

Definition and classification of lipids. Chemistry and biological importance of fatty acids, waxes, glycerides, phospholipids, sphingolipids, glycolipids, sterols and prostaglandins. Significance of liquids in biological membranes and transport mechanism.

Proteins

Chemistry and Classification of Amino acids, Physical and chemical properties of amino acids. Biological significance of amino acids, peptides. Proteins; their classification, properties and biological significance, Primary, secondary tertiary and quaternary structure of proteins. Denaturation of proteins.

Nucleic Acids

Chemical composition of nucleic acids. Structure and biological significance of nucleic acids. Chemical synthesis of oligonucleotides. Nucleic acids hydrolysis. Isolation and separation of Nucleic acids. Introduction to recombinant DNA technology.

Recommended Books

1. Lehninger, A. L, Principles of Biochemistry, Worth Publisher, New York, (2001).
2. Voet, D. and Voit J. G., Biochemistry, John Wiley & Sons, New York, (2000).
3. Murray, R. K., Mayes P. A., Granner, D. K. and Rodwell, V. W., Harper's Biochemistry, Appleton & Lange (2000).
4. Robert, Harper's Biochemistry, 25th Ed, (2000).

5. West, Text Book of Biochemistry, 4th Ed., (2000).
6. Zubay, G., Biochemistry, 4th Ed., Macmillan Publishing Co. (1999).
7. Bhagavan. N. V., Biochemistry, 2nd Ed., J.B. Lippincott Company (1978)

Course Name: Animal Diversity II: Chordates
Course Code: Bot –243
Cr. Hr. 03(2+1)
Domain: Allied

Objectives

The course aims to:

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

Course Contents

Protochrodates:

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

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

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

Reptiles: The First Amniotes: cladistic interpretation of the amniotic lineage; Testudines or Chelonia, Rhynchocephalia, Squamata, and Crocodilia; adaptations in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, and temperature regulation, nervous and sensory functions, excretion and osmoregulation, reproduction and development; further phylogenetic considerations.

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

Mammals: 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: Museum study of:

1. Protochordates
2. Pisces
3. Amphibia
4. Reptilia
5. Aves
6. Mammalia
7. Field trips to study animal diversity in an ecosystem.

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

Books Recommended

1. Hickman, C.P., Roberts, L.S., Larson, A. 2011. Integrated Principles of Zoology, 15th Ed. (International). Singapore: McGraw Hill.

2. Campbell, N.A. Biology, 9th Ed. 2011. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc. Miller, S.A. and Harley, J.B. 2010. Zoology, 8th Edition (International) Singapore: McGraw Hill.

3. Miller, S.A. 2002. General Zoology Laboratory Manual. 5th Ed. (International), Singapore: McGraw Hill.

4. Kent, G.C., Miller, S. 2001. Comparative Anatomy of Vertebrates. Latest edition New York: McGraw Hill.

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

Course Name: Introduction to Expository Writing

Course Code: Bot-244

Cr. Hr. 3 (3+0)

Domain: GE

COURSE DESCRIPTION

This course prepares undergraduates to become successful writers and readers of English. The course helps students develop their fundamental language skills with a focus on writing so that they can gain the confidence to communicate in oral and written English outside the classroom. The course is divided into five units and takes a PBL (Project-based Learning) approach. Unit

themes target the development of 21st century skills and focus on self-reflection and active community engagement. Course activities include lectures, group, pair and individual activities, as well as a series of required assignments, including reading and writing across various genres. Finally, the course prepares students for taking the next course in the sequence, 'Expository Writing II: Cross-cultural Communication and Translation Skills'.

COURSE OBJECTIVES

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

1. Analyze basic communication skills and use them effectively in oral and written English
2. Develop skills as reflective and self-directed learners
3. Critically evaluate and review various types of texts and summarize them
4. Develop analytical and problem-solving skills to address various community-specific challenges
5. Intellectually engage with different stages of the writing process, such as: brainstorming, mind mapping, free writing, drafting and revision, etc.

LEARNING OUTCOMES

By the end of this course, the students will be able to

1. Write, edit and proofread a short essay in English language
2. Present ideas to the whole class in team presentations using English that is comprehensible and engaging.
3. Critically analyze a text written in English using SQW3R strategies
4. Conduct small-scale research about their communities
5. Draft a letter to editor.

COURSE CONTENTS

Unite 1: Expository Writing

- Introduction
- Types
- Usage

Unit 2: 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 freewriting
- Students practice outlining of the essay

Unit 3: 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 4: 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 5: 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 6: 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 f letter (to teacher and peer review group)
- Groups revise first draft of letter
- Differentiate among revision, proofreading and evaluation (as substages 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

Course Name: Information and Communication Technologies
Course Code: Bot – 245
Cr. Hr. 03(2+1)
Domain: GE

Week 01: Basic of Computers

- Introduction and history of computers
- Types of computers (analog, digital, hybrid)
- Block diagram of Computer System.

Week 02, 03: Parts of the Computer System

- Hardware (Essential Computer Hardware (Processor, Memory, Input Devices, Output Devices & Storage devices)
- Memory and types
- Primary/Internal memory (RAM & ROM)
- Units of Computer Memory (Bit, Byte, KB, MB, GB, TB)
- Secondary Storage
- Input Devices & Output device

Week 04, 05: Software

- System software
- Application software
- General purpose and Special purpose Software

Week 06: Data Communication and Data Communication System (DCS)

- Components of DCS (Sender, Receiver, medium, Message & Protocol)

Week 07: The Internet & Internet Services

- Electronic mail
- Chat, Online Services
- Web Browsers, URL, Web Searching/ Browsing, Search Engine

Week 08, 09: Operating Systems

- Introduction to Windows 10 & Installation
- Working with the Windows 10 Desktop

Week 10,11,12: Microsoft Word

- Creating and Modifying a Flyer
- Creating CV and Resume
- Creating a Research Paper

Week 13: Microsoft PowerPoint

- Creating and Editing Presentations with Pictures
- Enhancing Presentations with Shapes and SmartArt

Week 14, 15: Microsoft Excel

- Creating a Worksheet and a Chart
- Formulas, Functions, and Formatting

Week 16: Use of computer in daily life

- Computer as a teacher
- Online education (Example: Virtual University of Pakistan

Course Name: Entrepreneurship

Course Code: Bot-246

Credit Hours: 2 (2+0)

Domain: GE

Defining Entrepreneurship: Creation economic organization, dimensions of entrepreneurship.

The Macro Environment for Entrepreneurship: process of environmental analysis, sources of opportunities, industry and market structure.

The Competitive Environment: the perfect competition model, industry analysis, buyer power, supplier power, the threats of substitutes, entry barriers, rivalry between firms, competitor's analysis.

The International Environment: the macro environment of international entrepreneurship, international entrepreneurial strategies, international organization behavior.

Business Plan and Entrepreneurial Strategy: entry wedges, resource based strategies, strategy and industrial environment.

Marketing New Ventures: the marketing of entrepreneurship interface, marketing concepts and orientation, marketing strategy and sales forecasting.

Element of New Ventures: creating the organization

SME Definition: Importance of SME, SME in Pakistan.

Best Quality Management Practice in SME: customer relation management in SME.

Strategies of success of SME: The Business plan. Case study, Practical plan and Implementation

RECOMMENDED BOOKS

1. SMALL BUSINESS MANAGEMENT A CASE STUDY APPROACH, Devid Stokes,

Latest Edition.
2. Mare J.Dollinger Entrepreneurship: Strategies and Resources. Austen Press.

SEMESTER-V

Course Name: Economic Botany
Course Code: Bot –351
Cr. Hr. 03(2+1)
Domain: Major

Objectives

To learn the diverse human uses of plants and plant products.
• To learn the taxonomic diversity of useful plants.
• To learn the biological reasons why certain plant resources are important.

• To acquire an increased awareness and appreciation of plants and plant products encountered in everyday life.

• To recognize geographic, historical, & cultural differences in the uses and importance of plants.

• To relate diverse aspects of human cultural endeavors to plant resources, and to gain a better understanding and perspective of the origins, histories, and roles of important plants and plant products to the development of human culture

Course content

1. Plant and their value in the Service of the mankind.
2. Fibers-Cotton Flax, jute Hemp and Coir, Elementary knowledge of Textile and Paper industries in India.
3. Timbers woods-their identification properties and uses. Details of Teak Shisham, Saal, Chir, Deodar, Neem, Mango, Babul and jamun
4. Tannins
5. Dyes
6. Gums and Resins
7. Rubber and Latex
8. Oil-Essential oil, their properties, antibiotics methods of extraction and uses.
9. Fatty oil general account and detailed study ground nut, peanut, sesame, Masturd, Coconut Cotton seed, Castor, linseed and sunflower oils.
10. Sugars-sugar cane and sugar beet.
11. Medicinal plants: Details of Aconitum, Ephedra, Gugal, Atropa, Aloe, Tulsi Neem, Bhango, Opium, Catharanthus, Nuxvomica, Isabgul, Cinchona, Sarpghanda, Artemisia and other important local plants.
12. Spices-Ginger, Turmeric, Asafoetida, Cinnamon, Clove, Black Peper and Chillies.
13. Beverages: Non Alcoholic-Coffee, Tea, Coca, Alcoholic-General account.
14. Fumitories and masticatories: Tobacco, Betel and Betel nut.
15. Concise knowledge of origin and evolution of crop Plants and including their centres of origin.
16. Ethno Botany: General account.

Practicals:

To design according to the lab facilities

Recommended Books:

1. Jains, S. K. 1987. A Manual of Ethnobotany Scientific Publisher jodhpur India.
2. Jain, S. K. 1991. Contribution to Ethnobotany of India. Scientific Publisher, Johdpur, India.

Course Name: Bacteriology and Virology
Course Code: Bot-352

Cr. Hr. 03(2+1)
Domain: Major

Specific objectives of course:

To understand the morphology, structure and economic importance of Viruses and Bacteria

Course outline:

a) Viruses

1. General features of viruses, viral architecture, classification, dissemination and replication of single and double – stranded DNA/RNA viruses.
2. Plant viral taxonomy.
3. Virus biology and virus transmission.
4. Molecular biology of plant virus transmission.
5. Symptomatology of virus-infected plants: (External and Internal symptoms).
6. Metabolism of virus-infected plants.
7. Resistance to viral infection.
8. Methods in molecular virology.

b) Bacteria

1. History, characteristics and classification.
2. Evolutionary tendencies in Monera (Bacteria, actinomycetes and cyanobacteria)
3. Morphology, genetic recombination, locomotion and reproduction in bacteria
4. Bacterial metabolism (respiration, fermentation, photosynthesis and nitrogen fixation)
5. Importance of bacteria with special reference to application in various modern sciences specially agriculture, biotechnology and genetic engineering.
6. Symptoms and control of major bacterial diseases in Pakistan

c) Plant microbe interaction

Lab outline:

a) Viruses

Observation of symptoms of some viral infected plant specimens.

b) Bacteria, Actinomycetes and Cyanobacteria

1. Methods of sterilization of glassware and media etc.
2. Preparation of nutrient medium and inoculation.
3. Preparation of slides for the study of various forms, capsule/slime layer, spores, flagella and Gram-staining.
4. Growth of bacteria, subculturing and identification of bacteria on morphological and biochemical basis (using available techniques).
5. Microscopic study of representative genera of Actinomycetes and Cyanobacteria from fresh collections and prepared slides.

Recommended Books:

1. Black, J. G. 2005 Microbiology - Principles and Exploration, John Wiley and Sons, Inc.

2. Prescott, L. M., Harley, J. P. and Klein, D. A. 2005. Microbiology McGraw-Hill Companies, Inc.

3. Arora, D. R. 2004. Textbook of Microbiology, CBS Publishers and Distributors, New Delhi.

4. Ross F. C. 1995. Fundamentals of Microbiology. John Willey & Sons, New York.

5. Khan, J. A. and Dijkstra J. Plant Viruses as Molecular Pathogens. The Haworth Press, Inc.

6. Hull R. Matthews, 2004, Plant Virology, Academic Press.

7. Tortora, G. J: Funke, B. R. and Case C. L., 2004, Microbiology. Pearson Education.

8. Molecular Plant-Microbe Interactions, Kamal Bouarab, Normand Brisson, Fouad Daayf (eds), 2009 MPG Books Group, Bodmin, UK.

9. Plant-Microbe Interactions Gary Stacey, Noel T. Keen (Eds) 2011, springer London.

Journals/Periodicals:

World Journal of Microbiology & Biotechnology, Current Microbiology, Journal of Industrial Microbiology and Biotechnology, Journal of General Virology, Journal of Virology

Course Name: Phycology and Bryology
Course Code: Bot- 353
Cr. Hr. 03(2+1)
Domain: Major

Specific objectives of course:

To understand the classification, morphology and economic importance of Algae and Bryophytes.

Course Outline:

a) Phycology

Introduction, general account, evolution, classification, biochemistry, ecology and economic importance of the following divisions of algae: Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Phaeophyta and Rhodophyta.

b) Bryology:

Introduction and general account of bryophytes, classification, theories of origin and evolution. Brief study of the classes: Hepaticopsida, Anthoceropsida and Bryopsida.

Lab Outline:

a) Phycology:

i. Collection of fresh water and marine algae.
ii. Identification of benthic and planktonic algae
iii. Section cutting of thalloid algae
iv. Preparation of temporary slides
v. Use of camera lucida/micrographs.

b) Bryology

Study of the following genera: Pellia, Porella, Anthoceros and Polytrichum.

Recommended Books:

1. Bold, H. C. and M. J. Wynne 1985. Introduction to Algae: structure and reproduction. Prentice Hall Inc. Engle Wood Cliffs

2. Lee. R. E. 1999. Phycology. Cambridge University Press, U.K.

3. Dawson, E. Y., Halt. 1966. Marine Botany. Reinhart and Winstan, New York.

4. Chapman, V. J. and D. J. Chapman. 1983. Sea weed and their uses. MacMillan and Co. Ltd. London.

5. Vashishta. B. R. 1991. Botany for degree students. Bryophytes 8th ed. S. Chand and Co. Ltd. Delhi.

6. Schofield, W. B. 1985. Introduction to Bryology. MacMillan Publishing Co. London.

7. Hussain, F. and I. Ilahi. 2012. A text book of Botany. Department of Botany, University of Peshawar.

8. Barsanti, L. and P. G. Gualtieri. 2006. Algae, anatomy, biochemistry, biotechnology. Taylor and Francis, New York.

9. Vashishta, B. R., A. K. Sinha and A. Kumar. 2010. Algae. S. Chand & Co.

10. Bellinger, E. G. and D. C. Sigee. 2010. Fresh water algae (Identification and use as bioindicators). John Wiley & Sons.

11. Hussain, F. 2013. Phycology. A text book of Algae. Pak Book Empire Lahore.

12. Vashishta, B. R., A. K. Sinha and A. Kumar. 2010. Bryophytes. S. Chand & Co. New Delhi.

13. Fida Hussain, Habib Ahmad and Syed Zahir Shah. 2012. The unicellular algae of District Peshawar, Pakistan. Lambert Publication, Germany.

Journals / Periodicals:

Pakistan Journal of Botany, International Journal of Phycology and Phyco- chemsitry, Bryology, Phycology.

Course Name: Mycology and Plant Pathology

Course Code: Bot- 354

Cr. Hr. 03(2+1)

Domain: Major

Specific Objectives of course:

To introduce the students to Mycology and Diseases caused by Fungi.

Course Outline:

a) Mycology

1. Introduction**:** General characters of fungi**,** Thallus, cell structure andultrastructure of fungi.

2. Reproduction: Asexual and sexual reproduction and reproduction structures, life cycle, haploid, heterokaryotic and diploid states.

3. Fungal Systematics**:** Classification of fungi into phyla with suitable examples to illustrate somatic structures, life cycle and reproduction of Myxomycota, Chytridiomycota, Zygomycota , Oomycota , Ascomycota , Basidiomycota and Deuteromycetes.

4. Symbiotic relationships of fungi with other organisms (mycorrhiza) and their significance.

5. Importance of fungi in human affairs with special reference to Industry and Agriculture

b) Pathology

1. Introduction and classification of plant diseases.
2. Symptoms, causes and development of plant diseases
3. Disease control
4. Epidemiology and disease forecast
5. Important diseases of crop plants and fruit trees in Pakistan caused by fungi, e.g., rusts, smuts, red rot of sugarcane etc.

Lab Outline:

a) Mycology

General characters and morphology of fungi. Study of unicellular andmycelial forms with septate and aseptate hyphae. Distinguishing charactersof different phyla: study of suitable examples. Study of asexual and sexualreproductive structures in different groups of fungi. Study of some common examples of saprophytic, parasitic and air-borne fungi belonging to different phyla.

b) Pathology

Identification of major plant pathogens under lab and field conditions, cultural studies of some important plant pathogenic fungi, application of Koch's postulates for confirmation of pathogencity. Demonstration of control measures through chemotherapeutants.

Recommended Books:

1. Agrios, G. N., 2005. Plant Pathology, Academic Press, London.

2. Ahmad, I. and Bhutta, A. R., 2004. Textbook of Introductory Plant Pathology. Book Foundation, Pakistan.

3. Alexopoulos, C. J., Mims, C. W. and Blackwell, M., 1996. Introductory Mycology, 4th Ed. John Wiley & Sons.

4. Khan, A. G. and Usman, R., 2005. Laboratory Manual in Mycology and Plant Pathology. Botany Department Arid Agriculture University, Rawalpindi.

5. Mehrotra, R. S. and Aneja, K. R., 1990. An Introduction to Mycology. Wiley and Eastern Ltd., New Delhi, India.

6. Moore-Landecker, E., 1996. Fundamentals of Fungi. 4th Edn. Prentice Hall Inc., New Jersey, USA.

7. Trigiano, R. N., Windham, M. T. and Windham, A. S., 2004. Plant Pathology: Concepts and Laboratory Exercises. CRC Press, LLC, N.Y.

Journals / Periodicals:

Pakistan Journal of Botany, Mycotoxin, Mycopath, Phytopathology, Australasian Journal of Plant pathology, Asian Journal of Plant Pathology, Annual Review of Plant Pathology.

Course Name: Diversity of Vascular Plants

Course Code:Bot- 355

Cr. Hr. 03(2+1)

Domain: Major

Specific Objectives of Course:

To enable the students to understand and appreciate the biology and evolution of plant architecture

Course Outline:

a) Pteridophytes

Introduction, origin, history, features and a generalized life cycle. Methods of fossilization, types of fossils, geological time scale and importance of paleobotany. First vascular plant - Rhyniophyta e.g. Cooksonia General characters, classification, affinities and comparative account of evolutionary trends of the following phyla: Psilopsida Psilotum), Lycopsida (Lycopodium, Selaginella), Sphenopsida (Equisetum), Pteropsida (Ophioglossum, Dryopteris and Azolla/Marsilea).

b) Origin and Evolution of seed habit.

c) Gymnosperms:

Geological history, origin, distribution, morphology, anatomy, classification and affinities of Cycadofillicales, Bennettitales, Ginkgoales, Cycadales and Gnetales. Distribution of gymnosperms in Pakistan. Economic importance of gymnosperms. An introduction to the Gondwana flora of world.

d) Angiosperms:

Origin, general characteristics, Importance, and life cycle of angiosperms

e) Palynology:

1. An introduction to Neopalynology and Paleopalynology, its applications in botany, geology, archaeology, criminology, medicines, honey and oil and gas exploration.

2. Basic information about the nomenclature, morphology and classification of living and fossil pollen and spores.

Lab Outline:

1. To study the morphological and reproductive features of available genera.

2. Study trips to different parts of Pakistan for the collection and identification of important pteridophytes, gymnosperms and angiosperms.

3. Study of pollen morphology

Recommended Books:

1. Beck, C. B. 1992. Origin and Evolution of Gymnosperms. Vol-1&II, Columbia University Press, New York,

2. Foster, A. S. and Gifford, E. M. Jr. 1998. Comparative Morphology of Vascular Plants. W. H. Freeman and Co.

3. Jones, D. 1983. Cycadales of the World, Washington, DC.

4. Mauseth, J. D. 1998. An Introduction to Plant Biology, Multimedia Enhanced, Jones and Bartlett Pub. UK.

5. Moore, R. C., W.d. Clarke and Vodopich, D. S. 1998. Botany McGraw-Hill Company, USA

6. Raven, P. H. Evert, R. E. and Eichhorn, S. E. 1999. Biology of Plants, W. H. Freeman and Company Worth Publishers.

7. Ray, P.M. Steeves, T. A. and Fultz, T. A. 1998. Botany Saunders College Publishing, USA.

8. Taylor, T. N. and Taylor, E. D. 2000. The Biology and Evolution of Fossil Plants, Prentice Hall.

9. Stewart, W. N. and Rothwell, G. W. 1993. Paleobotany and the Evolution of Plants, University Press, Cambridge.

10. Faegri, K., P. E. Kaland & K. Krzywinski 1989. Text Book of Pollen Analysis, John Wiley & Sons. N. Y.

11. Vashishta, B. R., A. K. Sinha and A. Kumar. 2010. Pterodophyta. S. Chand & Co. New Delhi

12. B. P. Panday. 2006. College Botany. Vol 1 & II. S. 7 th Edition. Chand & Co. New Delhi 13. Vashishta, B. R., A. K. Sinha and A. Kumar. 2010. Gymnosperms. S. Chand & Co.

Journals / Periodicals:

Pakistan Journal of Botany, New Phytologist, Review of Palaeobotany & Palynology, Palaeontographica, Palaeobotanist

Course Name: Plant Systematics
Course Code: Bot- 356
Cr. Hr. 03(2+1)
Domain: Major

Specific Objectives of course:

To know floral composition/system of classification focusing on identification, classification, description nomenclature and flora writings, monographs.

Course Outline:

1. **Introduction:** Importance and relationship with other sciences,
2. **Taxonomic Evidence:** Introduction and Importance

3. Nomenclature: Important rules of botanical nomenclature including effective and valid publication, typification, principles of priority and its limitations, author citation, rank of main taxonomic categories, conditions for rejecting names.

4. Classification: Why classification is necessary? Importance of predictive value. Brief history, Different systems of classification with at least one example of each (Linnaeus, Bentham and Hooker, Engler and Prantl, and Takhtajan.

5. General characteristics, distribution, evolutionary trends, phyletic relationships and economic importance of the following families of angiosperm:

1. Apiaceae (Umbelliferae)
2. Asteraceae (Compositae)
3. Brassicaceae (Cruciferae)
4. Capparidaceae
5. Chenopodiaceae
6. Cucurbitaceae
7. Euphorbiaceae
8. Fabaceae (Leguminosae)
9. Liliaceae
10. Magnoliaceae
11. Malvaceae
12. Papaveraceae
13. Poaceae (Gramineae)
14. Rosaceae
15. Solanaceae

Lab Outline:

1. Technical description of plants of the local flora and their identification up to species level with the help of a regional/Flora of Pakistan

2. Preparation of indented and bracketed types of keys

3. Preparation of permanent slides of pollen grains by acetolysis method and study of different pollen characters.

4. Study of variation pattern in different taxa.

5. Submission of properly mounted and fully identified hundred herbarium specimens at the time of examination

6. Field trips shall be undertaken to study and collect plants from different ecological zones of Pakistan.

Recommended Books:

1. Ali, S. I. and Nasir, Y. 1990-92. Flora of Pakistan. Karachi Univ. Press, Karachi

2. Ali, S. I. and Qaiser, M. 1992-2007 -todate. Flora of Pakistan. Karachi Univ. Press, Karachi.

3. Greuter, W., McNeill, J., Barrie, F. R., Burdet, H. M., Demoulin, V., Filguerras, T. S., Niclson, D. H. Silva, P. C., Skog, J. E., Trehane, P., Turland, N. J. & Hawksworth, D.L., (eds.) 2000. International code of botanical nomenclature (Saint Louis Code) adopted by the Sixteenth International botanical congress St. Louis Missouri, July –August 1999. Koeltz, Konigstein. (Regnum Veg.138.)

4. Davis, P. H. & Heywood, V. H. 1963. Principles of Angiosperm Taxonomy. Oliver & Boyd, London

5. Ingrouille, M. 1992. Diversity and Evolution of Land Plants, Chapman & Hall. London

6. Nasir, E. & Ali, S. I. 1970-89. Flora of Pakistan. Karachi Univ. Press, Karachi.

7. Stace, C. (1992). Plant Taxonomy and Biosystematics, Edward Arnold.

8. Takhtajan, A. (1986). Flowering Plant: Origin and Dispersal, Oliver and Boyd, Edinburgh

9. Jones, S. B. and Luchsinger, A. E. 1987. Plant Systematics. McGraw-Hill, Inc. New York.

10. Naik, V. N. 2005. Taxonomy of Angiosperms. Tata McGraw-Hill Publishing Company, New Delhi.

11. Stussy, T. F. 1990. Plant Taxonomy, Columbia University Press, USA.

12. Jeffrey C. 1980. An Introduction to Plant Taxonomy. Cambridge University Press.UK

13. Levin, D. A. 2000. The Origin, Expansion and Demise of Plant Species. Oxford University Press.

14. Shinwari, M. I. and M. A. Khan. 1998. Ethnobotany of Margalla Hills. Department of Biological Sciences, Quaid-i-Azam University Islamabad Pakistan.

15. Shinwari, M. I., M. I. Shinwari and Shah, M. 2007. Medicinal Plants of Margalla Hills National Park Islamabad. Higher Education Commission Islamabad. Pp.218.

16. Sivarajan V. V and N. K. P Robson 1991 Introduction to the Principles of Plant Taxonomy.

17. Radford, A. E., W. C. Dickison, J. R. Massey, and C. R. Bell. 1998 Vascular Plant Systematic. Harper and Row, New York.

18. Leadlay, E. and Stephen 2006. Taxonomy and Plant Conservation.

19. Rajput, M. T., S. Saliha and K. M. Khan. 1996 Plant Taxonomy. Nasim Book Depot Hyderabad.

20. Heywood V. H. 1978. Flowering Plants of the World. Oxford University Press.

21. Simpson, M. G. 2006. Plant Systematics. Elsevier Academic Press.

22. Soltis, D. E. P. S. Soltis, P. K Endress, and M. W. Chase, 2005. Phylogeny & evolution of angiosperms. Sinauers associates, Inc. Publishers.

23. Pullaiah, T. 2007 Taxonomy of Angiosperms 3rd Ed. Regency Publication, New Delhi.

Journals / Periodicals:

Pakistan Journal Botany, Flora of Pakistan, Taxon, Botanical Journal of the Linnaean Society

SEMESTER-VI

Course Name: Plant Anatomy
Course Code: Bot-361
Cr. Hr. 03(2+1)
Domain: Major

Specific objectives of course:

To provide the students understanding about anatomical features of vascular plants

Course Outline:

1. The plant body and its development: fundamental parts of the plant body, internal organization, different tissue systems of primary and secondary body.

2. Meristematic tissues: classification, cytohistological characteristics, initials and their derivatives.

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

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

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

6. Origin, structure, development, functional and evolutionary specialization of the following tissues: Epidermis and epidermal emergences, Parenchyma, Collenchyma, Sclerenchyma, Xylem, Phloem with special emphasis on different types of woods, Periderm.

7. Secretory tissues: Laticifers (classification, distribution, development, structural characteristics, functions) and Resin Canals.

8. Anatomy of reproductive parts:

a. Flower
b. Seed
c. Fruit

9. Economic aspects of applied plant anatomy

10. Anatomical adaptations

11. Molecular markers in tree species used for wood identification.

Lab outline:

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

Recommended Books:

1. Dickison, W. C. 2000. Integrative plant anatomy. Academic Press, U. K.
2. Fahn, A. 1990. Plant Anatomy. Pergamum Press, Oxford.
3. Esau, K. 1960. Anatomy of Seed Plants. John Wiley, New York.
4. Metcalf, C. R. and Chalk, L. 1950. Anatomy of the Dicotyledons. Clerondon Press. Oxford.
5. Anon. Manual of Microscopic Analysis of Feeding Stuffs. The American Association of feed Microscopists.
6. Vaughan, J. G. 1990. The structure and Utilization of Oil Seeds. Chapman and Hall Ltd. London.
7. Metcalfe, C. R. 1960. Anatomy of the Monocotyledons. Gramineae. Clerondon Press, Oxford.
8. Metcalfe, C. R. 1971. Anatomy of the Monocotyledons.V. Cyperaceae. Clerondon Press, Oxford.
9. Cutler, D. F. 1969. Anatomy of the Monocotyledons. IV. Juncales. Clarendon Press, Oxford.
10. Cutler, D. F. 1978. Applied Plant Anatomy. Longman Group Ltd. England
11. Raymond, E. S. and E. Eichhorn. 2005. Esau's Plant Anatomy; Meristematic cells and tissues of plant body. John Willey Sons.

12. Eames, A. J. and L. H. Mac Daniels. 2002. An introduction to Plant Anatomy. Tat McGraw-Hill Publishing Company Limited, New Delhi.

Journals / Periodicals:

Pakistan Journal of Botany

Course Name: Genetics-I
Course Code: Bot- 362
Cr. Hr. 03(2+1)
Domain: Major

Specific Objectives of course:

To understand the nature and function of genetic material

Course Outline:

1. Extensions of Mendelian Analysis: Variations on dominance, multiple alleles, lethal alleles, several genes affecting the same character, penetrance and expressivity.
2. Linkage I: Basic Eukaryotic Chromosome Mapping: The discovery of linkage, recombination, linkage symbolism, linkage of genes on the X chromosome, linkage maps, three-point testcross, interference, linkage mapping by recombination in humans,
3. Linkage II: Special Eukaryotic Chromosome Mapping Techniques: Accurate calculation of large map distances, analysis of single meioses, mitotic segregation and recombination, mapping human chromosomes.
4. Recombination in Bacteria and their Viruses: Bacterial chromosome, bacterial conjugation, bacterial recombination and mapping the E.coli chromosome, bacterial transformation, bacteriophage genetics, transduction, mapping of bacterial chromosomes, bacterial gene transfer.
5. The Extranuclear Genome : Variegation in leaves of higher plants, cytoplasmic inheritance in fungi, extranuclear genes in chlamydomonas, mitochrondrial genes in yeast, extragenomic plasmids in eukaryotes.
6. Developmental Genetics: Gene Regulation and Differentiation, Crown gall disease in plants, cancer as a developmental genetic disease.
7. Population Genetics: Gene frequencies, conservation of gene frequencies, equilibrium, Hardy-Weinberg law, factors affecting gene equilibrium.

Lab Outline:

1. Numerical problems

a) Arrangement of genetic material:
   i. Linkage and recombination.
   ii. Gene mapping in diploid.
   iii. Recombination in Fungi.
   iv. Recombination in bacteria.
   v. Recombination in viruses.

b) Population Genetics:

i. Gene frequencies and equilibrium.
ii. Changes in gene frequencies,

2. Blood group and Rh-factor

3. Drosophila

i. Culture technique
ii. Salivary gland chromosome

4. Fungal Genetics Sacchromyces culture techniques and study.

5. Studies on variation in maize ear size and colour variation

6. Bacterial Genetics.

i. Bacterial cultural techniques, Gram staining (E. coli, B. subtilis)
ii. Transformation. ii. Conjugation.

Recommended Books:

1. Gelvin, S, B. 2000. Plant Molecular Biology Manual. Kluwer Academic Publishers.

2. Pierca, B. A. 2005. Genetics. A conceptual approach, W. H. Freeman and Company, New York.

3. Synder, L, and Champness, W. 2004. Molecular Genetics of Bacteria. ASM Press, Washington D. C.

4. Klug, W. S. and Cummings, M. R. 1997. Concepts of Genetics, Prentice Hall International Inc.

5. Roth Well, N. V. 1997. Understanding Genetics, 2nd Edition, Oxford University Press Inc.

6. Gardner, E. J., 2004. Principles of Genetics, John Willey and Sons, New York.

7. Ringo J, 2004. Fundamental Genetics, Cambridge University Press.

8. Griffiths A. J. F: Wessler, S. R; Lewontin, R. C, Gelbart, W. M; Suzuki, D. T. and Miller, J. H., 2005, Introduction to Genetic Analysis, W. H. Freeman and Company.

9. Snyder, L and Champness W, 2003, Molecular Genetics of Bacteria, ASM Press.

10. Hartl, D. L. and Jones, E. W. 2005, Genetics - Analysis of Genes and Genomes, Jones and Bartlett Publishers. Sudbry, USA.

11. Hedrick, P. W. 2005. Genetics of Population. Jones and Bartlett Publisher, Sudbury, USA.

12. Mahmut Caliskan. 2012. The Molecular basis of plant genetic diversity. In Tech Publishers.

13. Ram J. Singh. 2011. Genetic resources, chromosome engineering and crop improvement. Medicinal plants. Vol. 6. CRC Press.

14. William S. Klug, Michael R. Cummings, Charlotte A. Spencer, Michael A. Palladino. 2011. Concepts of genetics. Pearson Educations.

15. Daniel Hartl. 2011. Genetics Johns and Bartlett Publishers.

16. David Hyde. 2008. Introduction to Genetic principles. McGraw-Hill.

17. Daniel, L. Hart, Elizabeth W. Jones. 2009. Analysis of genes and genomes. John and Barlett.

18. Noureddine Benkeblia. 2011. Sustainable agriculture and new biotechnologies. CRC Press.

Journals/Periodicals:

J. Genetics, Theoretical and Applied Genetics, Cytologia, Chromosoma, Genome

Course Name: Plant Biochemistry-I

Course Code: Bot- 363

Cr. Hr. 03(2+1)

Domain: Major

Specific Objectives of course:

To elucidate the structure and role of primary metabolites in plants

Course Outline:

Introduction to photosynthetic organisms, Photosynthesis: The Light Reaction Photosystems, ATP Synthesis, CO 2 Fixation, RuBisCo and enzyme kinetic, C-3 Cycle, C-4 Cycle, Regulation of photosynthesis

Introduction to carbohydrates: Occurrence and classification, Sugar structures, synthesis of polysaccharides, Carbon metabolism in the chloroplast, Starch synthesis Pentose phosphate pathway Carbon export Sucrose synthesis and transport in vascular plants, Cellulose synthesis and composition of primary cell walls

Introduction to lipids: Occurrence, classification. Structure and chemical properties of fatty acids, Fatty acid biosynthesis in plants, di and triglycerides, phospholipids, glycolipids, sulpholipids, waxes and sterols.

Introduction to Proteins: Amino acids and their structure. Electro chemical properties and reactions of amino acids. Classification of proteins. Primary, secondary, tertiary and quaternary structure of proteins. Protein targeting. Protein folding and unfolding. Transport, storage, regulatory and receptor proteins. Protein purification. Protein sequencing. Biological role. Plant defense proteins and peptides, Defensins and related proteins, Synthesis and functions of non-ribosomal peptides

Introduction to Nucleic Acids: General introduction. Purine and pyrimidine bases, nucleosides, nucleotides. Structure and properties of DNA and RNA. Types and functions of RNA. Nucleic Acid Metabolism.

Introduction to Enzymes: Nature and functions, I.U.E. classification with examples of typical groups. Isozymes, ribozymes, abzymes. Enzyme specificity. Enzyme kinetics. Nature of active site and mode of action. Allosteric enzymes and feedback mechanism. Enzymes with multiple functions - mechanisms and evolution.

Lab Outline:

1. Solutions, acids and bases. Electrolytes, non-electrolytes, buffers, pH. Chemical bonds.
2. To determine the Rf value of monosaccharides on a paper Chromatogram.

3. To estimate the amount of reducing and non-reducing sugars in plant material titrimetrically/spectrophoto metrically.

4. To determine the saponification number of fats.

5. To extract and estimate oil from plant material using soxhlet apparatus.

6. Analysis of various lipids by TLC methods.

7. To estimate soluble proteins by Biuret or Lowry or Dye-binding method.

8. To estimate the amount of total Nitrogen in plant material by Kjeldahl's method.

9. To determine the Rf value of amino acids on a paper chromatogram.

10. Extraction of Nucleic acids from plant material and their estimation by UV absorption or colour reactions.

11. To estimate the catalytic property of enzyme catalase or peroxidase extracted from a plant source.

12. To determine the PKa and isoelectric point of an amino acid.

Recommended Books:

1. Conn E E. and Stumpf P. K., 2002. Outlines of Biochemistry, John Wiley and Sons Inc. New York.

2. Lehninger, A L. 2004. Principles of Biochemistry. Worth Publishers Inc.

3. Voet, D., Voet J. G. and Pratt, C. W. 1998. Fundamentals of Biochemistry, John Wiley and Sons, New York.

4. Dey, P. M. and Harborne, J. B. 1997. Plant Biochemistry. Harcourt Asia PTE Ltd. Singapore.

5. Smith, E. L, Hill, R L, Lehman, R I., Lefkowits, R J. Handler and Abraham. 2003, Principles of Biochemistry, (General Aspects). White. International Student Edition. McGraw Hill International Book Company.

6. Zubay G,.2003, Biochemistry, MacMillan Publishing Co., New York.

7. Chesworth,.J. M., Strichbury T. and Scaife., J. R. 1998. An introduction to agricultural biochemistry. Chapman and Hall, London.

8. Mckee, T. and Mckee, J. R. 1999. Biochemistry – An Introduction. WCB/McGraw-Hill, New York, Boston, USA.

9. Lea, P. J.. and Leegood, R. C. 1993. Plant Biochemistry and Molecular Biology. Wiley and Sons, New York.

10. Abdes, R. H. Frey, P. A. and Jencks W. P. 2004, Biochemistry, Jones and Bartlet, London.

11. Goodwin T. W. and Mercer, E. I. 1997. Introduction to Plant Biochemistry. Pergamon Press, Oxford.

12. Heldt, H. W. 2008. Plant Biochemistry. 3rd Edition, Academic Press, U. K.

13. Bowsher, C. 2008. Plant Biochemistry.

14. Campbell, M. K. and F. Shawn. 2008. Biochemistry 6th Edition.

Journals / Periodicals:

Plant Physiology and Biochemistry, Annual Review of Biochemistry, Biochemistry Journal, Critical Review in Biochemistry and Molecular Biology

Course Name: Plant Ecology-I

Course Code: Bot- 364

Cr. Hr. 03(2+1)

Domain: Major

Specific Objectives of course:

To understand the role and interaction of plants with their environment

Course Outline:

1. Introduction: history and recent developments in ecology.

2. Soil: Nature and properties of soil (Physical and Chemical). Water in the soilplant-atmosphere continuum. The ionic environment and plant ionic relations, Nutrient cycling. Physiology and ecology of N, S, P and K nutrition. Heavy metals (brief description), Salt and drought stress and osmoregulation. Soil erosion.

3. Light and temperature: Nature of light, Factors affecting the variation in light and temperature, Responses of plants to light and temperature, Adaptation to temperature extremes,

4. Carbon dioxide: Stomatal responses, water loss and CO2-assimilation rates of plants in contrasting environments. Functional significance of different pathways of CO2 fixation.

5. Water: Water as an environmental factor, Role of water in the growth, adaptation and distribution of plants, Water status in soil, Water and stomatal regulation, Transpiration of leaves and canopies.

6. Oxygen deficiency: Energy metabolism of plants under oxygen deficiency, Morpho-anatomical changes during oxygen deficiency, Post-anoxic stress

7. Wind as an ecological factor.

8. Fire as an ecological factor.

Lab Outline:

1. Determination of physico-chemical properties of soil and water.

2. Measurements of light and temperature under different ecological conditions.

3. Measurements of wind velocity.

4. Measurement of CO2 and O2 concentration of air and water.

5. Effect of light, temperature, moisture, salinity and soil type on germination and growth of plants.

6. Measurement of ions, stomatal conductance, osmotic potential, water potential, xylem. pressure potential, leaf area and rate of CO2 exchange in plants in relation to various environmental conditions.

Recommended Books:

1. M. Ahmad and S. S. Shaukat. 2012. A test book of vegetation ecology. Publisher Abrar Sons New Urdu Bazar Karachi.

2. Schultz, J. C. 2005. Plant Ecology, Springer-Verlag

3. Bazzaz, F. A. 2004. Plants in Changing Environments: Linking Physiological, Population, and Community Ecology, Cambridge University Press

4. Chapin, F. S. et al. 2002. Principle of Terrestrial Plant Ecology, Springer- Verlag

5. Lambers, H. et al. 2002. Plant Physiological Ecology, Springer-Verlag

6. Larcher, W. 2003., Physiological Plant Ecology: Ecophysiology and Stress Physiology of Function Groups - Springer-Verlag

7. Nobel, P. S 1999, Physico-chemical and Environmental Plant Physiology, Academic Press.

8. Lambers, H., T. L. Pons and F. Stuart. 2008. Plant Phyiological Ecology.

9. Smith, R. L. 2004. Ecology and field Biology. Addison Wesley Longman, Inc., New York.

10. Barbour, M. G., Burke, J. H and Pitts, W. D. 2004 Terrestrial Plant Ecology, The Benjamin, Cumming Publishing C. Palo Alto, California, USA.

11. Smith R. L. 1998 Elements of Ecology. Harper & Row Publishing.

12. Townsend. C. R. Begon. M and J. L Harper. 2002 Essentials of ecology. Blackwell Publishing.

13. Gurevitch. J. Scheiner, S. M. and G. A Fox. 2006 The Ecology of Plants\. Sinaur Associate Inc.

14. Hussain. F. 1989 Field and Laboratory Manual of Plant Ecology, National Academy of Higher Education, Islamabad.

15. Hussain. S. S. 1989 Pakistan Manual of Plant Ecology. National Book Foundation Islamabad.

16. More. P. D. and Chapman S. B. 1986 Methods in Plant Ecology, Blackwell Scientific Publication Oxford.

17. Rashid, A. 2005. Soil Science. National Book Foundation, Islamabad.

Journals / Periodicals:

Pakistan Journal of Botany, Journal of Ecology, Journal of Applied Ecology, Ecology, Journal of Arid Environment

Course Name: Plant Physiology-I
Course Code: Bot- 365
Cr. Hr. 03(2+1)
Domain: Major

Specific Objectives of course:

To provide comprehensive knowledge on some vital functions and mechanisms of plants.
Course Outline:

1. Photosynthesis: History of photosynthesis. Nature and units of light. Determination of oxygenic and anoxygenic photosynthesis. Ultrastructure of thylakoid vesicle. Various pigments and photosynthetic activity. Ultrastructure and composition of photosystem-I and II. Absorption and action spectra of different pigments. Mechanism of photosynthesis - light absorption, charge separation or oxidation of water (water oxidizing clock), electron and proton transport through thylakoid protein-pigment complexes. Photophosphorylation and its mechanism. CO2 reduction (dark reactions) - C3 pathway and Photorespiration, Regulation of C3 pathway, C4 pathway and its different forms, C3-C4 intermediates, CAM pathway. Methods of measurement of photosynthesis.

2. Respiration: Synthesis of hexose sugars from reserve carbohydrates. Mechanism of respiration- Glycolysis, Differences between cytosolic and chloroplastidic glycolysis, Oxidative decarboxylation, Krebs cycle, Regulation of glycolysis and Krebs cycle, Electron transport and oxidative phosphorylation. Aerobic and anaerobic respiration. Energetics of respiration. Pentose phosphate pathway. Glyoxylate cycle. Cyanide resistant respiration.

3. Translocation of Food: Pathway of translocation, source and sink interaction, materials translocated, mechanism of phloem transport, loading and unloading.

4. Leaves and Atmosphere: Gaseous exchange, mechanism of stomatal regulation. Factors affecting stomatal regulation.

5. Assimilation of Nitrogen, Sulphur and Phosphorus: The nitrogen cycle. Nitrogen fixation. Pathways of assimilation of nitrate and ammonium ions. Assimilation of sulphur and phosphorus.

Lab Outline:

1. To determine the volume of CO2 evolved during respiration by plant material.
2. To determine the amount of O2 used by respiring water plant by Winkler Method.
3. Separation of chloroplast pigments on column chromatogram and their quantification by spectrophotometer.
4. To extract and separate anthocyanins and other phenolic pigments from plant material and study their light absorption properties.
5. To categorize C3 and C4 plants through their anatomical and physiological characters.
6. To regulate stomatal opening by light of different colours and pH.

Recommended Books:

1. Dennis, D.T., Turpin, D.H., Lefebvre, D.D. and Layzell, D.B. 1997. Plant Metabolism. 2nd Edition. Longman Group, U.K.
2. Dey, P.M. and Harborne, J.B. 1997. Plant Biochemistry. Harcourt Asia PTE Ltd. Singapore.
3. Fitter, A. and Hay, R.K.M. 2001. Environmental Physiology of Plants. Academic Press, UK.
4. Heldt, H-W. 2004. Plant Biochemistry. 3rd Edition, Academic Press, U.K.
5. Ihsan Illahi, 1991. Plant Growth, UGC Press, Islamabad.

6. Ihsan Illahi, 1995. Plant Physiology, Biochemical Processes in Plants, UGC Press.

7. Nobel, P.S. 1999. Physicochemical and Environmental Plant Physiology. Academic Press, UK.

8. Press, M.C., Barker, M.G., and Scholes, J.D. 2000. Physiological Plant Ecology, British Ecological Society Symposium, Volume 39, Blackwell Science, UK.

9. Salisbury F.B. and Ross C.B. 1992. Plant Physiology. 5th Edition. Wadsworth Publishing Co. Belmont CA.

10. Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4th Edition. Sinnauers Publ. Co. Inc. Calif.

11. W.B. Hopkins. 1999. Introduction to Plant Physiology. 2nd Ed. John Wiley and Sons. New York.

12. Epstein, E. and Bloom, A.J. 2004. Mineral Nutrition of Plants: Principles and Perspectives. 2nd Edition. Sinauer Associates, California, USA.

13. Kirkham, M.B. 2004. Principles of Soil and Plant Water Relations. Elsevier, Amsterdam, Netherlands.

14. Barton, W. 2007. Recent Advances in Plant Physiology.

Journals/Periodicals:

Pakistan Journal of Botany, Plant Physiology, Physiologia Plantarum, lanta, Annual Review of Plant Biology, Journal of Plant Physiology

Course Name: Plant Pathology
Course Code: Bot –366
Cr. Hr. 03(2+1)
Domain: Major

Specific Objectives

To enable the students to understand the basics of pathology and pathogen.

Course Content

1. The importance of plant disease.
2. The nature and classification of plant diseases.
3. Causes of plant disease.
4. The nature and classification of plant pathogens.
5. Growth and reproduction of plant pathogens.
6. Pathogenesis-I, The parasite in Relationship with its host.
7. Pathogenesis-II. Resistance and susceptibility.
8. The production and liberation of inoculums.
9. The dissemination of plant pathogens.
10. The phenomena of infection.
11. The effect of environment and nutrition on disease development.

12. Detailed study of the following plants diseases. Black rot of crucifers, Bacterial will of cucurbits, damping off caused by Pythium sp. Late Blight of potato and tomato, white rust of crucifers, downy mildew of cereals and grasses, corn smut, loose smut of Barley, Bunt, or stinking smut of wheat, black stem rust of wheat, white heart rot of deciduous trees. Tobacco Mosaic.
13. Diseases in transit and storage.
14. The principles of the control of plant disease: Quarantines, Eradication campaigns, and International Plant Protection, Cultural practices in disease control, Chemical control and resistant varieties.

Book Recommended

1. Principles of Pathology of E.C. Stakman and J.G. Harrar.
2. Plant Pathology by J.C. Walker.
3. Plant Pathology by E.J. Butler and S.G. Jones.
4. Principles of Plant Infection of E. Gaumann.
5. Fungi and Plant disease by Mundkar.
6. Fungi of Pakistan by Sultan Ahmed. Part I and II.
7. Principles of Plant Pathology by J.G. Manners.
8. Introduction to Plant Diseases by G.B. Lucas and C.L. Campbell

SEMESTER-VII

Course Name: Molecular Biology
Course Code: Bot- 471
Cr. Hr. 03(2+1)
Domain: Major

Specific Objectives of course:

To disseminate the knowledge of molecular basis of life

Course Outline:

1. Nucleic Acids: DNA-circular and superhelical DNA. Renaturation, hybridization, sequencing of nucleic acids, synthesis of DNA, Central Dogma

2. Proteins: Basic features of protein molecules. Folding of polypeptide chain, α- helical and β-secondary structures. Protein purification and sequencing.

3. Transcription: Enzymatic synthesis of RNA, transcriptional signals Translation: The genetic code. The Wobbling, polycistronic and monocistronic RNA. Overlapping genes.

4. Gene regulation in Eukaryotes: Differences in genetic organization and prokaryotes and eukaryotes. Regulation of transcription, initiation, regulation of RNA processing, regulation of nucleocytoplasmic mRNA transport, regulation of mRNA stability, regulation of translation, regulation of protein activity.

5. Plant Omics: Transcriptomics; DNA libraries, their construction, screening and application. Microarray of gene technology and its application in functional genomics.

6. Proteomics; structural and functional proteomics. Methods to study proteomics Metabolomics; methods to study metabolomics; importance and application of metabolomics

7. Bioinformatics and computational biology. Levels, scope, potential and industrial application of bioinformatics and computational biology, Docking.

Lab Outline:

Following techniques will be used for the isolation and analysis of different components:

1. Extraction of RNA, DNA and proteins
2. Electrophoreses: One and two dimensional
3. Purification of proteins, RNA and DNA.
4. Amplification using PCR. 5. Northern, Western and Southern Blotting.

Recommended Books:

1. Cullis, C. A. 2004. Plant Genomics and Proteomics. Wiley-Liss, New York.

2. Gibson, G. and S. V. Muse, 2002. A Premier of Genome Science, Sinauer Associates Inc. Massachusetts.

3. Gilmartin, P. M. and C. Bowler. 2002. Molecular Plant Biology. Vol. 1 & 2. Oxford University Press, UK.

4. Lodish, H. et al., 2004. Molecular Cell Biology. 5th Edition. W. H. Freeman & Co., New York.

5. Malacinski, G. M. 2003. Essentials of Molecular Biology, 4th Edition. Jones and Bartlett Publishers, Massachusetts.

6. Watson, J. D. et al. 2004. Molecular Biology of the Gene. Peason Education, Singapore.

7. Ignacimuthu, S. 2005. Basic bioinformatics. Narosa Publishing House, India.

8. Weaver, R. F. 2005. Molecular Biology. McGraw-Hill, St. Louis.

9. Lehninger, A L. 2004. Principles of Biochemistry. Worth Publishers Inc.

10. David Figurski. 2013. Genetic manipulation of DNA and protein, example from current research. In Tech Publishers.

11. Bruce Alberts et al. 2007. Molecular biology of the cell. 5th Edition. Garland and Sons.

12. M. Madan Babu. 2013. Bacterial gene regulations and transcription network. Caister Publishers. Academic Publishers.

Course Name: Plant Biochemistry-II
Course Code: Bot- 472
Cr. Hr. 03(2+1)
Domain: Major

Specific Objectives of course:

To explicit the fundamentals of metabolic energy, Metabolism and Plant constituents.

Course Outline:

1. Bioenergetics: Energy, laws about energy changes. Oxidation and reduction in living systems.

2. Metabolism:

i. Biosynthesis, degradation and regulation of sucrose and starch. Breakdown of fats with special reference to beta-oxidation and its energy balance. Biosynthesis of fats.

ii. Replication of DNA. Reverse transcription. Biosynthesis of DNA and RNA.

iii. Components of protein synthesis. Genetic code, protein synthesis: initiation, elongation and termination.

3. Alkaloids: Occurrence, physiological effects, chemical nature with special reference to solanine, nicotine, morphine, theine and caffeine. Aflatoxins, their nature and role.

4. Terpenoids: Classification: monoterpenes, sesquiterpenes, diterpenes, triterpenes, tetraterpenes, polyterpenes and their chemical constitution and biosynthesis.

5. Vitamins: General properties and role in metabolism.

Lab Outline:

1. Separation of soluble proteins by polyacrylamide gel (PAGE) electrophoresis.
2. Separation of nucleic acids by gel electrophoresis.
3. To estimate the amount of vitamin C in a plant organ (orange, apple juice).
4. To determine potential alkaloids in plants.
5. To estimate terpenoids in plants.

Recommended Books:

1. Conn E. E. and Stumpf, P. K. 2002. Outlines of Biochemistry, John Wiley and Sons Inc. New York.

2. Albert L. Lehninger, 2004. Principles of Biochemistry. Worth Publishers Inc.

3. Voet, D. Voet J. G. and Pratt, C. W. 1998. Fundamentals of Biochemistry, John Wiley and Sons, New York.

4. Dey, P. M. and Harborne, J. B. 1997. Plant Biochemistry. Harcourt Asia PTE Ltd. Singapore.

5. Smith; E L., Hill; R. L., Lehman; R. I., Lefkowits, R J. and Abraham. H. Principles of Biochemistry, (General Aspects). White. International Student Edition. McGraw Hill International Book Company.

6. Zubay. G. 2003, Biochemistry, MacMillan Publishing Co., New York.

7. Chesworth, J. M., Strichbury T. and Scaife, J. R. 1998. An introduction to Agricultural Biochemistry. Chapman and Hall, London.

8. Mckee, T. and Mckee, J. R. 1999. Biochemistry – An Introduction. WCB / McGraw-Hill, New York, Boston, USA.

9. Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4th Edition. Sinnauers Publ. Co. Inc. Calif.

10. Lea, P. J. and Leegood, R. C. 1993. Plant Biochemistry and Molecular Biology. Wiley and Sons, New York.

11. Abides, R. H., Frey P. A. and Jencks, W. P. 1992. Biochemistry, Jones and Bartlet, London.

12. Goodwin T. W. and Mercer, E. I. 1997. Introduction to Plant Biochemistry. Pergamon Press, Oxford.

13. Heldt, H. W. 2008. Plant Biochemistry. 3rd Edition, Academic Press, U. K.

14. Campbell, M.K. and F. Shawn. 2008. Biochemistry 6th Edition.

Journals / Periodicals:

Plant Physiology & Biochemistry, Annual Review of Biochemistry, Biochemistry Journal, Critical Review in Biochemistry and Molecular Biology

Course Name: Plant Ecology-II

Course Code:Bot- 473

Cr. Hr. 03(2+1)

Domain: Major

Specific Objectives of Course:

To provide comprehensive knowledge of population, community, ecosystem ecology and its relevance to mankind.

Course Outline:

A. Population Ecology

1. Population structure and plant demography: Seed dispersal, Dormancy, Seed Bank, Seed dormancy, Recruitment, Demography

2. Life history pattern and resource allocation: Density dependent and density independent factors, Resource allocation, Reproductive effort, Seed size vs seed weight, Population genetics, Evolution

B. Community Ecology: Historical development of community ecology, Community concepts and attributes, Methods of sampling of plant communities, Ecological succession, Community soil-relationship, Local Vegetation, Vegetation of Pakistan, Major formation types of the world

C. Ecosystem Ecology: Ecological concepts of ecosystem, Boundaries of ecosystem. Compartmentalization and system concepts, Energy flow in ecosystem, Biogeochemical cycles: water carbon and nitrogen Case studies: any example

Lab Outline:

Determination of seed bank in various populations.

Seed dispersal pattern of local populations.

Demography and life history of local annual population.

Study of community attributes.

Sampling of vegetation including Quadrat, plotless, transect and Braun-Blanqut.

Correlate soil properties with vegetation type.

Field trip to study different communities located in different ecological regions of Pakistan.

Slide show of the vegetation of Pakistan.

Slide show of the major formations of the world.

Soil physical and chemical properties

Recommended Books:

1. Ahmad, M. and S. S. Shaukat. 2012. A test book of vegetation ecology. Publisher Abrar Sons, New Urdu Bazar, Karachi.

2. Schultz J. C. 2005. Plant Ecology, Springer-Verlag.

3. Townsend C. R. Begon. M and J. L. Harper 2002. Essentials of Ecology, Blackwell Publishing,

4. Chapin, F.S. et al. 2002. Principle of Terrestrial Plant Ecology, Springer-Verlag

5. Gurevitch, et al., 2002.The Ecology of Plants, Sinauer Associates, Inc.

6. Barbour M. G. et al., 1999, Terrestrial Plant Ecology, The Benjamin-Cumming Publishing Co.

7. Smith, R. L. 1998. Elements of Ecology by Harper & Row Publishers,

8. Moore P.D. and Chapman S. B. 1986. Methods in Plant Ecology, Blackwell Scientific Publication, Oxford.

9. Hussain, S. Pakistan Manual of Plant Ecology,

10. Hussain, F. 1989. Field and Laboratory Manual of Plant Ecology, National Academy of Higher Education. Islamabad

11. Lambers, H., T. L. Pons and F. Stuart. 2008. Plant Physiological Ecology.

12. Larcher. W. 2003 Physiological Plant Ecology. Ecophysiology and Stress Physiology of Function Groups. Springer- Verlag.

1. Conn E. E. and Stumpf, P. K. 2002. Outlines of Biochemistry, John Wiley and Sons Inc. New York.

2. Albert L. Lehninger, 2004. Principles of Biochemistry. Worth Publishers Inc.

3. Voet, D. Voet J. G. and Pratt, C. W. 1998. Fundamentals of Biochemistry, John Wiley and Sons, New York.

4. Dey, P. M. and Harborne, J. B. 1997. Plant Biochemistry. Harcourt Asia PTE Ltd. Singapore.

5. Smith; E L., Hill; R. L., Lehman; R. I., Lefkowits, R J. and Abraham. H. Principles of Biochemistry, (General Aspects). White. International Student Edition. McGraw Hill International Book Company.

6. Zubay. G. 2003, Biochemistry, MacMillan Publishing Co., New York.

7. Chesworth, J. M., Strichbury T. and Scaife, J. R. 1998. An introduction to Agricultural Biochemistry. Chapman and Hall, London.

8. Mckee, T. and Mckee, J. R. 1999. Biochemistry – An Introduction. WCB / McGraw-Hill, New York, Boston, USA.

9. Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4th Edition. Sinnauers Publ. Co. Inc. Calif.

10. Lea, P. J. and Leegood, R. C. 1993. Plant Biochemistry and Molecular Biology. Wiley and Sons, New York.

11. Abides, R. H., Frey P. A. and Jencks, W. P. 1992. Biochemistry, Jones and Bartlet, London.
12. Goodwin T. W. and Mercer, E. I. 1997. Introduction to Plant Biochemistry. Pergamon Press, Oxford.
13. Heldt, H. W. 2008. Plant Biochemistry. 3rd Edition, Academic Press, U. K.
14. Campbell, M.K. and F. Shawn. 2008. Biochemistry 6th Edition.

Journals / Periodicals:

Plant Physiology & Biochemistry, Annual Review of Biochemistry, Biochemistry Journal, Critical Review in Biochemistry and Molecular Biology

Course Name: Plant Physiology-II

Course Code: Bot- 474

Cr. Hr. 03(2+1)

Domain: Major

Specific Objectives of course:

To give it comprehensive and advance knowledge of growth regulators, mechanism of water uptake and role of essential nutrients in plant metabolism

Course Outline:

1. Plant Growth Regulators: Major natural hormones and their synthetic analogues. Bioassay, structure, biosynthesis, receptors, signal trasduction and mode of action, transport, physiological effects of Auxins, Gibberellins, Cytokinins, Abscisic acid, Ethylene, Polyamines, Brassinosteriods, Jasmonates, and Salicylic acid.

2. Water Relations: The soil -plant -atmosphere continuum - an overview. Structure of water. Physico-chemical properties of water. Water in the soil and its potentials. Water in cell components. Absorption of water in plants (pathways and driving forces, Aquaporins,-their structure and types). Cell water relations terminology. Hofler diagram - analysis of change in turgor, water and osmotic potential with changes in cell volume. Modulus of elasticity coefficient; Hydraulic conductivity. Osmoregulation, Methods for measurement of water, osmotic and turgor potentials- Pressure chamber, psychrometry, pressure probe, pressure volume curve.

3. Plant Mineral Nutrition: Inorganic composition of plant and soil. Absorption of mineral nutrients - roots, mycorrhizae. Effect of soil pH on nutrient availability. Ion traffic into root. The nature of membrane carriers, channels and electrogenic pumps. Passive and active (primary and secondary) transports and their energetics. Essential and beneficial elements-their functions and deficiency symptoms in plants. Fertilizers and their significance in Agriculture.

4. Phytochromes: Discovery of phytochromes and cryptochromes. Physical and chemical properties of phytochromes. Distribution of phytochromes among species, cells and tissues and their role in biological processes. Phytochromes and gene expression.

5. Control of Flowering: Autonomous versus environmental regulation. Circadien rhythms. Classification of plants according to photoperiodic reaction, photoperiodic induction, locus of photoperiodic reaction and dark periods in photoperiodism. Role of photoperiodism in flowering.

Biochemical signaling involved in flowering. Vernalization and its effect on flowering. Floral meristem and floral organ development. Floral organ identity genes and the ABC model.

6. Signal transduction in prokaryotes and eukaryotes.

7. Dormancy; definition and causes of seed dormancy; methods of breaking seed dormancy; types and physiological process of seed germination.

8. Plant Movements; Tropic movement-phototropism, gravitropism and their mechanism. Nastic movements.

Lab Outline:

1. To investigate the preferential absorption of ions by corn seedlings and potato slices.
2. To determine osmotic potential of massive tissue by freezing point depression method or by an osmometer.
3. To investigate water potential of a plant tissue by dye method and water potential apparatus.
4. Determination of K uptake by excised roots.
5. Measurement of stomatal index and conductance.
6. Qualitative determination of K content in Guard cells by Sodium cobalt nitrite method.

Recommended Books:

1. Dennis, D. T., Turpin, D. H., Lefebvre, D. D. and Layzell, D. B. 1997. Plant Metabolism. 2nd Edition. Longman Group, U. K. Dey, P. M. and Harborne, J. B. 1997. Plant Biochemistry. Harcourt Asia PTE Ltd. Singapore.

2. Fitter, A. and Hay, R. K. M. 2001. Environmental Physiology of Plants. Academic Press, UK.

3. Heldt, H. W. 2004. Plant Biochemistry. 3rd Edition, Academic Press, U.K.

4. Ihsan Illahi, 1991. Plant Growth, UGC Press, Islamabad.

5. Ihsan Illahi, 1995. Plant Physiology, Biochemical Processes in Plants, UGC Press.

6. Nobel, P. S. 1999. Physicochemical and Environmental Plant Physiology. Academic Press, UK.

7. Press, M. C., Barker, M. G., and Scholes, J. D. 2000. Physiological Plant Ecology, British Ecological Society Symposium, Volume 39, Blackwell Science, UK.

8. Salisbury F. B. and Ross C. B. 1992. Plant Physiology. 5th Edition. Wadsworth Publishing Co. Belmont CA.

9. W. B. Hopkins. 1999. Introduction to Plant Physiology. 2nd Ed. John Wiley and Sons. New York.

10. Epstein, E. and Bloom, A. J. 2004. Mineral Nutrition of Plants: Principles and Perspectives. 2nd Edition. Sinauer Associates, California, USA.

11. Kirkham, M. B. 2004. Principles of Soil and Plant Water Relations. Elsevier, Amsterdam, Netherlands.

12. Barton, W. 2007. Recent Advances in Plant Physiology.

13. Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4th Edition. Sinnauers Publ. Co. Inc. Calif.

Journals / Periodicals:

Pakistan Journal of Botany, Plant Physiology, Physiologia Plantarum, Planta, Annual Review of Plant Biology, Journal of Plant Physiology

Course Name: Genetics-II
Course Code: Bot- 475
Cr. Hr. 03(2+1)
Domain: Major

Specific Objectives of Course:

To introduce students recombination of genetic material at molecular levels with emphasis on introduction to biotechnology and genomics.

Course Outline:

1. Recombinant DNA: Recombinant DNA Technology Introduction, Basic Techniques, PCR and Rt PCR, Restriction enzymes, Plasmids, Bacteriophages as tools, the formation of recombinant DNA, recombinant DNA methodology, Site directed Mutagenesis, DNA sequencing.

2. Application of Recombinant DNA: Applications of recombinant DNA technology using prokaryotes, recombinant DNA technology in eukaryotes: An overview, transgenic yeast, transgenic plants, transgenic animals, screening for genetic diseases, identifying disease genes, DNA typing, gene therapy, genetically modified organisms and apprehensions.

3. Mechanisms of Genetic Change I: Gene Mutation: The molecular basis of gene mutations, spontaneous mutations, induced mutations, reversion analysis mutagens and carcinogens, biological repair mechanisms.

4. Mechanisms of Genetic Change II: Recombination: General homologous recombination, the holiday model, enzymatic mechanism of recombination, site-specific recombination, recombination and chromosomal rearrangements.

5. Mechanisms of Genetic Change III: Transposable Genetic Elements: Insertion sequences, transposons, rearrangements mediated by transposable elements, review of transposable elements in prokaryotes, controlling elements in maize.

6. Human Genome Project: Strategies and application, achievement and future prospects.

7. Plant Genome Projects: Arabidopsis, achievement and future prospects. Other plant genome projects

8. Bioinformatics: Application of computational tests to the analysis of genome and their gene products

9. Bioethics: Moral, Religious and ethical concerns

Lab Outline:

Problems relating to the theory

1 Isolation and separation of DNA and protein on Gel electrophoresis.

i. Bacterial chromosome
ii. Plasmid DNA (minipreps)
iii. Plant DNA iv. Protein

2 DNA Amplification by PCR

Recommended Books:

1. Trun, N and Trempy J. 2004, Fundamental Bacterial Genetics, Blackwell Publishing House.

2. Winnacker, E. L.2003, From Gene to Clones Introduction to Gene Technology, Panima Publishing Corporation, New Delhi.

3. Beaycgamp T. L. and Walters L., Contemporary Issues in Bioethics, Wadsworth Publishing Company.

4. Brown, T. A. 2002 Genomes, Bios Scientific Publishers Ltd.

5. The Genome of Homo Sapiens, 2003, Cold Spring Harbor Laboratory Press.

6. Ignacimuthu, S. 2005, Basic Bioinformatics, Narosa Publishing House, India.

7. Lwein, B. 2004, Gene VIII, Pearson Education Int.

8. Miglani, 2003, Advanced Genetics, Narosa Publishing House, India.

9. Hartt, D. L, and Jones, E. W. 2005. Genetics, Analysis of Gene and Genomes. Jones and Bartlett Publishers, Sudbury, USA

10. Gelvin, S. B. 2000. Plant Molecular Biology Manual. Kluwer Academic Publishers.

11. Primrose, S. B., Twyman, R. M. and Old R. W. 2004. Principles of Gene Manipulation, an Introduction to Genetic Engineering (6th Edition), Blackwell Scientific Publications.

12. Snyder, L and Champness W, 2003, Molecular Genetics of Bacteria, ASM Press.

13. Wilson, J. and Hunt, T. 2004. Molecular Biology of the cell – the problems book, Garland publishing Inc.

14. Anthony J. F Griffiths, Jeffrey H Miller, David T Suzuki, Richard C Lewontin, and William M Gelbart. W. H. 2009. An Introduction to Genetic Analysis, 7th Edition. Freeman and Company.

15. Hedrick, P. W. 2005. Genetics of Population. Jones and Bartlett Publisher, Sudbury, USA.

16. Mahmut Caliskan. 2012. The Molecular basis of plant genetic diversity. In Tech Publishers.

17. Ram J. Singh. 2011. Genetic resources, chromosome engineering and crop improvement. Medicinal plants. Vol. 6. CRC Press.

18. William S. Klug, Michael R. Cummings, Charlotte A. Spencer, Michael A. Palladino. 2011. Concepts of Genetics. Pearson Educations.

19. Daniel Hartl. 2011. Genetics Johns and Bartlett Publishers.

20. David Hyde. 2008. Introduction to Genetic principles. McGraw-Hill.

21. Daniel, L. Hart, Elizabeth W. Jones. 2009. Analysis of genes and genomes. John and Barlett.

22. Noureddine Benkeblia. 2011. Sustainable agriculture and new biotechnologies. CRC Press.

Journals / Periodicals:

J. Genetics, Theoretical and Applied Genetics, Cytologia, Chromosoma, Genome

Course Code: Bot-476

Course Name: Field Experience **Cr. Hr. 03(2+1)**

SEMESTER-VIII

Course Name: Pharmacognosy
Course Code: Bot –481
Cr. Hr. 03(2+1)
Domain: Major

Objectives of Course:

Course Outline:

Definition of pharmacognasy, drug crude drug, official and unofficial drugs, cultivation, collection, curing, drying preservation, evaluation and classification of drugs. Therapeutic classes of drugs.

Details study of the following medicinal plants giving them synonyms, botanical origin, local names distribution of plants, method of cultivation, macroscopical characteristics and microscopical characteristics of the drugs (histology and powdered drug of the part used) chemical constituents and adulterants with special references to species growing in Pakistan. Ethnopharmacognosy of the medicinal plants.

Gymnosperm

i. Ephedra (Ephedra Sp.) Edphedraceae

Angiosperm

(a) Dicotyledons

i. Aconite (Root) (Aconitum nepallus Family Ranunculaceae)
ii. Mandrake (Rhizome) (Podophyllum peltatum Family Podophyllaceae)
iii. Opium (Papaver somniferum Family Papaveraceae)
iv. Liquorice (Rhizome) (Glycyrhiza glabra Family Fabaceae)
v. Gum acacia (Gum) (Acacia Senegal Family Mimosaceae)
vi. Senna (leaflet) (Cassia angustifolia Family Caesalpinaceae)
vii. Linseed (Seed) (Linun usitatissimum Family Linaceae)
viii. Fennel (Fruit) (Foeniculum vulgare Family Apiaceae)
ix. Rauwolfia (Rhizome) (Rauwolfia serpentina Family Apocynaceae)

x. Mentha (Leaf) (Mentha piperata Family Lamiaceae)
xi. Atropa (Root & Leaf) (Atropa belladonna Family Solanaceae)
xii. Stramonium (Leaf) (Datura stramonium Family Solanaceae)
xiii. Henbance (Leaf) (Hyocyamus niger Family Solanaceae)
xiv. Floxglove (Leaf) (Digitalis purpurea Family Scrophulariaceae)
xv. Valeriana (Rhizome) (Valeriana officinalis Family Valerianaceae)
xvi. Cinchona (Bark) (Cinchona succirubra Family Valerianaceae)
xvii. Santonica (Florets) (Artemisia Family Asteraceae)

(b) Monocotyledons

i. Colchicum (Corm) (Colchicum autumnale Family Liliaceae)
ii. Zingiber (Rhizome) (Zingiber officinale Family Zingiberaceae)

Fungi

i. Ergot (Claviceps purpurea, Family Clavicipitaceae)

PRACTICALS

1. Microscopical Characters of the drugs.
2. Microscopical Characters of the drugs (T.S of the past used, powdered drugs)
3. Properties of gums
4. Properties of different oils studied in theory.
5. Identification tests for Starch, Ca-oxalate etc
6. Volatile and fixed oils, tannin, mucilage etc

Note: The students are required to submit Collections at Least 30 medicinal plants

Books Recommended

1. Tyler V.E.L.R Brady & E. P. Clayst, pharmacognosy 6th Ed Leimption London.
2. Trease, G. E & W.C Evans.1985 pharmacognosy, 12 Ed. English language Soc .Baillere Tindall.
3. Wallis, T. E. 1981. A Text book of pharmacognosy, J & A Churchill Ltd. Glousester palace, W. I. London.
4. Youngkin, H. W. 1950. A Textbook of Pharmacognosy. The Blackistan CO. Toronto Philadelphia.
5. Jains, S. K. 1987. A Manual of Ethnobotany Scientific Publisher jodhpur India.
6. Jain, S. K. 1991. Contribution to Ethnobotany of India. Scientific Publisher, Johdpur, India.

Course Name: Environmental Biology
Course Code: Bot- 482
Cr. Hr. 03(2+1)
Domain: Major

Specific Objectives of Course:

To provide updated knowledge of environmental problems and sustainable environmental management.

Course Outline:

1. Environment: Introduction, scope, pressure
2. Pollution: definition, classification and impact on habitats

i. Air pollution: Sources and effect of various pollutants (inorganic, organic) on plants, prevention, control, remediation. Photochemical smog. Smog. Acid rain: 1. Theory of acid rain, 2. Adverse effects of acid rains. Chlorofluorocarbons and its effects.

ii. Water pollution: Major sources of water pollution and its impact on vegetation, prevention, control remediation, eutrophication, thermal pollution.

iii. Sediments pollution: fungicide, pesticides, herbicide, major sources of soil pollution and its impact. Prevention, control remediation. Heavy metal pollution. Tanneries. Hospital waste. Treatments of sewage, sludge, and polluted waters.

iv. Noise pollution.

v. Radiation pollution (including nuclear): Measurement, classification and effects, Principle of radiation protection, waste disposal

3. Forest: importance, deforestation, desertification and conservation
4. Ozone layer:
   i. Formation
   ii. Mechanism of depletion
   iii. Effects of ozone depletion
5. Greenhouse effect and global warming: causes, impacts.
6. Human population explosion: impact on environment.
7. Impact assessment: Industrial urban, civil developments.
8. National conservation strategy: Brief review of major problems of Pakistan and their solutions.
9. Sustainable Environmental management.
10. Wetlands and sanctuaries protection: The pressures, problems and solutions.
11. Range management: Types of rangelands, potential threats, sustainable management.
12. Aerobiology (Pollen allergy & dust allergy).

Lab Outline:

1. Examination of industrial waste water and Municipal sewage and sludge for
   i. Total dissolved solids.
   ii. pH and EC.
   iii. BOD/COD.
   iv. Chlorides, carbonate, and Nitrates.
2. Examination of water samples forms different sites for the presence and diversity of organisms.
3. Effect of air pollutants on plants.

4. Visits to environmentally compromised sites and evolution of remediation methods.

Recommended Books:

1. Newman, E. I. 2001. Applied Ecology. Blackwell Science. UK

2. Mooney, H. A. and Saugier, B. 2000. Terrestrial Global Productivity. Academic Press, UK.

3. Eugene, E. D. and Smith, B. F. 2000. Environmental Science: A study of interrelationships. McGraw-Hill. USA.

4. French, H. 2000. Vanishing Borders: Protecting the Planet in the Age of Globalization. W. W. Norton and Company, NY.

5. Hall, C. A. S. and Perez, C. L. 2000. Quantifying Sustainable Development. Academic Press, UK.

6. Bazzaz, F. A. 2004. Plants in changing environments: Linking physiological, population, and community ecology. Cambridge Univ. Press.

7. Bush, M.B. 1997. Ecology of a changing planet. Prentice Hall, UK.

8. Marsh, M.W. and Grossa Jr., J.M. 1996 Environmental geography: Science, land use, and earth systems. John Wiley and Sons.

9. Lambers, H., T. L. Pons and F. Stuart. 2008. Plant Physiological Ecology.

10. Mohamamd Ashfaq and Mushtaq A. Saleem. Environmental Pollution and Agriculture.

11. Shah Faisal Muhamamd and Sultan Mehmood. 2012. Lambert Publishers Germany.

12. Advanced Air and Noise Pollution Control, L. K. Wang, N. C. Pereira and Y. T. Hung, Humana Press, 2005.

13. Air Pollution Control Technology Handbook, K. B. Schnelle and C. A. Brown, CRC Press, 2002. Handbook of Solid Waste Management and Waste Minimization Technologies, N. P. Cheremisinoff, Butterworth-Heinemann, 2003.

14. Pollution Control In Process Industries, S. P. Mahajan, Tata McGraw-Hill, 1985.

15. Industrial Pollution control: issues and techniques, N. J. Sell, Van Nostrand Reinhold, 1992.

16. Environmental Biotechnology: Basic Concepts and Applications, I. S. Thakur, I.K. International Publishing House Pvt. Limited, 2006.

17. Vandermeer, John H. 2011. The ecology of agro-ecosystems - Jones and Bartlett Publishers; Sudbury, Mass; 2011 - xv, 387 p.

18. Greipsson, Sigurdur. 2011. Restoration ecology - Jones and Bartlett Publishers; Sudbury, MA; 2011 - xvi, 408 p 54.

19. Santra, S. C. 2010. Fundamentals of ecology and environmental biology - New Central Book Agency; London; 2010 - 353p.

20. Singh, M.P. 2007 Forest environment and biodiversity Daya; New Delhi; 2007 - 556p.

Journals/Periodicals:

Environmental Biology, Environment, Bioremediation

Course Name: Plant Tissue Culture
Course Code: Bot –483
Cr. Hr. 03(2+1)
Domain: Major

Objectives:

- Introduce the underlying principles of aseptic culture of plant organs.
- Provide information about equipment, procedures and terminology of aseptic culture.
- Provide an understanding of the advantages of using cell culture system.
- Provide students with an understanding of the benefits and issues of tissue culture.

Course outline:

1. **Introduction:** Introduction to plant cell and tissue culture. Plant tissue culture, plant genetic engineering and crop improvement. Tissue culture in agriculture, forestry, Botany and industry.
2. **Explant Preparation and Selection Strategies:** Explant types, size, age, quality, location and season. Sterilization of explants.
3. **Culture Facilities and Sterile Techniques:** The basic laboratory layout and equipment. Sterilization of glassware, equipments and working area.
4. **Media Components and Preparation:** Inorganic nutrients, organic nutrients, vitamins, amino acids, carbohydrates, gelling agents, antibiotic, plant hormones, complex organic supplements. Preparation of MS media from commercial packages and from stock solution. Contamination and its disposing. Safety in the laboratory.
5. **Initiation and Maintenance of Callus:** Origin and types of callus. Role of callus in embrogenesis, organogenesis and cell culture. Initiation and propagation of callus cultures. Monitoring the growth of callus. Genetic transformation of callus. Sub-culturing of callus. Organogenesis (Rooting and Shooting). Deflasking or Acclimatization.
6. **Production of Virus Free Plants:** Disease elimination by tissue culture. Disease elimination by chemotherapy. Disease elimination by thermotherapy.
7. **Types of Culture:** Initiation, maintenance, growth characters and uses of cell suspension culture. Introduction of anther and microspore culture. Pollen culture. Haploid for plant breeding and genetics. Factors affecting the success of anther culture. Organ and embryo culture. Culturing of Hairy roots, Minitubers and Microtubers. Callus culture, Meristem culture, and fern spore culture.
8. **Isolation and culture of plant protoplast:** Types of isolation, determination of protoplast, viability, protoplast morphology, culture of isolated chloroplast, cell wall regeneration by cultured protoplast, uses of protoplast, protoplast fusion.
9. **Somaclonal Variation:** Origin, mechanism and uses of somaclonal variation. Somaclonal variations for salt, herbicide, drought, and disease tolerance. Somaclonal variations in major crops.

10. **Somatic Hybridization and Germplasm Conservation:** Protoplast fusion and hybridization. Somatic hybrids plants and their regeneration. Germplasm conservation, methods for germplasm conservation. Cryopreservation. Artificial seeds.

Practicals:

1. Starting a primary culture (tissue digestion, cell count and cell culture).
2. Maintenance of a cell line.
3. Cryopreservation of cell line.
4. Plant cell culture.
5. Vital staining.
6. Organ culture

Recommended Books:

1. John, H.D. and L.W. Roberts. Plant tissue culture. Second edition. Cambridge University Press Cambridge. 1985.
2. Smith.R.H. Plant Tissue Culture Techniques and experiments. Second edition. Academic press 2000.
3. Evans, D.E. J.O.D. Coleman and A. Kearns. Plant Cell Culture. BIOS Scientific Publishers London.
4. Chopra V.L., V.S.Malik and S.R. Bhat. Plant Biotechnology. Oxford IBHPublishers New Delhi.
5. Attege, C.R and B. Kristiansen.2001. Basic Biotechnology, CambridgeUniversity, PressUK.
6. Halford, N., 2006. Plant Biotechnology: Current and Future Applications of Genetically Modified Crops. John Wiley and Sons Limited.
7. Vunjak-Novakovic, G., Freshney, R.I., 2006.Culture of Cells for Tissue Engineering.1st Edition Wiley, John & Sons
8. Freshney, R.I., 2006. Culture of Animal Cells: A Manual of Basic Technique. 5th Edition. Wiley, John & Sons.
9. Neumann, K-H., Kumar,A., Imani, J., 2009. Plant Cell and Tissue Culture - A Tool in Biotechnology: Basics and Application .1st Edition. Springer-Verlag New York, LLC.
10. Abbot. 2013. Recent Advances in Plant Tissue Culture and Biotechnology. RDM

Course Name: Introduction to Horticulture
Course Code: Bot -484
Cr. Hr. 03(2+1)
Domain: Major

Specific Objectives

To enable the students to understand the basics of Horticulture.

Learning Outcomes:

Students must be able to prepare media, identify and propagate important horticultural plants

Students are expected to grow different horticultural crops of the region

Course Outlines:

Introduction, history, importance and future scope, Definition and divisions of horticulture.

Classification of horticultural crops, Plant parts, their modifications and functions.

Plant environment; climate (temperature, light, humidity etc) and soil (structure, texture, fertility)

Phases of plant growth, Propagation of horticultural plants.

Establishment of orchards, vegetable farms and ornamental gardens; site selection, layout methods, wind breaks and their role.

Management practices; irrigation, manures and fertilizers, training and pruning, cultivation and weed control.

Climate, soil, propagation, rootstocks, cultivars, important pests, harvesting, post-harvest handling and marketing of important horticultural crops (fruits, vegetables and ornamentals) of the region.

Practicals

- Visit of nurseries, commercial gardens and public parks.
- Identification and nomenclature of important fruits, vegetables and ornamental plants; Garden tools and their uses.
- Media and its preparation. Techniques of propagation.
- Practice in layout methods, Selection of plants from nursery, propagation methods.
- Planting and after care.
- Production techniques and identification of important cultivars of horticultural crops of the region.

Recommended Books

1. Acquaah, G. 2009. Horticulture: Principles and Practices (4th Ed.). Prentice-Hall India Learning Pvt. Ltd. New Delhi, India.
2. Adams, C. R., K.M. Bamford and M. P. Early. 2012. Principles of Horticulture (6th Ed.). Routledge, new yark, USA.
3. Ingles, J. 2009. Ornamental Horticulture. Delmar 5 Maxwell Drive, Cifton, Park, New York.
4. Malik, M.N. 1994. Horticulture, National Book Foundation, Islamabad.
5. Chadha, K.L. 2006. Handbook of Horticulture (6th Ed.). ICAR, New Delhi, India.
6. Christopher, E. P. 2012. Introductory Horticulture. Biotech books, new Dehli, India.
7. Carrol,L., J.R.Shry and H.E. Reily. 2011. Introductory Horticulture (8th Ed.) Delmar-Thomson Learning , Albany, USA

8. Hartmann, H.T., D.E. Kester, E.T. Davies and R.L. Geneve. 2009. Plant Propagation–Principles and Practices (7th Ed.). Prentice-Hall India Learning Pvt. Ltd., New Delhi, India.
9. Peter, K.V. 2009. Basics of Horticulture. New India publishing Agency, New Dehli, India.
10. Reiley, H.E., C.L. Shry (Jr). 2004. Introductory Horticulture (6th Ed.).

Course Name: Research Report

Course Code: Bot-485

Cr. Hr.: 3 (3+0)

Domain: Major

Course Description

Students are required to write a 20–25-page research report depending on their majors. The students are required to submit three drafts: rough, revised, and final through the semester.

Each student will be provided individual supervision and guidance in the proposed research that he or she undertakes to conduct.

Students will be required to undertake a small-scale investigation on a topic of individual interest in their area of specialization.

Report Evaluation

a. The Research Report will be assessed by two examiners (one of them will be the supervisor and the second will be an external examiner). Or as per the university directives in vague.

Formatting: MLA/APA