SEMESTERWISE BREAK DOWN AND CURRICULUM FOR BS BOTANY NEW UNDERGRADUATE POLICY (2023)

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DEPARTMENT OF BOTANY

Introduction

An associate degree is a post-secondary degree awarded to students who have completed an associate degree program. Students who earn this degree have a higher level of education than people with a high school diploma but a lower level of education than those with a bachelor's degree. Admission requirements for associate degree programs can vary, but most programs require applicants to have a high school diploma or the equivalent. Associate degree programs can be completed within two years. There are many different reasons to consider earning an associate degree. First off, an associate degree can lead to better job prospects and a higher salary than what can be obtained with just a high school diploma. Second, an associate degree can provide the occupational training you need to enter a specific business field. Graduates of an Associate Degree will demonstrate the application of knowledge and skills with initiative, judgment in planning, problem solving and decision making in paraprofessional practice. Other reasons for earning an associate degree:

- Most of the credits earned in an associate degree program can be transferred to a bachelor's degree program.
- Employers may hire applicants who have associate degrees over applicants who have high school diplomas.
- In only two years, you can acquire the necessary training to enter fast-growing business fields.

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OVERVIEW

The Associate Degree qualifies individuals who apply underpinning technical and theoretical knowledge in arrange of contexts to undertake advanced skilled or paraprofessional work and as a pathway to further learning. The introduction of the Associate Degree is a dire need timely felt by Higher Education Commission to bridge the gap between the career opportunities and graduates. Associate degree in Botany is a strong preparatory two years program for pursuing a career in Botany and related discipline including: Biochemistry, Microbiology, Biotechnology and Environmental Biology. This post intermediate associate degree will be accomplished in four semesters covering 60 credit hours with 5 courses in each semester. Courses of Associate Degree are comprising of Breath Courses; courses from each discipline of Art and Humanities, Social Sciences and Natural Sciences. Writing Expository and Quantitative reasoning Subjects included Communication skills, Mathematics, and Quantitative Research Tool. The application area for graduates of this associate degree are; textile, chemical industry, agriculture, research organization, academic institution and related areas. The main focus of this program is to train man-power in basic education and to develop skill for enhancement of employability of individuals. The graduates with understanding of scientific principles may continue their academic studies and will be eligible to enroll themselves in third year of BS program in the relevant discipline. Moreover, the graduates equipped with problem solving skills may perform selected tasks relative to laboratory experiments in the various disciplines of Botany.

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OBJECTIVES AND SCOPE

Objectives:

The objectives of Associate Degree in Botany are:

- To provide knowledge and expertise in various disciplines of botany, which are exploited in many fields of life.
- To prepare students to transfer into a four-year program in the botany.
- To enhance the skills of students to a level that they can apply biological techniques in every field of life with best results that are fruitful to our society.
- To enhance the skills of the students to create an environment of understanding the Science for the benefit of country and nation.

Scope:

An associate degree in Botany is two-year course of study that aims to provide students with a foundation in biosciences and the lab skills. First year students will expect to participate in a large number of lectures and practical coursework, along with a considerable amount of lab-based work in different subjects. Successful completion of introductory biology courses in associate degree prepares students for advanced studies in a wide range of biological sub-disciplines that include Biotechnology, Biochemistry, Molecular Biology, Cell Biology, Microbiology, Genetics and Computational Biology. Candidates with an Associate degree may be engaged as; Educationists, Researchers, Research associates, Lab Technicians and Pathologists they can also serve in Public departments in Middle East, Europe etc and can work in Independent Private Companies. Whereas overall public and private sectors jobs availabilities could be as follows:

Public Sector

- Institutes for biological sciences
- Research and development (R&D) organizations
- Forensic institutes
- International Organizations: UNICEF, UNDP, WHO, FAO, World Bank, WWF

- Non-Governmental Organizations
- Community Development Programs
- Motivational speaker

Private Sector

- Multinational Companies
- Food Industries
- Pharmaceuticals Industry
- Research institutes
- Consultant for Private Companies
- Wildlife department
- Microbiologists
- Biotechnologist

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SCHEME OF STUDIES BS BOTANY (2023)

Semester-I				
Course Code	**Course Name**	**Credit Hours**	**General Education Course /Major/Interdisciplinary**	**Marks**
BBA-322	Entrepreneurship	02	General Education Course	
PSY-301	Introduction to Psychology	02	General Education Course	
ENG-301	English-I (Functional English)	03	General Education Course	
ISL-301	Islamic Studies	02	General Education Course	
`PSC-301	Civic and Community Engagement	02	General Education Course	
BOT-311	Diversity of Plants	03	Major Disciplinary Specific	
CHEM-322	Organic Chemistry	03	Interdisciplinary	
Semester Credit Hours		**17**		
Semester-II				
CS-301	Application of Information and Communication Technology	3(2+1)	General Education Course	
ENG-402	Expository Writing	03	General Education Course	
ISI-302	History of Islamic Civilization	02	General Education Course	
PSC-302	Ideology and Constitution of Pakistan	02	General Education Course	
MTH-433	Quantitative Reasoning-I	03	General Education Course	
BOT-321	Introduction to Plant Systematics & Anatomy	03	Major Disciplinary Specific	
Semester Credit Hours		**16**		

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Semester-III				
MTH-444	Quantitative Reasoning-II	03	General Education Course	
BIOT-321	Introduction to Biotechnology	03	Interdisciplinary	
BOT-441	Principles of Biological Sciences (NS-I)	03 (2+1)	General Education Course	
BOT-442	Cell Biology, Genetics & Evolution	03 (2+1)	Major Disciplinary Specific	
ZOO-432	Animal Diversity-I	03 (2+1)	Interdisciplinary	
Semester Credit Hours		**15**		
Semester-IV				
CHEM-311	Inorganic Chemistry	03	Interdisciplinary	
ZOO-443	Animal Diversity-II	03	Interdisciplinary	
BOT-441	Biochemistry	03	Major Disciplinary Specific	
BOT-442	Biodiversity and Conservation	03	Major Disciplinary Specific	
BOT-443	Bioinformatics	03	Major Disciplinary Specific	
Semester Credit Hours		**15**		
Semester-V				
BOT-551	Bacteriology and Virology	03	Major Disciplinary Specific	
BOT-552	Phycology	03	Major Disciplinary Specific	
BOT-553	Mycology	03	Major Disciplinary Specific	
BOT-554	Non-Flowering Vascular Plants and Palynology	03	Major Disciplinary Specific	
BOT-555	Taxonomy of Angiosperms	03	Major Disciplinary Specific	
Semester Credit Hours		**15**		
Semester-VI				
BOT-561	Plant Ecology-I	03	Major Disciplinary Specific	
BOT-562	Genetics-I	03	Major Disciplinary Specific	
BOT-563	Molecular Biology	03	Major Disciplinary Specific	

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BOT-564	Plant Physiology-I	03	Major Disciplinary Specific	
BOT-565	Plant Anatomy and Embryology	03	Major Disciplinary Specific	
Semester Credit Hours		**15**		
Semester-VII				
BOT-671	Plant Ecology-II	03	Major Disciplinary Specific	
BOT-672	Plant Biochemistry	03	Major Disciplinary Specific	
BOT-673	Research Methodology	03	Major Disciplinary Specific	
BOT-674	Plant Pathology	03	Major Disciplinary Specific	
BOT-679	Field Experience	03	Internship	
Semester Credit Hours		**15**		
Semester-VIII				
BOT-681	Genetics-II	03	Major Disciplinary Specific	
BOT-682	Environmental Biology	03	Major Disciplinary Specific	
BOT-683	Plant Physiology-II	03	Major Disciplinary Specific	
BOT-684	Pharmacognosy (Medicinal Plants)	03	Major Disciplinary Specific	
BOT-689	Capstone Project	03	Major	
Seester Credit Hours		**15**		
Total Credit Hours		**123**		
SUMMARY				
General Education Courses		**30**		
Disciplinary Major Courses		**72**		
Interdisciplinary/Allied Courses		**15**		
Field Experience/Internship		**03**		
Capstone Project		**03**		
Total Credit Hours		**123**		

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SEMESTER-WISE BREAKUP

Semester-I				
Course Code	**Course Name**	**Credit Hours**	**General Education Course /Major/Interdisciplinary**	**Marks**
BBA-322	Entrepreneurship	02	General Education Course	
PSY-301	Introduction to Psychology	02	General Education Course	
ENG-301	English-I (Functional English)	03	General Education Course	
ISL-301	Islamic Studies	02	General Education Course	
`PSC-301	Civic and Community Engagement	02	General Education Course	
BOT-311	Diversity of Plants	03	Major Disciplinary Specific	
CHEM-322	Organic Chemistry	03	Interdisciplinary	
Semester Credit Hours		**17**		

ENTREPRENEURSHIP

BBA-322 **Credit Hours:** Two (2)

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

Course Outline:

1. Entrepreneurship: an evolving concept
2. Entrepreneurship – a perspective
3. The Role of Entrepreneurship
4. Kinds of Entrepreneurs

5. Role and Functions of Entrepreneurs
6. Understanding strategic issues in business plan development
7. Pitfalls in selecting new ventures
8. Innovation: the creative pursuit of ideas
9. Opportunity identification: the search for new ideas
10. Reason for failures of new ventures
11. Legal challenges for entrepreneurial ventures
12. Sources of capital for entrepreneurial ventures
13. Assessment of entrepreneurial plan
14. Marketing challenges for entrepreneurial ventures
15. Developing an effective business plan
16. Strategic entrepreneurial growth
17. Problems Faced by Newly Established Company
18. Post and Field Problems Faced by a New Enterprise
19. Franchising and the Entrepreneur

Recommended Books:

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

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INTRODUCTION TO PSYCHOLOGY

PSY-311 **Credit Hours:** Two (2)

Objectives: To ensure that the students are aware of the nature, origin, history and scope of Psychology as a modern discipline and its relationship with other sciences and to have a working knowledge of the application and the practice of psychology in real life.

Course Outline:

- Nature and Application of Psychology with special reference to Pakistan.
- Historical Background and Schools of Psychology (A Brief Survey)

Methods of Psychology:

- Observation
- Case History Method
- Experimental Method
- Survey Method
- Interviewing Techniques

Biological Basis of Behavior:

- Neuron: Structure and Functions
- Central Nervous System and Peripheral Nervous System
- Endocrine Glands

Motivation:

- Definition and Nature
- Classification
    - Primary(Biogenic) Motives: Hunger, Thirst, Defection andUrination, Fatigue, Sleep, Pain, Temperature, Regulation,Maternal Behavior, Sex
    - Secondary (Sociogenic) Motives: Play and Manipulation,Exploration and Curiosity, Affiliation, Achievement and Power,Competition, Cooperation, Social Approval and Self Actualization.

Emotions:

- Definition and Nature
- Physiological changes during Emotions (Neural, Cardial,Visceral, Glandular), Galvanic Skin Response; Pupilliometrics
- Theories of Emotion
    - James Lange Theory; Cannon-Bard Theory
    - Schachter –Singer Theory

Learning:

- Definition of Learning
- Types of Learning

- Classical Conditioning
- Operant Conditioning

- Methods of Learning
  - Trial and Error
  - Learning by Insight
  - Observational Learning

Recommended Books

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

FUNCTIONAL ENGLISH

ENG-301 **Credit Hours:** Three (3)

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

Outcomes:

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

Course Outline:

1. Vocabulary (Frequently confused / misused words,
2. Phrases,
3. synonyms,
4. antonyms,

5. idioms & General vocabulary),
6. Practical Use of Grammar (Nouns, Pronouns, Verbs, Adjectives, Adverbs, Prepositions, Conjunctions, Articles, Interjections & Tenses),
7. Sentences (Types of sentences, Parts of sentences),
8. Direct and Indirect Speech,
9. Active & Passive Voice & Conditional Sentences),

Recommended Books:

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

ISLAMIC STUDIES

ISL-301 **Credit Hours:** Two (2)

Objectives: This course is aimed at:

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

Course Outline: Introduction to Quranic Studies

1) Basic Concepts of Quran

2) History of Quran

3) Uloom-ul -Quran

Study of Selected Text of Holly Quran

1) Verses of Surah Al-Baqra Related to Faith (Verse No-284-286)

2) Verses of Surah Al-Hujrat Related to Adab Al-Nabi

(Verse No-1-18)

3) Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)

4) Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)

5) Verses of Surah Al-Inam Related to Ihram (Verse No-152-154)

Study of Sellected Text of Holly Quran

1) Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6, 21, 40, 56, 57, 58.)

2) Verses of Surah Al-Hashar (18, 19, 20) Related to thinking, Day of Judgment

3) Verses of Surah Al-Saf Related to Tafakar,Tadabar (Verse No-1,14)

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

1) Life of Muhammad Bin Abdullah (Before Prophet Hood)

2) Life of Holy Prophet (S.A.W) in Makkah

3) Important Lessons derived from the life of Holy Prophet in Makkah

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

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

2) Important Events of Life Holy Prophet in Madina

3) Important Lessons derived from the life of Holy Prophet in Madina

Introduction to Sunnah

1) Basic Concepts of Hadith

2) History of Hadith

3) Kinds of Hadith

4) Uloom –ul-Hadith

5) Sunnah & Hadith

6) Legal Position of Sunnah

Selected Study from Text of Hadith

Introduction to Islamic Law & Jurisprudence

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

Islamic Culture & Civilization

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

Islam & Science

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

Islamic Economic System

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

Political System of Islam

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

Islamic History

1) Period of Khlaft-E-Rashida

2) Period of Ummayyads

3) Period of Abbasids

Social System of Islam

1) Basic Concepts of Social System of Islam

2) Elements of Family

3) Ethical Values of Islam

Recommended Books:

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

CIVIC AND COMMUNITY ENGAGEMENT

PSC-301 **Credit Hours:** Two (2)

Objectives:

1. Understand, critically think about, and reflect upon the history of democracy and civic engagement in the Pakistan.
2. Identify and utilize - civic/community engagement skills such as: (advocacy, organizing, communications) and knowledge- (working in groups and teams, leadership, diversity, how systems work)
3. Create civic sense and establish importance of civic and community engagement.

4. Identify and explain the values and ethics for community engagement.
5. Carry out a civic engagement activity incorporating some of their new knowledge and skills of civic engagement and reflect on their learning about the community, the issue addressed, and about themselves.

Course Outline:

Divided into categories for in-depth comprehension-

Category A: General

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

Category B: Pakistan's context

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

Recommended Books:

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

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

DIVERSITY OF PLANTS

Code: BOT-311 **Credit Hrs 3**

Objectives:

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

Course Contents:

- Comparative study of life form, structure, reproduction and economic significance of:
- **Viruses** (RNA and DNA types) with special reference to TMV
- **Bacteria and Cyanobacteria** (*Nostoc, Anabaena, Oscillatoria*) with specific reference to biofertilizers, pathogenicity and industrial importance;
- **Algae** (*Chlamydomonas, Spirogyra, Chara, Vaucheria, Pinnularia, Ectocarpus, Polysiphonia*)
- **Fungi** (*Mucor, Penicillium, Phyllactinia, Ustilago, Puccinia, Agaricus*), their implication on crop production and industrial applications
- **Lichens** (Physcia)
- **Bryophytes**
- *Riccia*
- *Anthoceros*
- *Funaria*
- **Pteridophytes**
- Psilopsida (*Psilotum*)
- Lycopsida (*Selaginella*)
- Sphenopsida (*Equisetum*)
- Pteropsida (*Marsilea*)
- **Gymnosperms**
- *Cycas*
- *Pinus*
- *Ephedra*
- **Angiosperms**
- Monocot (Poaceae)
- Dicot (Solanaceae)

Practical

- 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. Hussain, F. 2012. A Text Book of Botany and Biodiversity. Pak Book Empire.
2. Agrios, G. N. 2004. Plant pathology. 8th Ed. Academic Press London.
3. Mauseth, J. D. 2003. Botany: An Introduction to Plant Biology 3rd Ed., Jones and Bartlett Pub. UK
4. Marti. J. Ingrouille& Plant: Diversity and Evolution. 2006 CUP

ORGANIC CHEMISTRY

CHEM-322 **Credit hours: 3**

` **Aims and Objectives**

The course is aimed to give student

- Knowledge about basic concepts of organic chemistry, chemistry of hydrocarbons and functional groups and the mechanism of organic reactions.
- Information will be useful for qualitative analysis and synthesis of organic compounds.

Course Outline

Bonding and hybridization. Localized and delocalized bonding. Structure aromaticity. Inductive effect, dipole moment, resonance and its rules, Hyperconjugation. Classification and nomenclature of organic compounds including IUPAC system, types of organic reactions (an overview). Saturated, unsaturated and aromatic hydrocarbons with emphasis on synthesis and free radical Electrophilic addition and electrophilic substitution reactions. Chemistry of Functional Groups.

Practical

- Qualitative analysis of compounds with different functional groups.
- Synthesis of organic compounds using as a tool for understanding techniques like reflux, distillation, filtration, recrystallization and yield calculation, organic syntheses may include preparation of benzanilide from benzoyl chloride, succinic anhydride from succinic acid, phthalimide from phthalic anhydride, oximes and hydrazones from carbonyl compounds, and an ester from a carboxylic acid and alcohol etc.

Recommended books

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1. John, E. M. *Organic Chemistry,* 8th ed., Brooks/Cole Publishing Co, USA, (2012).
2. Younus, M., *A Textbook of Organic Chemistry*, Ilmi Kitab Khana, Urdu Bazar, Lahore, Pakistan, (2006).
3. Solomons, T. W. G. and Fryhle, C. B., *Organic Chemistry,* 10th ed., John- Wiley & Sons, Inc., (2011).
4. Pavia, D. L., Kriz, G. S., Lampman, G. M. and Engel, R. G., *A Microscale Approach to Organic Laboratory Techniques,* 5th ed., Brooks/ Cole Cengage Learning, (2013).
5. Mayo, D. W., Pike, R. M. and Forbes, D. C., *Microscale Organic to Laboratory with Multistep and Multisacle Syntheses,* 5th ed., John-Wiley & Sons, Inc., (2011).
6. Gilbert, J. C. and Martin, S. F., *Experimental Organic Chemistry: A Miniscale and Microscale Approach,* 5th ed., Brooks/ Cole Cengage Learning, (2010).
7. Brown, W. H., Fotte, C. S., Iverson, B. L. and Anslyn, E. V., *Organic Chemistry,* 6th ed., Brooks/ Cole Cengage Learning, (2012).

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Semester-II				
CS-301	Application of Information and Communication Technology	3(2+1)	General Education Course	
ENG-402	Expository Writing	03	General Education Course	
ISI-302	History of Islamic Civilization	02	General Education Course	
PSC-302	Ideology and Constitution of Pakistan	02	General Education Course	
MTH-433	Quantitative Reasoning-I	03	General Education Course	
BOT-321	Introduction to Plant Systematics & Anatomy	03	Major Disciplinary Specific	
Semester Credit Hours		**16**		

APPLICATION OF INFORMATION AND COMMUNICATION TECHNOLOGY

CS-301 **Credit Hours:** Three 3 (2+1)

Objectives: To learn the basic and advancements in the field of IT and their applications.

Pre-requisites: None

Course Introduction:

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

CLO No. Course Learning Outcomes Bloom Taxonomy

CLO-1 Understand basics of computing technology C1 (Knowledge)

CLO-2 Do number systems conversions and arithmetic C2(Understand)

CLO-3 Have knowledge of types of software C2(Understand)

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CLO-4 Have knowledge of computing related technologies C3 (Apply)

Course Outline:

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

Reference Materials:

1. Charles S. Parker, Understanding Computers: Today and Tomorrow, Course Technology, 25 Thomson Place, Boston, Massachusetts 02210, USA

2. Livesley, Robert Kenneth. An introduction to automatic digital computers. Cambridge University Press, 2017.

3. Zawacki-Richter, Olaf, and Colin Latchem. "Exploring four decades of research in Computers & Education." Computers & Education 122 (2018): 136-152.

4. Sinha, Pradeep K., and Priti Sinha. Computer fundamentals. BPB publications, 2010.

5. Goel, Anita. Computer fundamentals. Pearson Education India, 2010

EXPOSITORY WRITING

ENG-402 **Credit Hours:** Three (3)

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

Outcomes:

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

Course Outline:

1. Topic sentence
2. Paragraph writing:
3. Essay writing:
4. Introduction and Practice: Essay types: descriptive, narrative, discursive, argumentative.
5. CV and job application
6. Letter and memo writing
7. Minutes of meetings
8. Summary and précis writing
9. Comprehension

Recommended Books:

1. Boutin, M.,& Brinand,S.,& Grellet, F. (1993). Oxford Supplementary Skills. Fourth Impression. Pages 45-53.
2. Nolasco, R. (1992). Oxford Supplementary Skills (3rd ed.). Fourth Impression.

3. Langan, J. (2004). *College Writing Skills*. Mc-Graw-Hill Higher Education.

HISTORY OF ISLAMIC CIVILIZATION

ISL-302 **Credit Hours: Two (2)**

Objectives: **1.** Definition of Islamic Culture & Civilization

2. Analysis of the Rise and Fall of Islamic Culture in various parts of the World

3. A Critical Study of the Effect and benefits of Islamic Civilization on other Cultures

Course Outline:

Introduction to civilization- 1	• Introduction of Civilization • Foundation of Civilization • Elements of Civilization
Important Civilization in the Pre-Islamic Era	• Greek Civilization • Roman Civilization
Important Civilization in the Pre-Islamic Era	• Egypt Civilization • Hindu Civilization
Principles of Islamic Civilization	• Pillars of Culture & Civilization
Foundations of Islamic Civilization in the Era of the Prophet (SAW) and the Caliphates	• Reasons for the evolution of Islamic Civilization in the Era of the Prophet (SAW) • Islamic Civilization in the Era of the Caliphates • • Elements of Islamic Civilization in the era of Caliphates
Islamic Civilization in the era of Banu Ummayads- 1	• Introduction of Banu Ummayads

	• Intellectual development among the Banu Ummayads • Educational Centers for the Banu Ummayads
Islamic Civilization in the era of Banu Ummayads- 2	• Social developments of the Banu Ummayads • Causes of the civilization development of the Banu Ummayads • Results of the civilization development of the Banu Ummayads
Islamic Civilization in the era of Banu Ummayads- 3	• Religious Movements in the era of Ummayads • Internal Disputes in Ummayads era • Reasons for the decline of the Ummayads
Islamic Civilization in the era of Abbasids- 1	• Beginning of Abbasid civilization • Educational movements of the Abbasid period
Islamic Civilization in the era of Abbasids- 2	• Cultural development in the Abbasid period • Social development in the Abbasid period • A Comparative study of the Islamic Culture of Abbasids with other Civilization
Islamic Civilization in the era of Abbasids- 3	• Battles of Crusades • Battlers of Tartarians • The Causes of the Fall of the Abbasids and its Effects on Islamic Civilization
Islamic Civilization in Spain	• Causes of the spread of Islamic civilization in Spain • Manifestations of Islamic civilization in Spain

	• Influence of Islamic civilization in Spain on European civilization
Islamic Culture and Civilization in the Sub-Continent	• Islamic civilization achievements in the Sub-Continent • Reasons for the spread of Islamic cultural in Sub-Content

Recommended Books

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

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

IDEOLOGY AND CONSTITUTION OF PAKISTAN

PSC-302 **Credit Hours: Two (2)**

Objectives:

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

Course Outline:

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

Section A: Ideological understanding and development of Pakistan

1. Basis of Ideology of Pakistan and Two Nations Theory
2. Ideology of Pakistan: Vision of Quaide e Azam and Allama Iqbal

3. Role of ideology in building national character
4. Democratic system of Pakistan (Issues)
5. Major causes of the Imposition of martial Law (1958, 1969, 1977&1999).

Section B: Constitutional Development of Pakistan

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

Recommended Books:

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

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

QUANTITATIVE REASONING I

MTH-433 **Credit Hours:** Three (3)

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

Course Outline:

1. Different types of standard numbers and their operations.

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

Recommended Books:

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

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

INTRODUCTION TO PLANT SYSTEMATICS & ANATOMY

BOT-321 **Credit Hours: 3**

Aims & Objectives:

To understand:

- Various systems of classification, identification and nomenclature of Angiosperms.
- Structures and functions of tissues and organs of different plants and trees.

Course outline

Physiology:

1. Introduction to Plant Systematics: aims, objectives and importance.
2. Classification: brief history of various systems of classification with emphasis on Takhtajan.

3. Brief introduction to nomenclature, importance of Latin names and binomial system with an introduction to International Code of Botanical Nomenclature (ICBN).Vienna code.
4. Morphology: a detailed account of various 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. Brassicaceae (Cruciferae)
iii. Fabaceae (Leguminosae)
iv. Rosaceae
v. Euphorbiaceae
vi. Cucurbitaceae
vii. Lamiaceae (Labiatae)
viii. Apiaceae (Umbelliferae)
ix. Asteraceae (Compositae)
x. Liliaceae (Sen. Lato)

Anatomy

- Cell wall: structure and chemical composition
- Concept, structure and function of various tissues like:
  i. Parenchyma
  ii. Collenchyma
  iii. Sclerenchyma
  iv. Phloem
  v. Epidermis (including stomata and trichomes)
  vi. Xylem
- Meristem: types, stem and root apices
- Vascular cambium
- Structure and development of root, stem and leaf. Primary and secondary growth of dicot stem, periderm
- Characteristics of wood: diffuse porous and ring porous, sap and heart wood, soft and hard wood, annual rings.

Practicals:

Physiology:

- Identification of families given in syllabus with the help of keys.
- Technical description of common flowering plants belonging to families mentioned in theory
- Field trips shall be undertaken to study and collect local plants.

- Students shall submit 40 fully identified herbarium specimens.

Anatomy:

- Study of stomata and epidermis
- Study of xylem 3-dimensional plane of wood
- Anatomy of germinating seeds

Recommended books

- Pullaiah, T. 2007. Taxonomy of Angiosperms. 3rd
- Edition,Regency Publications, New Delhi.
- Naik, V. N. 2005 Taxonomy of Angiosperms. 20th Reprint. TataMacGraw-Hill Publishing Company, Limited New Delhi.
- Rajput, M. T., S. S. Hassney and K. M. Khan. 1996. Plant Taxonomy. New Trends Computer Service, Hyderabad, Sindh, Pakistan.
- Panday, B.P. 2004. A textbook of Botany (Angiosperms). S. Chand and Co.New Delhi.
- Raymond E, S. E. Eichhorn. 2005. Esau's Plant Anatomy. Meristems cells and tissues of the plant body, 3rd Ed.
- John Wiley & Sons. Inc.
- Fahn, A. 1990. Plant Anatomy. Pergamon Press, Oxford.
- Esau, K. 1960. Anatomy of Seed Plants. John Wiley, New York

WOMEN UNIVERSITY MARDAN

Semester-III				
MTH-444	Quantitative Reasoning-II	03	General Education Course	
BIOT-321	Introduction to Biotechnology	03	Interdisciplinary	
BOT-441	Principles of Biological Sciences (NS-I)	03 (2+1)	General Education Course	
BOT-442	Cell Biology, Genetics & Evolution	03 (2+1)	Major Disciplinary Specific	
ZOO-432	Animal Diversity-I	03 (2+1)	Interdisciplinary	
Semester Credit Hours		**15**		

QUANTITATIVE REASONING-II

MTH-444 **Credit Hours:** Three (3)

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

Course Outline:

1. Investigating relationships between variables
2. Exploring tools to find relationship between variables
3. Population and samples,
4. Exploring and summarizing data
5. Finding a representative value in a data
6. Measure and spread of a data,measuring degree of relationship among variables
7. Measure of central tendency, dispersion, data interpretation
8. Basic probability theory
9. Basics of estimation and confidence interval
10. Testing hypothesis
11. Statistical inferences in decision making
12. Survey sampling

Recommended Books:

1. Heumann, Christian, and Schomaker, Michael. Introduction to Statistics and Data Analysis: With Exercises, Solutions and Applications in R. Switzerland, Springer International Publishing, 2023.
2. James, Gareth, et al. An Introduction to Statistical Learning: With Applications in R. Germany, Springer New York, 2013.

3. Reid, Howard M.. Introduction to Statistics: Fundamental Concepts and Procedures of Data Analysis. United States, SAGE Publications, 2013.

INTRODUCTION TO BIOTECHNOLOGY

BIOT- 321 **Credit hours: (3+0)**

Course Objectives:

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

Course Contents:

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

Recommended Books:

- 1. Daugherty E, 2012. Biotechnology: Science for the New Millennium. 1st Edition, Revised;
- Paradigm Publication.
- 2. Smith JE, 2009. Biotechnology. 5th Edition; Cambridge University Press.
- 3. Nicholl TSD, 2004. An Introduction to Genetic Engineering. 2nd Edition; Cambridge
- University Press, UK.
- 4. Purohit SS, 2005. Biotechnology Fundamentals & Application. 4th Edition; Agro Bios, India.
- 5. Ratlegde C and Kristiansen B, 2006. Basic Biotechnology. 2nd Edition; Cambridge University
- Press, UK.

PRINCIPLES OF BIOLOGICAL SCIENCES (Natural Sciences)

BOT-441 **Credit Hours: 03 (2+1)**

Objectives:

The aims of the teaching and study of sciences are to encourage and enable students to: develop inquiring minds and curiosity about science and the natural world.

Course Outline

I. **Biological Sciences**

The Basis of Life: Cell Structures and Functions (Sub-cellular Organelles such as Nucleus, Mitochondria and Ribosomes).

Biomolecules: - Proteins, Lipids, Carbohydrates and Enzymes.

Common diseases and Epidemics: Polio, Diarrhoea, Malaria, Hepatitis, Dengue their Causes and Prevention.

II. **Environmental Science**

Environment and Pollution: The Atmosphere (Layered Structure and Composition), Hydrosphere (Water Cycle, Major Water Compartments), Biosphere (Major Biomes) and Lithosphere (Minerals and Rocks, Rock Types, Plate Tectonics).

III. **Food Science**

Concept of Balance Diet: Vitamins, Carbohydrates, Protein, Fats and oil, Minerals, Fiber.

Quality of Food: Bioavailability of Nutrients, Appearance, Texture, Flavor, Quality of Packed and Frozen Food, Food Additives, Preservatives and Antioxidants

Food Deterioration and its control: Causes of Food Deterioration, Adulteration, Food, Preservation.

Recommended Books:

- Exploring Life Science 1975 Walter A. Thurber, Robert E. Kilburn, Peter S. Howell
- Principles of Animal Biology 2011 Lancelot Hogben.
- Forensic Science Fundamentals & Investigation 2008 Anthony J. Bertino.
- Basics of Environmental Science 2002 Michael Allaby.
- Food Science 1998 Norman N. Potter, Joseph H. Hotchkiss.
- Environmental Science: Systems and Solutions. 5th ed. 2013 Michael L. McKinney, Robert Schoch and Logan Yonavjak.
- Environmental Science: A Global Concern 2012. William P. Cunningham, Barbara Woodworth Saigo.

CELL BIOLOGY, GENETICS & EVOLUTION

Code: BOT-442 **Credit hrs: 3 (2+1)**

Objectives:

- To learn about the cell and its organization of architecture and the unified role it plays for the ultimate sustainability of the organisms.
- To learn the various ultra-structural, molecular and functional aspects of the cells.

Course Content:

- Introduction to cell biology
- Different Prokaryotes and eukaryotes
- Physio-chemical properties of protoplasm
- Ultra structure, chemical composition and function:
- Cell wall,
- Cell membrane,
- Cell organelles,
- Cytoskeleton.
- Chemical composition and molecular structure of chromosomes
- Cell cycle
- Cell reproduction and chromosomal aberration
- Genetic engineering
- Animal cloning
- Extensions of Mendelian Analysis:Variations on dominance, multiple alleles, lethal alleles, several genes affecting the same character, penetrance and expressivity.
- 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,
- Linkage II: Special Eukaryotic Chromosome Mapping Techniques: Accurate calculation of large map distances, analysis of single meioses, mitotic segregation and recombination, mapping human chromosomes.
- 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.
- The Structure of DNA: DNA: The genetic material, DNA replica tion in eukaryotes, DNA and the gene.
- The Nature of the Gene: How genes work, gene-protein relationships, genetic observations explained by enzyme structure, genetic fine structure, mutational sites, complementation.
- DNA Function: Transcription, translation, the genetic code, protein synthesis, universitality of genetic information transfer, eukaryotic RNA.
- The ExtranuclearGenome : Variegation in leaves of higher plants, cytoplasmic inheritance in fungi, extranuclear genes in chlamydomonas, mitochrondrial genes in yeast, extragenomic plasmids in eukaryotes.
- Developmental Genetics: Gene Regulation and Differentiation, Crown gall disease in plants, cancer as a developmental genetic disease.
- Population Genetics: Gene frequencies, conservation of gene frequencies, equilibrium, Hardy-Weinberg law, factors affecting gene equilibrium.

c) Evolution

The nature of evolutionary forces, adaptive radiations, differential reproductive potential, first plant cell, origin of organized structures, early aquatic and terrestrial ecosystem, first vascular plant.

Practical

- Study different types of prokaryotic and eukaryotic cell
- Study of different cell organelles
- Identification of DNA
- Study of chromosome morphology
- Study of variation in chromosome number

Recommended books

1. Stephen R. Bolsover, Elizabeth A. Shephard, Hugh A. White, Jeremy S. Hyams. (2011) Cell Biology: A Short Course, 3rd ed.
2. S. C. Rastogi. (2012) Cell Biology 3rd ed.
3. Lodish, H., (2011). Solutions Manual for Molecular Cell Biology.7th Edition. W.H. Freeman & Company
4. Lodish, H., Berk, A., Kaiser, C. A., M Krieger; Bretscher, A., Ploegh,H; Amon,A., Scott, M., 2012. Molecular Cell Biology.7th Edition. W. H. Freeman Company.
5. James, D. W. 2013. Molecular Biology of Gene Benjamin Cumming.
6. MahmutCaliskan. 2012. The Molecular basis of plant genetic diversity. In TechPublishers.
7. Ram J. Singh. 2011. Genetic resources, chromosome engineering and crop improvement. Medicinal plants. Vol. 6. CRC Press.
8. William S. Klug, Michael R. Cummings, Charlotte A. Spencer, Michael A.Palladino. 2011. Concepts of genetics. Pearson Educations.

ANIMAL DIVERSITY I

ZOO-432 **Credit Hours: 3(2+1)**

Aims and Objectives

- To learn about the modifications and evolution of different groups of animals.
- To learn about the characteristics of animals of different groups of animals.
- To understand how different processes occur in different animals and about its economic importance.

Course outline

WOMEN UNIVERSITY MARDAN

- **Introduction to biodiversity of animals**
- History
- Evolution introduction
- **Classification of living organisms**
- Two kingdom system
- Five kingdom system
- Eight kingdom system
- **Classification of animals**
- Different classes of animals
- Vertebrates and invertebrates
- Phylums introduction
- **Phylum Protozoa**
- General characteristics
- Morphology
- Reproduction
- Encystment
- Economic importance
- **Phylum Poriffra**
- Introduction
- General characteristics
- Processes
- Economic Importance
- **Phylum Coelenterata**
- Introduction
- General characteristics
- Processes
- Economic Importance

- **Phylum Platyhelminthes**
- Introduction
- General characteristics
- Processes
- Economic Importance
- **Phylum Aschelmlinthes**
- Introduction
- General characteristics

- Processes
- Economic Importance

➢ **Phylum Annelida**

- Introduction
- General characteristics
- Processes
- Economic Importance

➢ **Phylum Molluscs**

- Introduction
- General characteristics
- Processes
- Economic Importance

➢ **Phylum Arthropoda**

- Introduction
- General characteristics
- Processes
- Economic Importance

➢ **Phylum Echinodermata**

- Introduction
- General characteristics
- Processes
- Economic Importance

➢ **Phylum Chordata**

- Introduction
- General characteristics
- Processes
- Economic Importance

➢ **Class Pieces**

- Introduction
- General characteristics
- Examples

➢ **Class Amphibia**

- Introduction
- General characteristics
- Economic Importance

➢ **Class Reptilia**

WOMEN UNIVERSITY MARDAN

- Introduction
- General characteristics
- Examples

➢ **Class Aves**

- Introduction
- General characteristics
- Examples

➢ **Class Mammalia**

- Introduction
- General characteristics
- Examples

Practical

- Study morphology of animals
- Study diagnostic features of some major groups of animals
- Identification of various types of animals from slides
- Collection of specimens of animals and their identification

Recommended Books

1. McGRAW. HILL. (2014).Animal Diversity 7thed.
2. Anne Elizabeth Maczulak. (2010). Biodiversity: Conserving Endangered Species
3. Gbolagade Akeem Lameed. (2012)Biodiversity Enrichment in a Diverse World.

WOMEN UNIVERSITY MARDAN

Semester-IV				
CHEM-311	Inorganic Chemistry	03 (2+1)	Interdisciplinary	
ZOO-443	Animal Diversity-II	03 (2+1)	Interdisciplinary	
BOT-441	Biochemistry	03 (2+1)	Major Disciplinary Specific	
BOT-442	Biodiversity and Conservation	03 (2+1)	Major Disciplinary Specific	
BOT-443	Bioinformatics	03	Major Disciplinary Specific	
Semester Credit Hours		**15**		

INORGANIC CHEMISTRY

CHEM-311 **Credit Hours 3(2+1)**

Aims and Objectives

The course is designed to enable the students

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

Course outline

Chemical Bonding **(**Types of chemical bonding, ionic and covalent bonding, localized bond approach**,** Theories of chemical bonding, valence bond theory (VBT),Hybridization and resonance, Prediction of molecular shapes using Valence Shell Electron Pair Repulsion (VSEPR) model,Molecular orbital theory (MOT) applied to diatomic molecules, delocalized approach to bonding,Bonding in electron deficient compounds,Hydrogen bonding.)

Acids and Bases (Brief concepts of chemical equilibrium , Soft and hard acids and bases (SHAB), Concept of relative strength of acids and bases, Significance of pH, pKa, pKb and buffer solutions.

Theory of indicators, Solubility and solubility product, Common ion effect and its industrial applications.)

P-Block Elements (Physical and chemical properties of p-block elements with emphasis on some representative compounds, Inter-halogens, Pseudo-halogens and polyhalides.)

Practical

- Lab safety and good laboratory practices, knowledge about material safety data sheets (MSD).
- Disposal of chemical waste and first-aid practices.
- Qualitative analysis of salt mixtures.
- Quantitative analysis.
- Acid- base titrations.
- Preparation and standardization of acid and alkali solutions
- Redox titrations.
- Preparation and standardization of potassium permanganate solution and its
- Use for the determination of purity of commercial potassium oxalate or oxalic acid.
- Preparation and standardization of sodium thiosulfate solution and its use in determination of copper in a given sample.
- Gravimetric analysis.
- Determination of barium in a given sample, determination of chloride in a given solution.

Recommended Books

1. Cotton, F. A. and Wilkinson, G., *Advanced Inorganic Chemistry*, 6th ed., John-Wiley & Sons, New York, (2007).
2. Huheey, J. E., *Inorganic Chemistry: Principles of Structure and Reactivity,* 3rd ed., Harper International SI Edition, (2006).
3. House, J. E., *Inorganic Chemistry,* Academic Press. USA, (2008).
4. Chaudhary S. U., *Ilmi Textbook of Inorganic Chemistry,* IlmiKitabKhana, Lahore, (2013).
5. Catherine E. House crdft, Alan G. Sharpe, *Inorganic Chemistry,* 3rd ed., Prentice Hall, (2008).

ANIMAL DIVERSITY II

ZOO-443 **Credit Hours: 3(2+1)**

Aims and Objectives

The course aims to:

- Provide understanding about taxonomic characteristics and classification of each phylum
- Develop concepts of evolutionary relationship of animal kingdom

- Provide knowledge and understanding about the different animal groups with special emphasis on their phylogenetic relationships

Course Outline

- **Protochrodates**
  Structure, anatomy and organ systems; reproduction; life histories and metamorphosis; phylogenetic relationships; further phylogenetic considerations.
- **Fishes**
  Vertebrate Success in Water: phylogenetic relationships; Agnatha and Gnathostomata: locomotory adaptations, nutrition and the digestive system, circulation, gas exchange, nervous and sensory functions, excretion and osmoregulation, reproduction and development; further phylogenetic considerations.
- **Amphibians**
  The first terrestrial vertebrates: phylogenetic relationships; Caudata, Gymnophiona, and Anura;Structure and locomotory adaptations, nutrition and the digestive system, circulation, gas exchange, temperature regulation, nervous and sensory functions, excretion and osmoregulation, reproduction, development, and metamorphosis; further phylogenetic considerations.
- **Reptiles**
  The First Amniotes: cladistic interpretation of the amniotic lineage; Testudines or Chelonia, Rhynchocephalia, Squamata, and Crocodilia; adaptations in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, and temperature regulation, nervous and sensory functions, excretion and osmoregulation, reproduction and development; further phylogenetic considerations.
- **Birds**
  Feathers, flight and endothermy: phylogenetic relationships; ancient birds and the evolution of flight; diversity of modern birds; adaptation in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, and regulation, nervous and sensory systems, excretion and osmoregulation, reproduction and development; migration and navigation.
- **Mammals**
  Specialized teeth, endothermy, hair and viviparity; diversity of mammals; adaptations in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, and temperature regulation, nervous and sensory functions, excretion and osmoregulation, behavior, reproduction and development.

Practical

Museum study of:

- Protochordates
- Pisces
- Amphibia

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

Recommended books:

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

BIOCHEMISTRY

BOT-441 **Credit Hours 3(2+1)**

Aims & Objectives:

- To help the students to understand the essentials of biomolecules in human life.
- To understand the principles of biochemistry.
- To understand the function and deficiency disorders related to biomolecules.

Course Outline:

- Introduction to biochemistry (Biomolecules)
- Carbohydrates (General characteristics, Classification)
- Lipids (General characteristics, Classification)
- Amino Acids (General characteristics, Classification)
- Proteins (General characteristics, Structure, Properties and Denaturation)
- Nucleic Acids (Introduction, Components of Nucleic acid)
- Nomenclature of nucleotides (Structure of DNA and RNA)

- Enzymes (Introduction, Classification, Importance)
- Vitamins (Nomenclature, Classification, Importance)
- Alkaloids (Classification, Properties, Importance)
- Terpenoids (Structure and Function)

Lab Outline:

- Identification of Proteins
- Identification of Carbohydrates
- Identification of Nucleic acids
- Identification of Lipids
- Identification of Enzymes
- Identification of Alkaloids
- Identification of Vitamins

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.

BIODIVERSITY & CONSERVATION

BOT-442 **Credit Hours 3**(2+1)

WOMEN UNIVERSITY MARDAN

Course Objectives:

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

Course outline:

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

Lab outline:

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

Recommended Books:

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

BIOINFORMATICS

WOMEN UNIVERSITY MARDAN

BOT-443 **Credit Hours 3**

Aims & Objectives:

To familiarize students with biological data mining from online databases and the use of various bioinformatics tools for extracting and processing biological data.

Course Outline:

Introduction; bio-computing; biological databases - types and retrieval of nucleic acid (or genomic) or protein sequence information; sequence alignment - pairwise, multiple; phylogenetics; *in silico* identification of protein motifs and domains; structural bioinformatics of proteins and RNAs including protein modeling and prediction of their interactions with other proteins and small molecules; identification of genes and promoter regions within genomes; networks; strategies for whole genome sequencing and assembly.

Recommended Databases and Tools:

1. NCBI, PDB, EcoCyc, DDBJ, SWISS-PROT, TIGR, KEGG etc.
2. Bioedit, Repeatmasker, PHRED, PHRAP, BLAST, Prosite/BLOCKS/PFAM, CLUSTALW, Emotif, RasMol, Oligo, Primer3, Molscript, Treeview, Alscript, Genetic Analysis Software, Phylip, MEGA4.0 etc.

Recommended Books:

1. Claverie JM and Notredame C, 2006. Bioinformatics for Dummies. 2nd Edition; Wiley Publishing.
2. Xiong J, 2006. Essential Bioinformatics. 1st Edition; Cambridge University Press.
3. Xia X, 2007. Bioinformatics and the Cell: Modern Computational Approaches in Genomics, Proteomics and Transcriptomics. 1st Edition. Springer
4. Mathura V and Kangueane P, 2009. Bioinformatics: A Concept-Based Introduction. Springer
5. Mount DW, 2004. Bioinformatics Sequence and Genome Analysis. 2nd Edition; Cold Spring Harbor Laboratory Press.
6. Sperschneider V, 2008. Bioinformatics: Problem Solving Paradigms. Springer

WOMEN UNIVERSITY MARDAN

Semester-V				
BOT-551	Bacteriology and Virology	03	Major Disciplinary Specific	
BOT-552	Phycology	03	Major Disciplinary Specific	
BOT-553	Mycology	03	Major Disciplinary Specific	
BOT-554	Non-Flowering Vascular Plants and Palynology	03	Major Disciplinary Specific	
BOT-555	Taxonomy of Angiosperms	03	Major Disciplinary Specific	
Semester Credit Hours		**15**		

BACTERIOLOGY & VIROLOGY

BOT-551 **Credit Hours: 3**

Aims and Objectives:

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

Course Outline:

Bacteriology:

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

Virology:

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

Practical:

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

Recommended Books

1. Tortora, G.J: Funke, B.R. and Case C.L., 2004, Microbiology. Pearson
2. Education.
3. Molecular Plant-Microbe Interactions, Kamal Bouarab, Normand Brisson, FouadDaayf (eds), 2009 MPG Books Group, Bodmin, UK.
4. Plant-Microbe Interactions Gary Stacey, Noel T. Keen (Eds) 2011, springer London.

PHYCOLOGY

BOT-552 **Credit Hours: 3**

Aims and Objectives:

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

Course Contents:

- Introduction

- General account
- Evolution
- Classification
- Biochemistry
- Ecology and
- Economic importance of the following divisions of algae:
- Chlorophyta,
- Charophyta,
- Xanthophyta,
- Bacillariophyta,
- Phaeophyta and
- Rhodophyta.

Practical:

- Collection of fresh water and marine algae
- Identification of benthic and planktonic algae
- Section cutting of thalloid algae
- Preparation of temporary slides
- Use of camera lucida/micrographs.

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. Barsanti, L. and P. G. Gualtieri. 2006. Algae, anatomy, biochemistry, biotechnology. Taylor and Francis, New York.
4. Vashishta, B. R., A. K. Sinha and A. Kumar. 2010. Algae. S. Chand & Co. Bellinger, E. G. and D. C. Sigee. 2010. Fresh water algae (Identification and use as bioindicators). John Wiley & Sons
5. Hussain, F. 2013. Phycology. A text book of Algae. Pak Book
6. Empire Lahore.

MYCOLOGY

BOT-553 **Credit Hours: 3**

Aims and Objectives:

- Learn the characteristics of fungi for classification.
- Examine fungal metabolism.
- Learn about pathogenic fungi and their infections in plant and animals

Course Outline:

- Introduction:General characters of fungi, Thallus, cell structure and ultrastructure of fungi.
- Reproduction: Asexual and sexual reproduction and reproduction structures, life cycle, haploid, heterokaryotic and diploid states.
- Fungal Systematics: Classification of fungi into phyla with suitable examples to illustrate somatic structures, life cycle and reproduction of
- Myxomycota,
- Chytridiomycota,
- Zygomycota (Mucrales),
- Oomycota
- (Peronosporales),
- Ascomycota (Erysiphales, Pezizales),
- Basidiomycota (Agaricales, Polyporales, Uredinales, Ustilaginales) and
- Deuteromycetes.
- Symbiotic relationships of fungi with other organisms (lichens and mycorrhiza) and their significance.
- Importance of fungi in human affairs with special reference to Industry and Agriculture

Practical:

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

Recommended Books:

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

2. Khan, A. G. and Usman, R., 2005. Laboratory Manual in Mycology and Plant Pathology. Botany Department Arid Agriculture University, Rawalpindi.
3. Mehrotra, R.S. and Aneja, K.R., 1990. An Introduction to Mycology. Wiley and Eastern Ltd., New Delhi, India.
4. Moore-Landecker, E., 1996. Fundamentals of Fungi. 4thEdn. Prentice Hall Inc., New Jersey, USA.

Non- Flowering Vascular Plants and Palynology

BOT-554 **Credit Hours: 3**

Aims and Objectives:

- 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) 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.

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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.

Recommended Books:

1. Beck, C.B. 1992. Origin and Evolution of Gymnosperms. Vol-1andII, 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.

TAXONOMY OF ANGIOSPERMS

BOT-555 **Credit Hours: 3(2-1)**

Aims and Objectives:

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

Course Outline:

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1. **Introduction**

Importance and relationship with other sciences, Phases of plant taxonomy. Origin and radiation of angiosperm, their probable ancestors, when, where and how did the angiosperms evolve; the earliest fossil records of angiosperms.

2. **Concept of Species**

What is a species? Taxonomic species, Biological species, Micro and macro species, Species aggregate, Infra specific categories.

3. **Speciation**

Mechanism of speciation, Mutation and hybridization Geographical isolation, Reproductive isolation, Gradual and abrupt.

4. **Variation**

Types of variation, Continuous and discontinuous variation, Clinal variation.

5. **Systematics and Genecology / Biosystematics**

Introduction and importance, Methodology of conducting biosystematics studies, Various

biosystematics categories such as ecophene, ecotype, ecospecies, coenospecies and comparium.

6. **Taxonomic Evidence**

Importance and types of taxonomic evidences: anatomical, cytological, chemical, molecular,

palynological, geographical and embryological.

7. **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.

8. **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, Bessey, Cronquist and Dahlgren.

9. **Numerical taxonomy**

A brief introduction of Numerical taxonomy.

10. **Study of representative families**

General characteristics, distribution pattern, evolutionary trends, phyletic relationships and
economic importance of the following families of angiosperm:
i. Apiaceae ix. Lamiaceae
ii. Solanaceae x. Caryophyllaceae
iii. Convolvolaceae xi. Cucurbitaceae
iv. Boraginaceae xii. Poaceae
v. Brassicaceae xiii. Cyperaceae
vi. Rosaceae xiv. Juncaceae
vii. Scrophulariaceae xv. Arecaceae (palmae)
viii. Asteraceae xvi. Orchidaceae

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. and 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. and Heywood, V.H. 1963. Principles of Angiosperm Taxonomy. Oliver and
Boyd, London
5. Ingrouille, M. 1992. Diversity and Evolution of Land Plants, Chapman and Hall. London
6. Nasir, E. and 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.

WOMEN UNIVERSITY MARDAN

Semester-VI				
BOT-561	Plant Ecology-I	03	Major Disciplinary Specific	
BOT-562	Genetics-I	03	Major Disciplinary Specific	
BOT-563	Molecular Biology	03	Major Disciplinary Specific	
BOT-564	Plant Physiology-I	03	Major Disciplinary Specific	
BOT-565	Plant Anatomy and Embryology	03	Major Disciplinary Specific	
Semester Credit Hours		**15**		

PLANT ECOLOGY-I

BOT-561 **Credit Hours: 3**

Course Objectives:
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 soil-plant-atmosphere continuum. 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 CO_2-assimilation rates of plants in contrasting environments. Ecophysiological effects of changing atmospheric CO_2 concentration. Functional significance of different pathways of CO_2 fixation. Productivity: response of photosynthesis to environmental factors, C and N balance

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**

Wind as an ecological factor.

8. **Fire**

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 CO_2 and O_2 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 CO_2 exchange in plants in relation to various environmental conditions.

Recommended Books:

1. Schultz, J. C. 2005. Plant Ecology, Springer-Verlag
2. Bazzaz, F.A. 2004. Plants in Changing Environments: Linking Physiological, Population, and Community Ecology, Cambridge University Press
3. Chapin, F.S. et al. 2002. Principle of Terrestrial Plant Ecology, Springer-Verlag
4. Lambers, H. et al. 2002. Plant Physiological Ecology, Springer-Verlag
5. Larcher, W. 2003., Physiological Plant Ecology: Ecophysiology and Stress Physiology of Function Groups - Springer-Verlag
6. Nobel, P.S 1999, Physico-chemical and Environmental Plant Physiology,.Academic Press.
7. Lambers, H., T. L. Pons and F. Stuart. 2008. Plant Phyiological Ecology.
8. Smith, R. L. 2004. Ecology and field Biology. Addision Wesley Longman, Inc., New York.
9. Barbour, M.G., Burke, J.H and Pitts, W.D. 2004 Terrestrial Plant Ecology, The Benjamin, Cumming Publishing C. Palo Alto, California, USA.

10. Smith R.L. 1998 Elements of Ecology. Harper and Row Publishing.
11. Townsend. C.R. Begon. M and J.L Harper. 2002 Essentials of ecology. Blackwell Publishing.
12. Gurevitch. J. Scheiner, S.M. and G.A Fox. 2006 The Ecology of Plants\. Sinaur Asssoicate Inc.
13. Hussain. F. 1989 Field and Laboratory Manual of Plant Ecology, National Academy of Higher Education, Islamabad.
14. Hussain. S.S. 1989 Pakistan Manual of Plant Ecology. National Book Foundation Islamabad.
15. More. P.D. and Chapman S.B. 1986 Methods in Plant Ecology, Blackwell Scientific Publication Oxford.

Genetics-I

BOT-562 **Credit Hours: 3**

Course Objectives:
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**

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, Eukaryotic Chromosome Mapping Techniques, Calculation of large map distances, segregation and recombination.

3. **Gene Mutation**

Somatic versus germinal mutation, mutant types, the occurrence of mutations, mutation and cancer, mutagens in genetic disorder, mutation breeding. Evolutionary significance of mutation.

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 Structure of DNA**

DNA as genetic material, DNA replication in eukaryotes, DNA and the gene.

6. **The Nature of the Gene**

How genes work, gene-protein relationships, gene fine structure, mutational sites, complementation.

7. **DNA Function**

Transcription, translation, the genetic code, protein synthesis, universitality of genetic information transfer, eukaryotic RNA.

8. **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.

9. **Developmental Genetics**

Gene Regulation and Differentiation, Crown gall disease in plants, cancer as a developmental genetic disease.

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

MOLECULAR BIOLOGY

BOT-563 **Credit Hours: 3**

Course Objectives:
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

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.

Lab Outline:

Following techniques will be used for the i\solation 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 and 2. Oxford University Press, UK.
4. Lodish, H. et al., 2004. Molecular Cell Biology. 5th Edition. W.H. Freeman and 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. Mc|Graw Hill, St. Louis.

PLANT PHYSIOLOGY-I

BOT-564 **Credit Hours: 3**

Course Objectives:

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. CO_2 reduction (dark reactions) - C_3 pathway and Photorespiration, Regulation of C_3 pathway, C_4 pathway and its different forms, C_3-C_4 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. **Assimilation of Nitrogen, Sulphur and Phosphorus**
   The nitrogen cycle. Nitrogen fixation. Pathways of assimilation of nitrate and ammonium ions. Assimilation of sulphur and phosphorus.

5. **Dormancy**
   Definition and causes of seed dormancy; methods of breaking seed dormancy; types and physiological process during seed germination.

6. **Plant Movements**: Tropic movement- phototropism, gravitropism and their mechanisms. Nastic movements.

Lab Outline:

1. To determine the volume of CO_2 evolved during respiration by plant material.
2. To determine the amount of O_2 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 C_3 and C_4 plants through their anatomical and physiological characters.
6. Determination of uptake of water by seeds when placed in sodium chloride solution of different concentrations.
7. Extraction of amylase from germinating wheat seeds and study of its effect on starch breakdown.

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.

PLANT ANATOMY AND EMBRYOLOGY

BOT-565 **Credit Hours: 3**

Course Objectives: To provide the students understanding about anatomical features of mature and embryonic organs vascular plants their development.

Course outline:

Plant Anatomy

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: Flower, Seed and Fruit
9. Anatomical adaptations

Embryology

Early development of plant body: *Capsella bursa-pastoris*

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

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.
5. Study of pollen grains and placenta

Recommended Books:

1. Cutler, D.F. 1969. Anatomy of the Monocotyledons. IV. Juncales. Clarendon Press, Oxford. 2. Cutler, D.F. 1978. Applied Plant Anatomy. Longman Group Ltd. England

3. Dickison, W.C. 2000. Integrative plant anatomy. Academic Press, U.K.
4. Eames A.J. and L.H Mac Daniels. 2002. An Introduction to Plant Anatomy. Tata-Mac GrawHill Publishing Company, Limited New Delhi.
5. Esau, K. 1960. Anatomy of Seed Plants. John Wiley, New York.
6. Fahn, A. 1990. Plant Anatomy. Pergamon Press, Oxford.
7. Maheshwari, P.1971. Embryology of Angiosperms, McGraw Hill.New York.
8. Metcalf, C.R. and Chalk, L. 1950. Anatomy of the Dicotyledons. Clerondon Press. Oxford.
9. Metcalfe, C.R. 1960. Anatomy of the Monocotyledons. Gramineae. Clerondon Press, Oxford.
10. Metcalfe, C.R. 1971. Anatomy of the Monocotyledons.V. Cyperaceae. Clerondon Press, Oxford.
11. Moore, R.C., W.D. Clarke and Vodopich, D.S. 1998. Botany. McGraw Hill Company, U.S.A.
12. Naik, V.N. 2005 Taxonomy of Angiosperms. 20th Reprint. Tata-Mac Graw-Hill Publishing Company, Limited New Delhi.
13. Pullaiah, T. 2007. Taxonomy of Angiosperms. 3rd Edition Regency Publications, New Delhi.
14. Raven, P.H., Evert, R.E. and Eichhorn, S.E. 1999. Biology of Plants. W.H. Freeman and Company Worth Publishers.
15. Raymond, E.S. and E. Eichhorn. 2005. Esau's Plant Anatomy; Meristematic cells and tissues of plant body. John Willey Sons.

16. Vaughan, J.G. 1990. The structure and Utilization of Oil Seeds. Chapman and Hall Ltd. London.

Semester-VII				
BOT-671	Plant Ecology-II	03	Major Disciplinary Specific	
BOT-672	Plant Biochemistry	03	Major Disciplinary Specific	
BOT-673	Research Methodology	03	Major Disciplinary Specific	
BOT-674	Plant Pathology	03	Major Disciplinary Specific	
BOT-679	Field Experience	03	Internship	
Semester Credit Hours		**15**		

PLANT ECOLOGY-II

BOT-671 **Credit Hours: 3**

Course Objectives:
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. Schultz J.C. 2005. Plant Ecology, Springer-Verlag .
2. Townsend C.R. Begon. M and J.L. Harper 2002. Essentials of Ecology, Blackwell Publishing,
3. Chapin, F.S. et al. 2002. Principle of Terrestrial Plant Ecology, Springer-Verlag 4. Gurevitch, et al., 2002.The Ecology of Plants, Sinauer Associates, Inc.
5. Barbour M. G. et al., 1999, Terrestrial Plant Ecology, The Benjamin-Cumming Publishing Co.
6. Smith, R. L. 1998. Elements of Ecology by Harper and Row Publishers,
7. Moore P.D. and Chapman S. B. 1986. Methods in Plant Ecology, Blackwell Scientific Publication, Oxford.
8. Hussain, S. Pakistan Manual of Plant Ecology,
9. Hussain, F. 1989. Field and Laboratory Manual of Plant Ecology, National Academy of Higher Education. Islamabad
10. Lambers, H., T. L. Pons and F. Stuart. 2008. Plant Phyiological Ecology.
11. Larcher. W. 2003 Physiological Plant Ecology. Ecophysiology and Stress Physiology of Function Groups. Springer- Verlag.

PLANT BIOCHEMISTRY

BOT-672 **Credit hours: 3**

Course Objectives:
To elucidate the structure and role of primary metabolites in plants.

Course Outline:
Nucleic Acids

General introduction. Purine and pyrimidine bases, nucleosides, nucleotides. Structure and properties of DNA and RNA. Types and functions of RNA. Chemical synthesis of oligonucleotides and DNA sequencing.

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.

Carbohydrates
Occurrence and classification. A general account of ribose, deoxyribose, xylulose, xylose, Dglucose, D-galactose, D-mannose, cellobiose, sucrose, maltose, trehalose, pentosans, fructosans, starch, cellulose, hemicellulose, amino sugars, derived acids and alcohols, glycosides, mucilages, pectins and lignins.

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.

Lipids
Occurrence, classification. Structure and chemical properties of fatty acids, triglycerides, phospholipids, glycolipids, sulpholipids, waxes and sterols

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

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

Vitamins
General properties and role in metabolism.

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/spectrophotometrically.
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. 1998. 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.

WOMEN UNIVERSITY MARDAN

RESEARCH METHODOLOGY

BOT-672 **Credit hours: 3**

Course Objectives:
To enable the students to know the theoretical aspects of planning research, handling, presentation of data, writing and submission of research papers and thesis

Course Outline:
Theory of Scientific and Research methods in Natural Sciences (Botany), Deduction, Induction and Generalization

1. Design, execution, analysis and evaluation of experiments.
2. Methodology (Selection of research topics and data retrieval : Using library, internet, compiling of working bibliography)
3. Preparation of abstracts, manuscripts, dissertation, thesis and reports: Typing or printing, paper, margins, spacing, title and heading , keywords and running title, page numbers, tables and illustration corrections and insertion.
4. Writing research grant proposal and reports.
5. Preparation of review article and book reviews.
6. Presentation of Research work: Paper presentation in Seminar/ Symposia etc.

Recommended Books:

1. Barzum, J and Graff Henry, 1977. The Modern researcher.
2. Edekar, V. H., 1982. How to write assignments, Research papers, dissertations, Kanak publ., New Delhi.
3. Berlyn, G.P. Miksche 1976. Botanical microtechnique and Cytochemistry. The lowa state University Press, Ames, lowa.
4. Falk, D.W. 1971 Biology teaching methods. John Wiley London. Gatner, E.S.M. and F. Cardasco 1970. Research and Report writing, Barnes and Nobel, New York.
5. Gibaldi Joseph and Achtert Walte S 1981. Modern Language Association Hand Book for writers of Research papers. Affiliated East West Press Pvt. Ltd.
6. Blick, D. and Reschbboum, R. M. 1977. Techniques of biological and biophysical methodology. John, E. Wiley and Jons London.
7. Gupta S. P. 1978. Science and its methodology. Ajanta publ.
8. Hercourt Brace Javanavich Inc. 3rd Ed.
9. Koch, K. F. 1972. Flurecence. Microscope, Instruments and application, Ernst Leitz, Wetzlor, Germany.

10. Salunkhe, D.K. and Bapat D.R. 1981. Preparation and presentation of scientific publication. Registrar, Mahatma Phule Agricultural University, Rahuri – 413722 Dist – Ahmednagar (M. S. India)

PLANT PATHOLOGY

BOT-674 **Credit hours: 3**

Objectives: To learn the major pathogens of plants, their control, remedies and various techniques to manage and overcome these diseases.

Course outline:

1. History of plant pathology, Concept of plant pathology, symptoms, classification of symptom , causes of plant diseases, diseases relationship , and establishment.
2. Nature and classification of plant pathogens.
3. Epidemology of diseases.
4. Dispersal of pathogens.
5. Physiology of parasitism
   a. Pre-penetration penetration, and post penetration, general method of plant disease control and principles. Biochemical basis of disease resistance. Phytoalexins. Elicitors and plant disease protection.
   b. Control of plant disease: Exclusion, eradication, protection, breeding resistant varieties. Major types of fungicides.
   c. Influence of environmental factors on plant diseases. General account of non-parasitic diseases.
6. Important diseases: Important diseases of crops, plants and fruit trees in Pakistan such as damping of (crucifers, tomatoes).Loose smut(wheat).Covered smut of wheat black stem rust. Yellow stripe rust of wheat, Apple scab. Peach leaf curl; Late blight of potatoes. Bacterial wilt of cucurbits, Tobacco Mosaic disease

Lab outline:

1. Basic plant pathological culture techniques.
2. Pathogenecity of a pathogen.
3. Effects of fungicides on spore germination.
4. Macroscopic and microscopic examination of diseases specimens of the types studied.
5. Growth of aerial contaminants in culture.
6. Isolation of pathogenic fungi from soil waters and air
7. Candidates will submit a collection of 20 fungi or diseased specimen properly preserved.

WOMEN UNIVERSITY MARDAN

FIELD EXPERIENCE/MID DEGREE INTERNSHIP

BOT-679 **Credit Hours: 3**

The aim of internship in Botany is to get practical orientation with the field of Botany by applying the knowledge in the areas of Botany. Students will be engaged in an activity from following list for their Mid Degree Internship.

1: Participation in Seminar

2: Attend a National/International Conferences

3: Visit to Biological Science Fields, Departments, Labs, Herbarium, Field trips

4: Active Participation in workshops / Science exhibitions

5: Reading and writing research/Review Articles

Internship Procedure

- Selection of relevant area from the field of Botany to be made in consultation with internship committee.
- Approval of area of internship has to be done by the internship committee (at least comprising of 2 members) from the university.
- Time period for internship is 2 months (8 weeks)
- Mid-Degree report after completion should be submitted to internship committee.
- Final report should be submitted and formally rated by the internship committee satisfactory/unsatisfactory.
- Students' evaluation will be done on the basis of satisfactory report and Viva Voce.

WOMEN UNIVERSITY MARDAN

Semester-VIII				
BOT-681	Genetics-II	03	Major Disciplinary Specific	
BOT-682	Environmental Biology	03	Major Disciplinary Specific	
BOT-683	Plant Physiology-II	03	Major Disciplinary Specific	
BOT-684	Pharmacognosy (Medicinal Plants)	03	Major Disciplinary Specific	
BOT-689	Capstone Project	03	Major	
Semester Credit Hours		**15**		

GENETICS-II

BOT-681 **Credit Hours: 3**

Course Objectives:
To introduce students to 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, recombinant DNA and social responsibility, 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, screening for genetic diseases, identifying disease genes, DNA typing, gene therapy, genetically modified organisms and apprehensions.

3. **Control of Gene Expression**
   Discovery of the *lac* system: negative control, catabolite repression of the *lac* operon: positive control, transcription: gene regulation in eukaryotes - an overview.

4. **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.

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

6. **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.

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.

ENVIRONMENTAL BIOLOGY

BOT-682 **Credit Hours: 3**

Course Objectives:
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: 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.

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 Phyiological Ecology.

PLANT PHYSIOLOGY-II

BOT-683 **Credit Hours: 3**

Course Objectives:

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. **Growth**

Definition; Plant Growth Regulators; Major natural hormones and their synthethic 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.

10. **Leaves and Atmosphere**
    Gaseous exchange, mechanism of stomatal regulation. Factors affecting stomatal regulation.

11. **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.
12. **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.

13. **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.

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.
7. 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. 2002. Plant Physiology. 3rd 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.
    nd
    2 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.
15. Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4th Edition. Sinnauers Publ. Co. Inc. Calif.

WOMEN UNIVERSITY MARDAN

PHARMACOGNOSY (Medicinal Plants)

BOT-684 **Credit Hours: 3**

Course Objectives:
To study medicinally important plants, their crude drugs and application in the life.

Course outline:

1. Definition of pharmacognosy, drug, crude drug, official and unofficial drugs.
2. Cultivation, collection, curing, drying, preservation, evaluation and classification of drugs.
3. Therapeutic classes of drugs.
4. Detail 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, uses and adulterants with special reference to species growing in pakistan.
   Ethnopharmacognosy of the medicinal plants.

Gymnosperms

Ephedra (*Ephedra* Sp. Family Ephedraceae)

Angiosperms

(A) Dicotyledons

i Aconite (Root) (*Aconitum napellus*, Family-Ranunculaccae)
ii Mandrake (Rhizome) (*Podophyllum pellatum*, Family-Podophyllaceae)
ii. Opium (*Papaver somniferum,* Family-Papaveraceae)
iii. Liquorice (Rhizome) (*Glycyrrriza glabra*, Family-Papilonaceae)
v. Gum acacia(Gum) (*Acacia senegal*, Family-Mimosaceace)
vi. Senna(Leaflet) (*Cassia angustifolia*, Family Caesalpinaceae)
vii. Cassia Fruit (*Cassia fistula*, Family Linaceae)
viii. Linseed (seed) (*Linum usitatissumum*, Family Linaceae)
ix. Fennel(Fruit) (*Foeniculum vulgare*, Family Apiaceac)
x. Coriander(Fruit) (*Coriandrum sativum*, Family Apiaceac)
xi. Berberis Root bark (*Berberis lyeeum,* Family Berberidaceae)
xii. (a) Peppermint (Leaf) (*Mentha piperita*, Family Lamiaceae)
(b) Thymus (Leaf) (*Thymus* sp Family Lamiaceae)
xiii. Atropa (Root andLeaf) (*Atropa belladonna*, Family Solanaceae)
xiv. Stramonium(Leaf) (*Datura stramonium*, Family Solanaceae)
xv. Henbane(Leaf) (*Hycocyamus niger*, Family Solanaceae)
xvi. Foxglove(Leafe) (*Digitalis purpurea*, Family Scrophulariaceae)

xvii. Valerian (Rhimoze) (*Valeriana officinalis*, Family Valerianaceae)
xviii. Euclyptus (Leaves) (*Eculyptus* spp, Family Myrataceae)
xix. Colve (Flower) (*Syzygium* arommaticum Family Myrataceae)
xx. Sontonica (Florets) (*Artemisia kurramensis*, Family Asteraceae)
xxi. Calendula (*Calendula officinalis*, Family Asteraceae)
xxii. Carthamus (*Carthamus tinctorius*, Family Asteraceae)
xxiii. Gentian (*Genetiana lutea*, Family Genetianaceae)

(B) Moncotyledons
i. Colchicum (Corm) (*Colchicum autumnale*, Family Liliaceae)
ii. Zingiber (Rhizome) (*Zingiber officinale*, Family Zingibaeraceae)

(C) Fungi
Ergot (*Claviceps purpurea*, Family Cavicipitaceae)

Lab outline:
1. Microscopical characters of the drugs.
2. Microscopical characters of the drugs(T.S of the part used, powdered drugs.
3. Property of gums.
4. Property of different oils studied in theory.
5. Identification tests for starch, Ca. Oxalate etc.
6. Volatile and fixed oils, tannin, mucalige etc

Note: The student are required to submit collection a least 30 Medicinal plants.

Recommended Books:
1. Tyler, V.E.L.R. Brady and E.P Clayse. 1970. Pharmacogonosy. 6th Ed. London 2. Trease, G.E and W.C Evans. 1985. 12th E.D English Language Soc.Baillere Tindall.
3. Wallis, T.E 1981. A Textbook of Pharmacognocy J.and A. Churchill Ltd.Glousester Palace, W.I. London.
4. Youngkin, H.W 1950. A Textbook of Pharmacognosy . The Blackistan Co.Toronto Philadelphia.
5. Jain, 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.

7. Jackson, B.P and D.W Snowdon 1992. Atlas of microscopy of medicinal plants. Culinary herbs and spices. Nazia printer Dehli India.
8. Said, H.M .., 1996. Medicinal Herbal Vol.1 Hamdard Foundation (Pakistan).Pp.14-98

CAPSTONE PROJECT

BOT-689 **Credit Hours: 3**

All the students will complete their capstone project and submit reports/thesis.