DEPARTMENT OF BOTANY BACHA KHAN UNIVERSITY CHARSADDA

REVISED CURRICULUM FOR FOUR YEARS BS IN BOTANY

EFFECTIVE FOR FOUR YEARS BS BOTANY PROGRAM FOR THE STUDENT ADMITTED IN SPRING 2021 SEMESTER AND ONWARDS IN THE DEPARTMENT OF BOTANY BACHA KHAN UNIVERSITY CHARSADDA, AND AFFILIATED COLLEGES WITH BACHA KHAN UNIVERSITY

Approved by the Board of Studies in its Second meeting held on August 11, 2014 and revised in its Fourth meeting held on March 9, 2018 and Fifth meeting held on October 26, 2020

DEPARTMENT OF BOTANY
BACHA KHAN UNIVERSITY
CHARSADDA, PAKISTAN

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The revise study scheme for BS (4-year program) is affective for spring 2021 and onward.

The detail of approved revise scheme of study is as fallow

Scheme of Studies for Four years BS (Botany) Programme				
SEMESTER WISE BREAKUP				
Courses: Code	Title of the Course	Theory	Lab	Credit hours
FIRST YEAR:FIRST SEMESTER				
BOT- 311	Diversity of plants-I	2	1	3
ZOO- 311	Zoology I: Animals Diversity I (Non Chordates)	2	1	3
ELL-311	English-I: Functional English	3	0	3
CS-311	QR-1 (Introduction to Computer)	2	1	3
CHEM- 315	Chemistry- I: Inorganic Chemistry	2	1	3
PS-321	Pakistan Studies	3	0	3
Sub Total		**14**	**4**	**18**
FIRST YEAR: SECOND SEMESTER				
BOT- 321	Plant Systematics, Anatomy and Development/Embryology	2	1	3
	Arts And Humanities I(Languages)	3	0	3
ZOO- 321	Zoology II: Animal Diversity-II (Chordates)	2	1	3
SOC-313	Citizenship Education and Community Engagement	3	0	3
ELL-321	English II: Composition Writing	3	0	3
IS- 312	Islamic studies	3	0	3
Sub Total		**16**	**2**	**18**
SECOND YEAR: THIRD SEMESTER				

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BOT-411	Cell Biology, Genetics & Evolution	2	1	3
BOT- 412	Diversity of plants-II	2	1	3
ZOO- 411	Zoology III:Animal Form and Function-I	2	1	3
CHEM-416	Chemistry II: Organic Chemistry	2	1	3
PHIL-312	QR-II (logic and quantitative reasoning)	3	0	3
ELL-411	English III: Academic Reading and Writing	3	0	3
Sub Total		**14**	**4**	**18**
SECOND YEAR: FOURTH SEMESTER				
BOT- 421	Plant Physiology and Biochemistry	2	1	3
BOT- 422	Biodiversity and Conservation	2	1	3
	Arts And Humanities II	3	0	3
	Social Science –II	3	0	3
BOT- 423	Biostatistics	3	0	3
Sub Total		**13**	**2**	**15**
THIRD YEAR: FIFTH SEMESTER				
BOT-511	Autecology of Plants	2	1	3
BOT-512	Phycology & Bryology	2	1	3
BOT-513	Diversity of Vascular plants	2	1	3
BOT-514	Virology and Bacteriology	2	1	3
BOT-515	Plant Physiology-I	2	1	3
Sub Total		**10**	**5**	**15**
THIRD YEAR: SIXTH SEMESTER				
BOT-516	Plant Physiology-II	2	1	3
BOT-517	Plant Anatomy	2	1	3
BOT-518	Plant Biochemistry-I	2	1	3

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BOT-519	Synecology of Plants	2	1	3
BOT-520	Cell Biology	2	1	3
BOT-521	Molecular Biology	2	1	3
Sub Total		**12**	**6**	**18**
FOURTH YEAR: SEVENTH SEMESTER				
BOT-611	Plant Systematics	2	1	3
BOT-612	Medicinal Plants (Pharmacognosy)	2	1	3
BOT-613	Genetics-I	2	1	3
BOT-614	Biochemistry-II	2	1	3
BOT-615	Research Methodology	3	0	3
BOT- 616	Research Thesis-I OR Optional paper-I	2	1	3
Sub Total		**13**	**5**	**18**
FOURTH YEAR: EIGHTH SEMESTER				
BOT-617	Research Thesis-II OR Optional paper-II	2	1	3
BOT-618	Plant Pathology	2	1	3
BOT-619	Plant Genetics-II	2	1	3
BOT-620	Environmental Biology	2	1	3
BOT-621	Mycology	2	1	3
Sub total		**10**	**5**	**15**
GRAND TOTAL		**102**	**33**	**135**

Arts and Humanities

I. Pashto,Urdu, Arabic, Turkish, Chinese or any other language

II. Islamic History and Culture, Philosophy, History, Education, Home Economics or any other approved course of BKUC

Social science II

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Political Science, Sociology, Psychology, Economics, Law , or any other approved Basic course of BKUC

Details of course content are below

FIRST YEAR

FIRST SEMESTER

Title of the Course: Diversity of Plants-I

Course Code: BOT-311 Credit Hours: 3 (2+1)

Specific Objectives of course: To introduce the students to the diversity of plants and their structures and significance.

Course Outline

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

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, Puccinia, Agaricus*), their implication on crop production and industrial applications.

Lichens: (*Physcia*)

Lab Outline

- Culturing, maintenance, preservation and staining of microorganisms.
- Study of morphology and reproductive structures of the types mentioned in theory.
- Identification of various types mentioned from prepared slides and fresh collections.
- Field trip to study local plant of different area of Pakistan.

Recommended Books

1. Agrios, G.N. 2004. Plant pathology. 8th ed. Academic press London.
2. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. 1996. Introductory Mycology. 4th ed. John Wiley and Sons Publishers.
3. Hussain, F. 2014. Phycology. A Text book of Algae. Pak Book Empire, Lahore.
4. Lee, R.E. 1999. Phycology. Cambridge University Press, UK

5. Mauseth, J.D. 2003. Botany: An Introduction to Plant Biology. 3rd ed., Jones and Bartlett Pub. UK
6. Prescott, L.M., Harley, J.P. and Klein, A.D. 2004. Microbiology, 3rd ed. WM. C. Brown Publishers.
7. Vashishta, B.R. 1991. Botany for Degree Students (all volumes). S. Chand and Company. Ltd. New Delhi.

Title of the Course: Animals Diversity (Non Chordates)

Course code: ZOO- 311 Credit Hours: 3 (2+1)

Objectives

Concepts of evolutionary relationship of animal kingdom. Knowledge about animal kingdom, emphasizing their phylogenetic relationships and simple to complex mode of animal life.

Course Contents

Introduction:

Classification of organisms; five kingdom classification, evolutionary relationships/ evolutionary perspective and tree diagrams; patterns of organization.

Animal-Like Protists: The Protozoa

Classification (up to phyla, subphyla and super classes, wherever applicable).Pseudopodia and amoeboid locomotion; cilia and other pellicular structures; nutrition; genetic control and reproduction; symbiotic ciliates.

Multicellular and Tissue Levels of Organization

Phylum porifera: cell types, body wall, and skeletons; reproduction. Phylum cnidaria (coelenterata) the body wall and nematocysts; alternation of generations; maintenance functions; reproduction and classification up to class. Phylumctenophora; further phylogenetic considerations.

Triploblastics and Acoelomate Body Plan

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

Aschelminths

Classification up to phyla with external features; feeding and the digestive system; other organ systems; reproduction and development of phylum rotifera and phylum nematoda; phylum kinorhyncha. Some important nematode parasites of humans.

Annelida

Metamerism and tagmatization; classification up to class. External structure and locomotion, feeding and the digestive system, gas exchange and circulation, nervous and sensory functions, excretion, regeneration, reproduction and development, in polychaeta, oligochaeta and hirudinea.

Arthropods

Classification, metamerism and tagmatization; the exoskeleton; metamorphosis; classification up to class.

Molluscs. Important characteristics, classification upto class.

Echinoderms Evolutionary perspective: relationships to other animals; echinoderm characteristics; classification up to class, Ambulacral system, tube feet, larvae

Lab out line

- Study of *Euglena, Amoeba, Entamoeba, Plasmodium, Trypanosoma, Paramecium* as representative of animal like protists. (Prepared slides).
- Study of sponges and their various body forms.
- Study of principal representative classes of phylum Coelenterata.
- Study of principal representative classes of phylum Platyhelminthes.
- Study of representative of phylum Rotifera, phylum Nematoda.
- Study of principal representative classes of phylum Mollusca.
- Study of principal representative classes of phylum Annelida.
- Study of principal representative classes of groups of phylum Arthropoda.
- Brief notes on medical/economic importance of the following: *Plasmodium, Entamoeba histolytica*, *Leishmania*, Liverfluke, Tapeworm, Earthworm, Silkworm, Citrus butterfly.
- Collection and preservation techniques, collection of specimens by students.

Books Recommended

1. Hickman, C.P., Roberts, L.S. and Larson, A. Integrated Principles of Zoology, 11th Edition (International), 2004. Singapore: McGraw Hill.
2. Miller, S.A. and Harley, J.B. Zoology, 5th Edition (International), 2002. Singapore: McGraw Hill.
3. Pechenik, J.A. Biology of invertebrates, 4th Edition (International), 2000. Singapore: McGraw Hill.

4. Kent, G.C. and Miller, S. Comparative Anatomy of vertebrates. 2001. New York: McGraw Hill
5. Hickman, C.P. and Kats, H.L. Laboratory Studies in integrated principles of Zoology. 2000. Singapore: McGraw Hill

COURSE TITLE: ENGLISH –I: FUNCTIONAL ENGLISH

COURSE CODE: ELL-311 CREDITS HOURS: 03

Course Description

The subject aims to enhance the students' ability in the meaningful use of grammatical structures. Students will be able to use the targeted grammatical structures meaningfully and appropriately both in oral and written production.

Course Objectives

1. To enable students to identify main/topic sentences.
2. To teach them to use effective strategies while reading texts.
3. To acquaint them with cohesive devices and their function in the text.

Course Contents

- Vocabulary (Frequently confused / misused words, Phrases, synonyms, antonyms, idioms & General vocabulary),
- Practical Use of Grammar (Nouns, Pronouns, Verbs, Adjectives, Adverbs, Prepositions, Conjunctions, Articles, Interjections & Tenses),
- Transitive and Intransitive verbs
- Punctuations, 14 American English Punctuations.
- Sentences (Types of sentences, Parts of sentences, Direct and Indirect Speech, Active & Passive Voice & Conditional Sentences),
- Composition + Summarization (Describing, Narrating, Argumentation, Short / long Composition)
- Comprehension + Précis writing.
- Phrase, Types of Phrase
- Clause, Types of Clause

Recommended Books

- High School English Grammar & Composition by Wren and Martin.

- Practical English Grammar by A.J. Thomson & A.V. Martinet. Exercises 1 & 2. 3rd edition. Oxford University Press.
- Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand& Francoise Grellet. Oxford Supplementary Skills. 4th Impression 1993.
- Reading. Upper Intermediate. Brian Tomilson & Rod Ellis. Oxford Supplementary Skills. 3rd Impression 1992.

Title of the Course: Introduction to Computer

Course Code: CS- 311Credit Hours: 3 (2+1)

Course Contents

Introductions to Computers: Data and Information, Information Processing Cycle, The Components of Computer, Advantages and Disadvantages of using Computers, Networks and the Internet. Computer Software, Categories of Computers, Elements of an Information System, Examples of Compute Usage, Computer Applications in Society.

The Internet and World Wide Web: Key Concept of the Internet, Evolution of Internet, The World Wide Web, E -commerce, Other Internet Services, Netiquettes

Application Software, Business Software, graphics and Multimedia Soft Ware, Software for Home, Personal and Educational Use, Web Applications, Application Software for Communications

The system unit: Processor, Data Representation, Memory, Expansion Slots and Adapter cards, Ports and Connectors, Busses, Bays, Power Supply

Input devices: What is Input, what are Input Devices, The Key Board, Pointing Devices, Mouse, Other Pointing Devices, Touch Screens, and Touch Sensitive Pads, Pen Input, Other Inputs for Smart Phones, Game Controllers, Digital Cameras, Voice Input, Video Input, Scanners and Reading Devices, Biometric Input, Terminals, Putting it all together, Input Devices for Physically Challenged Users

Output Devices: What is Output, Display Devices, Printers, Speakers, Headphones, and Ear Buds, Other Output Devices?

Storage: Hard Disk, Flash Memory Storage, Cloud Storage, Optical Discs, Other Types of Storage,

System Software: Operating Systems, Operating System Functions, Types of Operating Systems, Stand Alone Operating Systems, Server Operating Systems, Embedded Operating Systems, Utility Programmes.

Communications: Use Of Computer Communications, Networks, Network Communications Standards Communications Software, Communications Over the Telephone Network, Communications Devices, Home Networks, Communications Channels,, Physical Transmission Media, Wireless Transmission Media.

Databases: Data and Information, The Hierarchy of Data, Maintaining Data, File Processing Verses Database, Database Management System, Relational, Object Oriented and Multidimensional Databases, Web Databases and Database Administration.

Computer Security and Safety Ethics And Privacy: Computer Security Risks, Internet and Network Attacks, Unauthorized Access and Use, Hardware Theft and Vandalism, Software Theft, Information Theft, System Failure, Backing Up, Wireless Security, Health Concerns of Computer Use, Ethics and Society

Lab:

Lab work should be carried out to develop students Computer Skills, Operating Systems, and Utility Software Skills, E-Mail Skills, Word Processing Skills, Spreadsheet Skills, Electronic Presentations Skills, Web Surfing Skills

Recommended books:

1. Discovering Computers by Gary B Shelly & Emisty E Vermaat, Course Technology; 1st Edition (January 25, 2011)
2. Computing Essentials 2012 by Timothy J,O, Leary and Linda I.O, Leary, McGraw Hill Higher Education;22 Revised Edition(February,1 2011)
3. Computers Understanding Technology by Fuller, Floyed; Larson, Brain, Fourth Edition.ISBN978-076383-927-7.
4. Concepts of Information Technology By Imran Saeed, Afsan Raza, Tariq Mahmood And Zafar Hussain, 6th Edition, IT Seris Publications.
5. The Essential Guide to Computing; The Story of Information Technology by E.Garrison Walters, Prentice Hall PTC (August11, 2000) ISBN-10; 013019469

Title of the Course: Inorganic Chemistry

Course Code: CHEM- 315 Credit Hours: 3 (2+1)

Course Objectives

After completing this course, students will have sufficient knowledge about; the development of periodic law, properties of elements in a systematic way, principal of chemical bonding, concepts of acid and bases and the chemistry of p-block elements.

Course Contents

Periodic Law and Periodicity

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

Principles of Chemical Bonding

Types of chemical bonding; ionic bonding; the localized bond approach: valance bond (VBT) theory, hybridization and resonance; MOT theory as applied to Homo-nuclear diatomic and hetero-nuclear molecules, Metallic Bonding, Band Theory of conductors, insulators and semiconductors; bonding in electron deficient compounds; Intermolecular Forces,. Multicentred bonding in electron deficient molecules, three centre two electron bond (3c-2e) and three-centred, four electron (3c-4e) bond models.

Acids and Bases

Concepts of acids and bases including SHAB concept, relative strength of acids and bases, significance of $_{p}$H, $_{p}$Ka, $_{p}$Kb and buffer solutions, solubility, solubility product, common ion effect and their industrial applications.

Chemistry of p-block Elements

Chemistry and structure of p-block elements; main emphasis on the chemistry and structure of noble gases and their compounds, chemistry and structure of interhalogens, pseudo halogens and polyhalides. Prediction of shapes of molecules using VSEPR model and hybridization.

Lab Outline

- Comparative study of different type of inorganic compound.
- Study their molecular structures

Recommended Books

1. Miessler, G. L.; Tarr, D.A., *Inorganic Chemistry*, Prentice-Hall International, New Jersey, USA, 1991.
2. Huheey, J. E.; Keiter, E. A.; Keiter, R. L., *Inorganic Chemistry: Principles of Structureand Reactivity*, 4thed.., Harper and Row, New York,2001.
3. Shriver, D. F.; Atkins, P. W.; Langford, C. H., *Inorganic Chemistry*, 2nd ed., Oxford University Press, 1994.Supplementary Reading Material
4. Cotton, F. A.; Wilkinson, G. *Basic Inorganic Chemistry*, 3rd ed., Wiley, New York, 1995.
5. Lee, J.D., *Concise Inorganic Chemistry*, Chapman and Hall, 5th ed., 1996.

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Title of the Course: Pakistan Studies (Compulsory)

Course Code: PS- 321 Credit Hours: 3 (3+0)

(The teacher reserve the right to teach the course in Urdu or English)

Specific objective of course:

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

Course Outline

Historical Perspective

Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah.

Factors leading to Muslim separatism

People and Land: i. Indus civilization, ii. Muslim Advent, iii. Location and geophysical features, Government and Politics in Pakistan

Political and constitutional phases:1947-58; b. 1958-71; c. 1971-77; d. 1977-88; e. 1988-99; f. 1999 onwards

Contemporary Pakistan

Economic institutions and issues, Society and social structure, Ethnicity

Foreign policy of Pakistan and challenges

Futuristic outlook of Pakistan

Recommended Books

1. Afzal, M. Rafique. 1998. *Political Parties in Pakistan,* Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research.
2. Akbar, S. Zaidi. 2000. *Issue in Pakistan's Economy.* Karachi: Oxford University Press.
3. Amin, Tahir. *Ethno-National Movement in Pakistan,* Islamabad: Institute of Policy Studies, Islamabad.
4. Aziz, K.K.1976. *Party, Politics in Pakistan,* Islamabad: National Commission on Historical and Cultural Research.
5. Burki, Shahid Javed.1980. *State & Society in Pakistan.* The Macmillan Press Ltd.
6. Haq, Noor ul. 1993. *Making of Pakistan: The Military Perspective.* Islamabad: National Commission on Historical and Cultural Research.

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7. Ziring, Lawrence.1980. *Enigma of Political Development.* Kent England: Wm Dawson & sons Ltd.

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FIRST YEAR

SECOND SEMESTER

Title of the Course: Plant Systematics, Anatomy and Development/Embryology

Course Code: BOT- 321 **Credit Hours:** **3 (2+1)**

Objectives of course:

To understand: Various systems of classification, identification and nomenclature of Angiosperms. Structures and functions of tissues and organs at embryonic level.

Course outline

a) Plant Systematics

Introduction to Plant Systematics: aims, objectives and importance.

Classification: brief history of various systems of classification with emphasis on Takhtajan.

Brief introduction to nomenclature, importance of Latin names and binomial system with an introduction to International Code of Botanical Nomenclature (ICBN).

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

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

i. Brassicaceae (Cruciferae) ii. Fabaceae (Leguminosae)

iii. Rosaceae iv. Solanaceae v. Poaceae vi. Liliaceae (Sen. Lato)

b) Anatomy

Concept, structure and function of various tissues like: Parenchyma, Collenchyma, Sclerenchyma, Epidermis (including stomata and trichrome) Xylem and Phloem

Meristem: types,

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.

Development / Embryology

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

Structure and development of Anther Microsporogenesis, Microgametophyte

Structure of Ovule Megasporogenesis Megagametophyte

Endosperm formation, Parthenocarpy, Polyembryony

Lab Outline

- Anatomy and Embryology

- Study of stomata, epidermis,
- Tissues of primary body of plant
- Study of xylem 3-dimensional plane of wood.
- T.S of angiosperm stem and leaf.
- Anatomy of germinating seeds
- Study of pollens
- Taxonomy
- Identification of families given in syllabus with the help of keys.
- Technical description of common flowering plants belonging to families mentioned in theory syllabus.
- Field trips shall be undertaken to study and collect local plants.
- Students shall submit 40 fully identified herbarium specimens.

Recommended Books

1. Eames A.J. and L.H Mac Daniels. 2002. An Introduction to Plant Anatomy. Tata-Mac Graw-Hill Publishing Company, Limited New Delhi.
2. Fahn, A. 1990. Plant Anatomy. Pergamon Press, Oxford.
3. Panday, B.P. 2004. A textbook of Botany (Angiosperms). S. Chand and Co. New Delhi.
4. Rajput, M. T., S. S. Hassney and K. M. Khan. 1996. Plant Taxonomy. New Trends Computer Service, Hyderabad, Sindh, Pakistan
5. Raymond E, S. E. Eichhorn. 2005. Esau's Plant Anatomy. Meristems cells and tissues of the plant body, 3rd ed. John Wiley & Sons. Inc.
6. Stuessy, T.F. 1990. Plant Taxonomy. Columbia University Press, USA.

Arts and Humanities

I. Arts and Humanities- I (Languages): Pashto, Urdu, Arabic, Turkish, Chinese or any other language

Title of the course: Animal Diversity-II (Chordates)

Code: ZOO- 321 Credit Hours: 3 (2+1)

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

Course Outline

1. Hemichordates and Invertebrate Chordates

Evolutionary perspective Introduction to hemichordates

2. Fishes: Vertebrate Success in Water

Evolutionary perspective, Introduction and brief classification of fishes, adaptations in locomotion, circulation, gas exchange, lateral line system , excretion and osmoregulation, reproduction and development.

3. Amphibians: The First Terrestrial Vertebrates

Evolutionary perspective, brief classification of amphibians, adaptations in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, temperature regulation, nervous and sensory functions, excretion and osmoregulation, reproduction, development, and metamorphosis; further phylogenetic considerations.

4. Reptiles: The First Amniotes

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

5. Birds: Feathers, Flight, and Endothermy

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

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

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

Lab outline:

- Study of representatives of group Fishes.
- Study of representative groups of class Amphibia.
- Study of representative groups of class Reptilia.

- Study of representative groups of class Aves.
- Study of representative groups of class Mammalia.
- Field trips to study animal diversity in an ecosystem.
- Visit to zoo and Wildlife Park.
- Collection and preservation techniques, collection of specimens by students.
- Note: Preserved specimen and/or colored projection slide and/or CD ROM projection of computer must be used.

Books Recommended:

1. Hickman, C.P., Roberts, L.S. and Larson, A. Integrated Principles of Zoology, 11thEdition (International), 2004. Singapore: McGraw Hill.
2. Miller, S.A. and Harley, J.B. Zoology, 5thEdition (International) 2002. Singapore: McGraw Hill.
3. Kent, G.C. and Miller, S. Comparative anatomy of Vertebrates. 2001. New York: McGraw Hill.
4. Campbell, N.A. Biology, 6th Edition. 2002. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.

Title of the course: Citizenship Education and Community Engagement

Course Code: SOC- 313 Credit Hours: 3 (3+0)

Course Objectives:

The overall objectives of this course are to:

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

Learning Outcomes:

The primary outcome is inclusive development through active citizenship locally and globally, Moreover, the following are the detailed outcomes of the course based on the three domains of Bloom's Taxonomy i.e Affective, Psychomotor and Cognitive. The students will be able to:

- Understand the overall organization of the society
- Recognize and exercise their rights, responsibilities and the significance of active citizenship in positive societal development
- Identify and critically evaluate social issues and implement practicable community based solutions
- Understand the concept of human rights and its significance
- Appreciate diverse viewpoints and inter-cultural harmony

Course Outline:

Introduction to Citizenship Education and Community Engagement

- Meaning & History
- Attributes of Active Citizenship
- Different Approach
- Republican Approach
- Liberal Approach
- Cosmopolitan Approach
- Dimensions of Active Citizenship
- Rights
- Membership
- Participation
- Identity

Identity, Culture, and Social Harmony

- Sociological Theories of Self Formation
- Sigmund Freud Theory
- George Herbert Mead Theory
- Charles Horton Cooley Theory
- Cultural & Religious Harmony
- Pluralism & Diversity
- Democracy & Democratic Norms
- Concept and Development of Identity
- Components of Cultural and Social Harmony

Inter-Cultural Dialogue (me versus you)

- Principles & Purpose
- Ability to Support, learn and share through dialogue
- Policy Dialogue (encourage young people to share their opinion and perspective with policy makers and opinion makers.

Local & Global Communities

- Concept of Community

- Needs, Issues & Conflicts
- Conflict Resolution
- Communication & Networking
- Social Cohesion
- Social Capital
- Social Networking
- Advocacy
- Social Entrepreneurship & Partnership

Social Action Planning

- Skills in project Planning & Management
- Project Cycle
- Stakeholder Analysis
- Problem Identification
- Writing Project Plan
- Monitoring & Evaluation
- Risk Analysis

Population Dynamics in Pakistan

- Population Growth Pakistan
- Factors Behind High Fertility Rate
- Legislative Actions
- Dearth of Medical Facilities
- Delayed VS Early Age Marriages
- Poverty
- Women Empowerment
- Spreading Awareness
- Providing Incentives
- Population Theory
- How to Control Population Growth

Text and Reference Books:

Core Readings:

1. Larsen A. K. Sewpaul, V., & Hole, G. O. (Eds.). (2013). Participation in community work: International Perspectives, Rutledge
2. Alan, T. (2008). Community work, London: Palgrave Macmillan
3. British Council, (2017) Active Citizen's social Action Projects Guide (Scotland: British Council)
4. Kaye, C. B. (2004). The complete guide to service learning: Proven, practical ways to engage students in civic responsibility, academic curriculum, & social action. Free spirit publishing.
5. Hans, R. (1993). Population Studies, Indian Council of Social Sciences Research, New Delhi.
6. Peterson, W. (1975). Population, New York, Macmillan.
7. United Nations Economic Commission for Europe-official web site.

8. Weeks, J. R. (1992). Population: An Introduction to Concepts and Issues, Belmart California, Wadsworth Publishing Company

COURSE TITLE: ENGLISH II: COMPOSITION WRITING

Course Code: ELL-321 Credit Hours: 3 (3+0)

Course Description:

The course focuses on the basic strategies of composition and writing skills. Good writing skills not only help students obtain good grades but also optimize their chances to excel in professional life. The course includes modes of collecting information and arranging it in appropriate manner such as chronological order, cause and effect, compares and contrast, general to specific etc. It enables the students to write, edit, rewrite, redraft and proofread their own document for writing effective compositions. Because of the use of a significant amount of written communication on daily basis, sharp writing skills have always been valued highly in academic as well as professional spheres.

Course Objectives:

This course aims to:

1. Assist students identify the audience, message, and the purpose of writing
2. Develop rhetorical knowledge and critical thinking
3. Enable them express themselves in a variety of writing styles
4. Help students write well organized academic texts including examination answers with topic/thesis statement and supporting details.
5. Make students write argumentative essays and course assignments
6. Use different mechanics of writing to produce various types of compositions effectively keeping in view the purpose and the audience
7. Demonstrate rhetorical knowledge
8. Demonstrate critical thinking in well-organized forms of academic texts

Course Contents:

- Writing Process,
- Invention in writing Process or brainstorming
- Generating Ideas (collecting information in various forms such as mind maps, tables, lists, charts etc)

- Identifying Audience, Purpose, and Message,
- Ordering Information,
- Chronology for a narrative,
- Stages of a process,
- Deductive vs Inductive approach in writing
- Comparison and contrast,
- Problem solution pattern,
- Drafting,
- Free Writing,
- Revising, Editing, Paraphrasing,
- Cohesion and Coherence, Cohesive Devices,
- Paragraph unity, Summary and Précis Writing,
- Creative Writing, Essay Writing,
- Developing a thesis, writing effective introduction and conclusion
- Organizing an essay, different types of essays, use of various rhetorical modes including exposition, argumentation and analysis

Recommended Books

Critical Reading and Writing: An Introductory Course by Goatly, A. 2000. London: Taylor & Francis

A Writer's Reference by Hacker, D. 1992. 2nd ed. Boston: St. Martin's

Study writing: A course in written English for academic and professional purposes. by Hamp-Lyons, L. & Heasley, B. 1987. Cambridge: Cambridge University Press.

Oxford English for Undergraduates by Howe, D. H, Kirkpatrick, T. A. & Kirkpatrick, D. L. 2004. Karachi: Oxford University Press.

- Patterns for College Writing: Fourth Edition. Kirszner, L.G & Mandell, S.R. 1989 USA: St. Martin's Press, Inc.
- Write to be Read: Reading, Reflection and Writing by Smazler, W. R. 1996. Cambridge: Cambridge University Press.

Title of the Course: Islamic studies

Dr.Fazli Rahim
Incharge Curriculum

Dr.TabassumYaseen
Head of Botany Department

Course Code: IS- 312 Credit Hours: 3(3+0)

(The Teacher reserve the right to teach the course in Urdu or English)

Specific Objectives of course:

1. To provide Basic information about Islamic Studies

2. To enhance understanding of the learners regarding Islamic Civilization

3. To enhance the skill of the learners to understand issues related to faith and religious life.

Course 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 Contents:

Introduction to Quranic Studies

- Basic Concepts of Quran
- History of Quran
- Uloom-ul -Quran

Study of Selected Text of Holly Quran

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

Study of Selected Text of Holly Quran

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

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

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

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

- Life of Holy Prophet (S.A.W) in Madina
- Important Events of Life Holy Prophet in Madina
- Important Lessons Derived from the life of Holy Prophet in Madina

Introduction To Sunnah

- Basic Concepts of Hadith
- History of Hadith
- Kinds of Hadith
- Uloom –ul-Hadith
- Sunnah & Hadith
- Legal Position of Sunnah

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Head of Botany Department

Introduction To Islamic Law & Jurisprudence

- Basic Concepts of Islamic Law & Jurisprudence
- History & Importance of Islamic Law & Jurisprudence
- Sources of Islamic Law & Jurisprudence
- Nature of Differences in Islamic Law
- Islam and Sectarianism

Islamic Culture & Civilization

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

Islam & Science

- Basic Concepts of Islam & Science
- Contributions of Muslims in the Development of Science
- Quranic & Science

Islamic Economic System

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

Political System of Islam

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

Islamic History

- Period of Khlaft-E-Rashida
- Period of Ummayyads
- Period of Abbasids

Social System of Islam

- Basic Concepts of Social System of Islam
- Elements of Family
- Ethical Values of Islam

COURSE RECOMMANDED BOOKS:

1. Bhatia, H.S. (1989). Studies in Islamic Law, Religion and Society. New Delhi: Deep & Deep Publications.
2. Hasan, Ahmad. (1993). Principles of Islamic Jurisprudence. Islamabad: Islamic Research
   Institute, IIU.
3. Waliullah, Mir. (1982). Muslim Jrisprudence and the Quranic Law of Crimes. Lahore: Islamic Book Service.
4. Zia-ul-Haq, Muhammad. (2001). Introduction to Al Sharia Al Islamia. Islamabad:Allama
   Iqbal Open University.

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Incharge Curriculum

Dr.TabassumYaseen
Head of Botany Department

SECOND YEAR

THIRD SEMESTER

Title of the course: Cell Biology, Genetics and Evolution

Course Code: BOT- 411 Credit hours: 3 (2+1)

Specific objectives of course: To understand: structure and functions of cell. Nature of genetic material and hereditary process. Familiarization with evolutionary processes.

Course outline

a) **Cell biology**

1. Cell: Cell theory, cell types (prokaryotes, eukaryotes), basic properties of cell.
2. Brief description of following cell organelles

i. Endoplasmic reticulum, ii. Plastids, iii. Mitochondria, iv. Ribosomes, v.Dictyosomes, vii. Vacuole

3. Reproduction in somatic and embryogenic cell, mitosis and meiosis, cell cycle

b) **Genetics**

1. Introduction, scope and brief history of genetics. Mendelian inheritance; Laws of segregation and independent assortment, back cross, test cross, dominance and incomplete dominance.
2. Sex linked inheritance, sex linkage in Drosophila and man (colour blindness), XO, XY, WZ mechanisms, sex limited and sex linked characters, sex determination.
3. Linkage and crossing over: definition, linkage groups, construction of linkage maps, detection of linkage.
4. Molecular genetics; DNA replication. Nature of gene, genetic code, transcription, translation, protein synthesis, regulation of gene expression (e.g. *lac* operon).
5. Chromosomal aberrations; Changes in the number of chromosomes.

Aneuploidy and euploidy. Changes in the structure of chromosomes, deficiency, duplication, inversion and translocation.

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 plan

Lab Outline

Cell Biology

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Incharge Curriculum

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Head of Botany Department

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

Genetics

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

Recommended Books

1. Carroll, S.B., Grenier, J. K. and S. D. Welnerbee. 2001. FromDNA to Diversity - Molecular Genetics and the Evolution of Animal Design. Blackwell Science.
2. Dyonsager, V.R. 1986. Cytology and Genetics. Tata and McGraw Hill Publication Co. Ltd, New Delhi.
3. Hoelzel, A. R. 2001. Conservation Genetics. Kluwer Academic Publishers.
4. Ingrouille M. J. & B. Eddie. 2006. Plant Diversity and Evolution. Cambridge University Press.
5. Strickberger, M. W. 2000. Evolution. Jones &Bartlet Publishers Canada.
6. Strickberger, M.V. 1988. Genetics, MacMillan Press Ltd., London.

Title of the Course: Diversity of plants-II

Course Code: BOT- 412 Credit Hours: 3 (2+1)

Specific Objectives of course: To enable the students to understand the diversity, taxonomy, morphology, reproduction and evolution of non flowering plants (Archegoniates)

Course Outline

Introduction, origin, history, feature and a generalized life cycle of the representative members.

1. Bryophytes: *Riccia, Anthoceros, Funaria*
2. Pteridophytes: i. Psilopsida (*Psilotum*), ii. Lycopsida (*Selaginella*), iii. Sphenopsida (*Equisetum*), iv. Pteropsida (*Marsilea*)
3. Gymnosperms: i. *Cycas*, ii. *Pinus*, iii. *Ephedra*.

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Lab Outline

1. Morphological and reproductive features of available genera.
2. Collection of members of the representative genra and study their morphology and anatomy.
3. Study trips to different parts of Pakistan for the collection and identification of important brrophytes, pteridophytes and gymnosperms.

Recommended Books

Beck, C.B. 1998. Origin and evolution of Gymnosperms, Columbia University Press, New York.

Erdtman, G. 1954. An Introduction to Pollen anylysis. 2nd.Ed. Ronald Press, New York.

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

Hussain, F. 2012. A Text Book of Botany and Biodiversity. Pak Book Empire Lahore.

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

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

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

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

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

Course Title: ANIMAL FORM AND FUNCTION-I

Course Code: ZOO-411 Cr. Hour: 3 (2+1)

Aims and Objectives*:*

The course aims to teach the students about:

- Animals diversity adapted in different ways for their functions through modifications in body parts.
- The diversity in integumentary, skeletal, muscular, nervous and sensory, endocrine, circulatory, respiratory, nutritive, excretory, osmoregulatory and

reproductive systems according to strategies to survive in their specific conditions.

- Organ systems, their specialization and coordination with each other and constantly changing internal and external environment, inside and outside the animal's body.
- The basic structure of each system that determines its particular function.

Course Contents:

Protection, Support, and Movement

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

Communication I: Nerves

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

Communication II: Senses

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

Communication III: The Endocrine System and Chemical Messengers

Chemical messengers: hormones chemistry; and their feedback systems; mechanisms of hormone action; some hormones of porifera, cnidarians, platyhelminthes, nemerteans, nematodes, molluscs, annelids, arthropods, and echinoderms invertebrates; an overview of the vertebrate endocrine system; endocrine systems of vertebrates, endocrine systems of birds and mammals.

Circulation, Immunity, and Gas Exchange

Internal transport and circulatory systems in invertebrates: characteristics of invertebrate coelomic fluid, hemolymph, and blood cells; transport systems in vertebrates; characteristics of vertebrate blood, blood cells and vessels; the hearts and circulatory systems of bony fishes, amphibians, reptiles, birds and mammals; the human heart: blood pressure and the lymphatic system; immunity: nonspecific defenses, the immune response; gas exchange: respiratory surfaces; invertebrate and vertebrate respiratory systems: cutaneous exchange, gills, lungs, and lung ventilation; human respiratory system: gas transport.

Lab Outlines:

- Study of insect chitin, fish scale, amphibian skin, reptilian scales, feathers and mammalian skin.
- Study and notes of skeleton of *Labeo, Rana tigrina, Varanus,* fowl and rabbit.
    - *Note*: *Exercises of notes on the adaptations of skeletons to their function must be done.*
- Earthworm or leech; cockroach, freshwater mussel, *Channa* or *Catla catla* or *Labeo* or any other
- Local fish, frog, pigeon and rat or mouse and rabbits are representative animals for study in dissections.
- Study of models or preserved brains of representative animals and notes on adaptations.
- Study of nervous system of earthworm and a fish.
- Study of endocrine system in an insect and a rabbit.
- Study of different types of blood cells in blood smear of rabbit.
- Study of heart, principal arteries and veins in a representative vertebrate (dissection of representative fish/mammals).
- Study of respiratory system in cockroach or locust and a vertebrate representative (Model).

Books recommended:

1. Hickman, C.P., Roberts, L.S. and Larson, A. Integrated principles of ZOOogy, 11th Edition (International), 2004. Singapore: McGraw Hill.

2. Miller, S.A. and Harley, J.B. ZOOogy, 5th Edition (International), 2002. Singapore: McGraw
Hill.

3. Pechenik, J.A. Biology of Invertebrates, 4th Edition (International), 2000. Singapore: McGraw Hill.
4. Kent, G.C. and Miller, S. Comparative anatomy of vertebrates. 2001. New York: McGraw Hill.
5. Campbell, N.A. BIOLOGY, 6th Edition. 2002. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.

Title of the Course: Chemistry II: Organic Chemistry

Course Code: CHEM- 416 Credit Hours: 3 (2+1)

Course Objectives

The objectives of Organic Chemistry offered in this semester are to provide the beginning student with the necessary knowledge and experience to be able to:

Realize the importance of organic chemistry in our daily life and learn the evolutionary historical developments of organic chemistry.

Draw proper chemical structures and ways in which organic structures may be drawn.

Get familiarized with the systematic nomenclature of hydrocarbons beside compounds having heteroatomic functional groups.

Understand the basic concepts of chemical bonding, molecular structure, inductive and field effects, resonance theory, aromaticity and tautomerism besides the Lewis and Bronsted–Lowry theories of acids and bases.

Identify centres of reactivity in organic structures, including the names, structures and basic chemical properties of the most important functional groups.

Learn characteristic reactions of basic organic functional groups and use this knowledge to predict products of reactions and distinguish related compounds.

Course Contents

Introduction to Organic Chemistry:

Organic Chemistry- the chemistry of Carbon compounds; Nature of organic chemistry-a historical perspective.

Basic Concepts in Organic Chemistry:

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

Nomenclature of Organic Compounds:

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

Functional Group Chemistry:

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

Recommended Books

1. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P., *Organic Chemistry*, Oxford University Press, New York.
2. Wade Jr., L. J., *Organic Chemistry*, Pearson Education, Delhi.
3. Younas, M., *A Text Book of Organic Chemistry*, IlmiKitabKhana, Lahore.
4. Morrison, R. T.; Boyd, R. N., *Organic Chemistry*, Prentice-Hall of India, New Delhi.
5. Morrison, R. T.; Boyd, R. N., *Organic Chemistry*, Prentice-Hall of India, New Delhi.
6. Carey, F. A.; Sundberg, R. J., *Advanced Organic Chemistry Part A: Structure and Mechanisms*, Kluwer Academic/Plenum Publishers, New York.
7. Sykes, P., *A Guide Book to Mechanism in Organic Chemistry*, Longman, London.
8. Hand, C. W.; Blewitt, H. L., *Acid-Base Chemistry*, Macmillan Publishing Company, New York.

Title of the Course: QR-II (Logic and Quantitative Reasoning)

Course Code: PHIL-312 Credit Hours: 3 (3+0)

Course Contents

Basic Concept of Quantitative Reasoning:

- Definition of Quantitative Reasoning
- The logic of Quantitative Reasoning.
- The scope of quantitative Logic
- Propositions, Arguments in quantitative Reasoning
- Conclusion-indicators and Premise-indicators

- The Laws of Thought
- Induction and Deduction in Quantitative Logic

Language and Quantitative Reasoning:

- The basic uses of language
- Discourse serving multiple functions
- The forms of discourse
- Kinds of agreement and disagreement

Quantitative Reasoning and Symbolic Logic:

- Quantitative Reasoning and Symbolic Language
- The symbols for Conjunction, Negation, and Disjunction
- The precise meaning of Valid and Invalid
- Testing arguments on Truth Table

Categorical Propositions and Quantitative Reasoning:

- Classes and Categorical Propositions
- The four kinds of Categorical Proposition
- Quality, Quantity and Distribution
- The traditional square of opposition
- Obversion, Contraposition
- Symbolism and Diagrams of Categorical Proposition

Quantitative Reasoning and Categorical Syllogism:

- Standard form of Categorical Syllogism
- The formal nature of Syllogistic arguments
- Venn diagram technique for testing Syllogism

- Syllogistic Rules and Fallacies
- Exposition of the 15 Valid forms of Categorical Syllogism
- Syllogistic Arguments
- Dilemma
- Disjunctive and Hypothetical Syllogism
-

Recommended Books:

1. Stewart, David and Blocker, Gene. H. (2006). Fundamentals of Philosophy. New Delhi: Pearson Education.
2. Copi, Iring. M. And Cohen, Carl. (2009). Introduction to Logic. New Delhi: Pearson Education.
3. Copi, Iring. M., Cohen, Carl. Jetli, Priyadarshi. and Prabhakar, Monica. (2009). Introduction to Logic. New Delhi: Dorling Kindersley Pvt, Ltd.

COURSE TITLE: ENGLISH III: ACADEMIC READING & WRITING

Course Code: ELL-411 Credit Hours: 3 (3+0)

Course Description

This course aims at inculcating proficiency in academic writing through research. It guides students to develop a well-argued and well documented academic paper with a clear thesis statement, critical thinking, argumentation and synthesis of information. This course also teaches students how to use different systems of citations and bibliography. It allows students to become independent and efficient readers armed with appropriate skills and strategies for reading and

Comprehending texts at under graduate level.

Course Objectives

To enable the students to:

1. Improve literal understanding, interpretation & general assimilation, and integration of knowledge

2. Write well organized academic texts including examination answers with topic/thesis statement and supporting details.

3. Write argumentative essays and course assignments

Course Contents:

Reading and Critical Thinking

- Read academic texts effectively by
- Using appropriate strategies for extracting information and salient points according to a given purpose
- Identifying the main points supporting details, conclusions in a text of intermediate level
- Identifying the writer's intent such as cause and effect, reasons, comparison and contrast, and exemplification
- Interpreting charts and diagrams
- Making appropriate notes using strategies such as mind maps, tables, lists, graphs.
- Reading and carrying out instructions for tasks, assignments and examination questions
- Enhance academic vocabulary using skills learnt in Compulsory English I course
- Acquire efficient dictionary skills such as locating guide words, entry words, choosing appropriate definition, and identifying pronunciation through pronunciation key, identifying part of speech, identifying syllable division and stress patterns
- Writing Academic Texts

Organization and development of effective compositions

- employ appropriate strategies for prewriting, drafting, revising, and editing as part of the writing process compose coherent paragraphs, supporting central ideas with specific details Compose organized essays with genre-specific structure including thesis introduction, body, and conclusion. demonstrate control of key conventions of standard written English summarize a text objectively respond to a text subjectively analyze, synthesize, interpret, and evaluate information from multiple texts apply active reading strategies such as skimming, scanning, questioning, and annotating develop vocabulary; choose correctly among different forms of related words; evaluate differences in diction

Recommended Books:

1. English Practice Grammar (New edition with tests and answers) by Eastwood, J. 2004. Karachi: Oxford University Press. Fisher, A. 2001. Critical Thinking. C UP
2. Critical Reading and Writing: An Introductory Course. By Goatly, A. 2000. London: Taylor & Francis
3. A Writer's Reference. 2nd Ed. By Hacker, D. 1992. Boston: St. Martin's
4. Study writing: A course in written English for academic and professional purposes. By Hamp-Lyons, L. & Heasley, B. 1987. Cambridge: Cambridge University Press.
5. Oxford English for Undergraduates. By Howe, D. H, Kirkpatrick, T. A., & Kirkpatrick, D. L. 2004. Karachi: Oxford University Press.
6. Grammar in Use. By Murphy, R. 2003. Cambridge: Cambridge University Press.
7. Write to be Read: Reading, Reflection and Writing. By Smazler, W. R. 1996. Cambridge: Cambridge University Press.
8. Study Skills. By Wallace, M. 1992. Cambridge: Cambridge University Press.

- Primary Texts: The Norton Field Guide to Writing, by Richard Bullock; or The St. Martin’s Guide to Writing, by Rise Axelrod and Charles Cooper; or The Allyn and Bacon Guide to Writing, by John Ramage and John Bean; or The Call to Write, by John Trimbu

SECOND YEAR

FOURTH SEMESTER

Title of the course: Plant Physiology and Biochemistry

Course Code: BOT- 421 Credit hours: 3 (2+1)

Specific objectives of course: To provide comprehensive knowledge of functioning of plant organs, organelles and biomolecules,

Course outline

Plant Physiology

Introduction: Plant cells & anatomy

Water & plant cells: whole plant water relations Water movement (water potential, osmotic potential, pressure potential, matric potential). Absorption and translocation of water, Stomatal regulation.

Mineral nutrition: Essential nutrients for plant growth, Soil as a source of minerals. Movements of nutrients and assimilate through plants Passive and active transport of nutrients. Role and deficiency symptoms of macronutrients. Ion uptake by cells, ion uptake by roots. Membrane transport processes, Source-sink relationships Nitrogen fixation and its environmental regulation.

Photosynthesis: Introduction, Oxygenic and non-oxygenic photosynthesis Mechanism: light reactions (electron transport and photophosphorylation) and dark reactions (Calvin cycle).Differences between C3 and C4 plants. Factors affecting this process, Products of photosynthesis, transport and storage of photoassimilate. Photosynthesis – ecological aspects.

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

Stable isotopes in plant physiology.

Responses to red light: phytochrome Blue & UV light responses

Photoperiodism, Control of flowering

Plant growth regulators (PGRs): intro, auxin PGRs cytokinins, PGRs---gibberellins, PGRs ABA, PGRs ethylene, PGRs brassinosteroids

Biochemistry

Introduction to carbohydrates: Occurrence and classification.

Introduction to lipids: Occurrence, classification. Structure and chemical properties of fatty acids

Introduction to Proteins: Amino acids and their structure.

Introduction to Enzymes: Nature and functions.

Lab Outline

- Basic dilutions, plant morphology Preparation of solutions of specific normality of acids/bases, salts, sugars, molal and molar solutions and their standardization.
- Water conduction & transpiration: Determination of uptake of water by swelling seeds when placed in sodium chloride solution of different concentrations.
- Measurement of leaf water potential by the dye method.
- Determination of the temperature at which beet root cells lose their permeability.
- Determination of the effects of environmental factors on the rate of transpiration of a leafy shoot by means of a porometer or by cobalt chloride paper method.
- Photosynthesis & plant pigments Extraction of chlorophyll from the leaves and separation of component pigments on a paper chromatogram. Study of absorption spectra using spectrophotometer.
- Seed germination & respiration
- Estimation of oxygen utilized by a respiring plant by Winkler's method.
- Plant growth regulators etc.

Recommended Books

1. Hopkins, W.B. 1999. Introduction to Plant Physiology. 2nd Ed. John Wiley and Sons. New York
2. Ihsan, I. 1995. Plant Physiology, Biochemical Processes in Plants, UGC Press.
3. Salisbury F.B. and Ross C.B. 1992. Plant Physiology. 5th Edition. Wadsworth Publishing Co. Belmont CA.
4. Taiz, L. & Zeiger, E. Plant Physiology, 5th Edition (2010), Sinauers Publ. Co. Inc. Calif.
5. Witham and Devlin. 1986 Exercises in Plant Physiology, AWS Publishers, Boston.

Title of the Course: Biodiversity and Conservation

Course Code: BOT- 422 Credit Hours: 3 (2+1)

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

Course outline

Biodiversity: Definition, types and importance.

Threats: Threats to Biodiversity; deforestation, over grazing, erosion, desertification, ecosystem degradation, bio invasion, pollution and climate change.

Biodiversity; Global and of Pakistan. Flora and faunal diversity of Pakistan.

Ecological services, indirect value of ecosystem by virtue of their ecological functions, direct value of ecosystem (i.e. Utility of Bio resources).

Sustainable and unsustainable use of biological resources.

Biodiversity Hot spots of Pakistan and the world.

Conservation *vs* preservation: Importance and methods.

IUCN categorized protected areas in Pakistan; red listing.

Environmental Impact Assessment.

Herbarium: Use of herbarium and Botanical Garden in biodiversity and conservation.

Lab outline

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

Recommended Books

1. Abbasi, A. M., Khan, M. A., M. Ahmad and M. Zafar. 2012. Medicinal plant biodiversity of Lesser Himalaya Pakistan. Springer Publishers USA.
2. Bush, M. B. 1997 Ecology of a changing Planet. Prentice hall. New Jersy.
3. Falk, D.A. &Holsinger, K.E. 1991. Genetics and Conservation of Rare Plants. Center for Plant Conservation. Oxford University Press, Oxford, UK.
4. Frankel, O.H., Brown, A.H.D. & Burdon, J.J. 1995. *The Conservation of Plant Biodiversity*. Cambridge University Press, Cambridge, UK.
5. Heywood, V. (ed.). 1995. Global Biodiversity Assessment. Published for the United Nations Environment Programme. Cambridge University Press, Cambridge, UK.
6. Leadlay, E. and Jury, S. 2006 Taxonomy and Plant Conservation. CUP.
7. Provincial conservation strategies.
8. Taylor, P. 2005. Beyond Conservation. Earth Scan Publication Ltd.

Arts and Humanities

II. Islamic History and Culture, Philosophy, History, Education, Home Economics or any other approved course of BKUC

Social science II

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Incharge Curriculum

Dr.TabassumYaseen
Head of Botany Department

Political Science, Sociology, Psychology, Economics, Law , or any other approved Basic course of BKUC

Title of the course: Biostatistics

Course Code: BOT- 423 Credit Hours: 3 (3 +0)

Specific objectives of course: To introduce the students with the basics of biostatistics, its importance, use in botany and some important aspects to help them in data collection and analysis.

Course Outline

Introduction to Biostatistics: Definition of Biostatistics, Introduction to Biostatistics, Variables in statistics, Independent and Dependent Variables, Scope of Biostatistics in Biology: Qualitative and Quantitative.

Statistical Data: Definition of Data, Collection of Primary and secondary Data, Editing of data, Presentation of Data, Tabulation of Data, Classification Of Data, Visual Presentation of Data.

Sampling: Concept of Population and Sample, Definition of Sampling Distribution, Distribution of sample, Mean, Confidence interval of Population mean, Confidence for Population Variance.

Measure of Central Tendencies: Mean, Mode, Median

Measures of Dispersion: Range, Quartile Deviation, Mean Deviation, Standard Error, Standard Deviation, Standard Deviation by direct and Short-cut method, Variance and their Co-efficient.

Frequency Distribution: Variable types, Formation of Frequency table from raw data, Summation, notation and statistical inference. Data transformation

Hypothesis Testing: Chi-square test, Student's t-test, F test, Z-test, Analysis of variance (ANOVA), LSD-test

Correlation and Regression: Correlation, Simple Correlation Table, Partial and Multiple Correlation Regression and method of least square

Recommended Books

1. Agostino, R. D., L. Sullivan and A. Beiser. 2005. Introductory Applied Biostatistics, 1st Edition Amazon Press.
2. Quinn, G. 2002. Experimental Design and Data Analysis for Biologists. Cambridge University Press.
3. Rosner, B. 2005. Fundamentals of Biostatistics, 6th Edition, Amazon press.

4. Samuels, M., J. Witmer and A. Schaffner., 2011. Statistics for the Life Sciences, 4th Edition, Pearson Education.

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THIRD YEAR

FIFTH SEMESTER

Title of the Course: Autecology of Plants

Course Code: BOT. 511 Credit Hours: 3 (2+1)

Specific Objectives of course: To understand the role and interaction of plants with their environment.

Course Outline

General Introduction

Introduction, Aims and Scope, its relation to other sciences, level of organization and hierarchy. Environmental complex.

Soil Factor: Introduction. Weathering process. Soil structure and texture. Soil porosity and soil temperature. Soil organic matter and its importance to plants. Soil organism their kinds, numbers, distribution and roles of ecological importance. Soil salinity and water logging with reference to Pakistan. Effects of excessive soluble salts on plants. Effectsof high-water table on plants. Reclamation of saline and waterlogged soils.

Water Factor: Atmospheric moisture, and its importance to plants. Precipitation, its causes. Forms of precipitation: Frog, Clouds, Rain and their importance to plants. Geographic aspects of precipitation. Importance of seasonal distribution of precipitation. Drought and drought resistance of plants. Soil moisture: states of water in the soil. Permanent wilting. Water-balance problem of land plants. Classification of plants based on water relationships. Adaptations of hydrophytes and Xerophytes. Soil erosion by water and methods of its control.

Light Factor: Introduction, relative importance of quality- of light. Spatial and temporal variations in light intensity. Eco physiological responses of plants to light (Heliophytes & Sciophytes).Adaptations minimizing injury from bright light; Photoperiodism, its practical applications and effect on plant distribution.

Temperature Factor: Introduction, Temporal and spatial variations in temperature. Importance of temperature to plants (Plants temperature and transpiration, thermoperiodism, temperature. Stimulating effects of low temperature.

Adaptive resistance to low temperature injury.Winter drought injury.Mechanical injury due to low temperature. High temperature injury).Temperature and plant distribution.

Wind: Wind as a factor affecting plant growth and distribution. Shelter belts. Wind Erosion of soil.

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Fire Factor: Kinds of fires. Adaptations related to fire. Indirect effects of fire on plants. Practical value of vegetation burning.

Biotic Factor: Biotic interactions and their classification: Grazing and browsing, competition and allelopathy and their ecological significance.

Lab Outline

1. Determination of physical and chemical characteristics of soil.
2. Measurements of wind velocity, light, temperature, rainfall, humidity etc.
3. Effect of light and temperature on seed germination.
4. Effect of soil type on germination and plant growth.
5. Study the effect of fir on plants and their habitat.
6. Study the Effect of light, temperature, moisture, salinity and soil type on germination and growth of plants.

Recommended Books

1. Barbour, M. G., Burke, J. H and Pitts, W.D. 2004. Terrestrial Plant Ecology, the Benjamin, Cumming Publishing C. Palo Alto, California, USA.
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. Gurevitch. J. Scheiner, S. M. and G. A Fox. 2006. The Ecology of Plants. SinaurAsssoicate Inc.
5. Hussain. F. 1989. Field and Laboratory Manual of Plant Ecology, National Academy of Higher Education, Islamabad.
6. Hussain. S. S. 1989 Pakistan Manual of Plant Ecology. National Book Foundation Islamabad.
7. Lambers, H., T. L. Pons and F. Stuart. 2008. Plant Phyiological Ecology. Springer-Verlag.
8. Larcher, W. 2003., Physiological Plant Ecology: Ecophysiology and Stress Physiology of Function Groups - Springer-Verlag
9. More. P. D. and S. B. Chapman. 1986. Methods in Plant Ecology, Blackwell Scientific Publication Oxford.
10. Nobel, P.S 1999, Physico-chemical and Environmental Plant Physiology. Academic Press.
11. Rashid, A. (Ed) 2005. Soil Science. National Book Foundation, Islamabad.

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12. Smith, R. L. 2004. Ecology and field Biology. Wesley Longman, Inc., New York.
13. Townsend. C.R. Begon. M and J.L Harper. 2002 Essentials of ecology. Blackwell Publishing.

Title of the Course: Phycology and Bryology

Course Code: BOT. 512 Credit Hours: 3 (2+1)

Specific objectives of course: To understand the classification, morphology and economic importance of Algae and bryophytes.

Course Outline

Introduction to Algae and their economic importance.

Occurrence, distribution and ecology of algae.

Characteristic features. Range of thallus in vegetative structure, cell structure and cell wall, Methods of reproduction, types of life cycles. Evolutionary trends.

Classification, history and outline of modern trends.

Classification upto order level and affinities of the following algal divisions, and orders with reference to representative genera.

Cyanophyta: Cyanophyceae: Oscillatoriales.

Chlorophyta: Chlorophyeae: Volvocales, Tetrasporales, Ulotrichales,

Chaetphorales, Ulvales, Cladophorlaes and Zygnematales.

Charophyta; Charophyceae: Charales

Euglenophyta: Euglenales, Eutreptiales

Phaeophyta: Phaeophyceae: Ectocarpales, Laminariales, Fucales.

Chrysophyta: Xanthophyceae: Heterochloridales, Michococcales,

Rhodophyta: a. Bangiophycida: Porphyridiales, Bangilaes.

b. Florideophycida: Nemalionales, Ceramiales

Algae and Biotechnology.Nitrogen fixation in Algae, biologically active algae.

Bryophyta

Introduction and general account of bryophytes, classification, theories of origin and evolution. Brief study of the classes: Hepaticopsida, Anthoceropsida and Bryopsida. Study of the genera: *Pellia, Porella, Anthoceros*and*Polytrichum/Funaria.*

Lab Outline

a) Phycology:

- Collection and preservation of algae collected from different habitats.

- Microscopic and macroscopic study of representative's algae and their identification with taxonomic keys.
- Section cutting of thalloid algae.
- Preparation of temporary and permanent slides.
- Use of camera lucida/micrographs and other techniques.
- Isolation of algae from soil and water.
- Submission of well preserved, labeled and 20 – 30 identified algal species at the end of course.

b) Bryology

- Morphological and reproductive features of available genera.
- Study trips to different parts of Pakistan for the collection and identification of important member of bryophytes.

Recommended Books

1. Bold, H. C. and M.J. Wynne 1985. Introduction to Algae: structure and reproduction Prentice Hall Inc. Engle Wood Cliffs.
2. Chapman, V.J. & D. J Chapman, 1975. The Algae.English Language Book Society and McMillillan.
3. Chapman, V.J. and D.J. Chapman. 1983. Sea weed and their uses. McMillan and Co. Ltd. London
4. Frisch, F.E. 1969. The structure and Reproduction of Algae.Vols.I& II. Cambridge University Press, London.
5. Lee. R. E. 1999. Phycology. Cambridge University Press, U.K. Dawson, E.Y.,
6. Prescott. G.W. 1968. The Algae: A Reviw. Houghton Mifflin Company, Boston.
7. Smith, G.M. 1993. CryptogamicBotany.Vol. I.McGraw Hill.(Reproduced by National Book Foundation).
8. Vashishta, B. R., A. K. Sinha and V. P. Singh. 2010. Botany for Degree students: Algae. S. Chand & Co., New Delhi. (Rev edition).

Title of the Course: Diversity of Vascular Plants

Course Code: BOT.513 Credit Hours: 3 (2+1)

Specific Objectives of course: To enable the students to understand the diversity, taxonomy, morphology, reproduction and evolution of archegoniate.

Course Outline

A) Pteridophyta

Introduction, origin, history, feature and a generalized life cycle. Methods of fossilization, types of fossils, geological time scale and importance of Paleobotany. First vascular plant – Rhyniophyta e.g. *Rhynia*.

General characters, classification, affinities and comparative account of evolutionary trends of the following phyla: Psilophyta (Psilotum), Lycophyta (Lycopodium), Selaginella), Sphenophyta Equisetum), Pterophyta (Ophioglossum, Dryopteris and Azolla/Marsilea).

b) Gymnosperms

Geological history, origin, distribution, morphology, classification affinities and anatomy of Cycadofillicales, Bennettitales, Coniferales, Ginkgoales, Cycadales and Gentiles. Origin an evolution of seed habit. Distribution of gymnosperms in Pakistan. Economic importance of gymnosperms. An introduction to the Gondwana flora of world.

c) Angiosperms:

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

Lab Outline

- Morphological and reproductive features of available genera.
- Study trips to different parts of Pakistan for the collection and identification of important pteridophytes, gymnosperms and angiosperms.

Recommended Books

1. Beck, C.B. 1998.Origin and evolution of Gymnosperms, Columbia University Press, New York.
2. Vashishta, B. R., A. K. Sinha and A. Kumar. 2010. Pteridophytes. S. Chand &Co. New Delhi
3. Panday, B. P. 2006. College Botany. Vol.1 & II. S .7th Edition. Chand & Co New Delhi
4. Vashishta, B. R., A. K. Sinha and A. Kumar. 2010. Gymnosperms. S. Chand &Co.

Title of the Course: Virology and Bacteriology

Course Code: BOT. 514 Credit Hours: 3 (2+1)

Specific objectives of course: To understand the morphology, structure and economic importance of Viruses and Bacteria.

Course outline

A. Viruses

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

B. Bacteria

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

C. Bioterrorism: Introduction and some examples.

Lab outline

- Observation of symptoms of some viral infected plant specimens.
- 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, sub-culturing and identification of bacteria on morphological and biochemical basis (using available techniques).

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- Microscopic study of representative genera of Actinomycetes and bacteria from fresh collections and prepared slides.

Recommended Books

1. Arora, D.R. 2004. Textbook of Microbiology, CBS Publishers and Distributors, New Delhi.
2. Black, J.G. 2005.Microbiology - Principles and Exploration, John Wiley and Sons, Inc.
3. Hull R. Matthews. 2004, Plant Virology, Academic Press.
4. Khan, J. A. and J. Dijkstra. Plant Viruses as Molecular Pathogens, the Haworth Press, Inc.
5. Prescott, L.M., Harley, J.P. and D. A. Klein. 2005. Microbiology McGraw Hill Companies, Inc.
6. Ross F.C. 1995. Fundamentals of Microbiology. John Willey Co. New York.
7. Tortora, G.J., B. R. Funke and C. L. Case. 2004. Microbiology. Pearson Education.
8. Journals/Periodicals: World Journal of Microbiology & Biotechnology, Current Microbiology, Journal of Industrial Microbiology and Biotechnology, Journal of General Virology, Journal of Virology

Title of the Course: Plant Physiology-I

Course Code: BOT. 515 Credit Hours: 3 (2+1)

Specific Objectives of course: To provide comprehensive knowledge on some Vital functions and mechanisms of plants.

Course Outline

Introduction, to plant physiology relationship with other field of Botany.

Photosynthesis: History of photosynthesis. Nature and units of light. Determination of oxygenic and an oxygenic 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 measurementof photosynthesis.

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.

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

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

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

Lab Outline

- To determine the volume of CO_2 evolved during respiration by plant material.
- To determine the amount of O_2 used by respiring water plant by Winkler Method.
- Separation of chloroplast pigments on column chromatogram and their quantification by spectrophotometer.
- To extract and separate anthocyanins and other phenolic pigments from plant material and study their light absorption properties.
- To categorize C_3 and C_4 plants through their anatomical and physiological characters.
- To regulate stomatal opening by light of different colours and pH.

Recommended Books

1. Barton, w. 2007. Recent Advances in Plant Physiology.
2. Epstein, E. and A.J. Bloom. 2004. Mineral Nutrition of Plants: Principles and Perspectives. 2nd Edition. Sinauer Associates, California, USA.
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. IhsanIllahi, 1995. Plant Physiology, Biochemical Processes in Plants, UGC Press.
6. Kirkham, M.B. 2004. Principles of Soil and Plant Water Relations. Elsevier, Amsterdam, Netherlands.

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

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THIRD YEAR

SIXTH SEMESTER

Title of the Course: Plant Physiology-II

Course Code: BOT- 516 Credit Hours: 3 (2+1)

Specific Objectives of course: To impart comprehensive and advance knowledge of growth regulators, mechanism of water uptake and role of essential nutrients in plant metabolism.

Course Outline

1. Plant Growth Regulators: Major natural hormones and their synthetic analogues. Bioassay, structure, biosynthesis, receptors, signal transduction and mode of action, transport, physiological effects of Auxins , Gibberellins, Cytokinins, Abscisic acid, Ethylene, Polyamines, 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. Absorption of water in plants (pathways and driving forces, Aquaporin's,-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, psychometry, pressure probe, pressure volume curve.

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

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

5. Control of Flowering: Autonomous versus environmental regulation. Circadienrhythms. Classification of plants according to photoperiodic reaction, photoperiodic induction, locus of photoperiodic reaction and dark periods in photoperiodism.Role of photoperiodism in flowering. Biochemical signalling involved in flowering. Vernalization and its effect on flowering. Floral meristem and floral organ development. Floral organ identity genes and the ABC model.

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6. Signal transduction in prokaryotes and eukaryotes.

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

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

Lab Outline

- To investigate the preferential absorption of ions by corn seedlings and potato slices.
- To determine osmotic potential of massive tissue by an osmometer or any other method.
- To investigate water potential of a plant tissue by dye method and water potential apparatus.
- Determination of K uptake by excised roots.
- Measurement of stomatal index and conductance.
- Qualitative determination of K content in Guard cells by Sodium cobalt nitrite method.

Recommended Books

1. Barton, W. 2007. Recent Advances in Plant Physiology.
2. Dennis, D.T., Turpin, D.H., Lefebvre, D.D. and Layzell, D.B. 1997. Plant Metabolism. 2nd Edition. Longman Group, U.K.
3. Dey, P.M. and Harborne, J.B. 1997. Plant Biochemistry. Harcourt Asia PTE Ltd. Singapore.
4. Heldt, H-W. 2004. Plant Biochemistry. 3rd Edition, Academic Press, U.K.
5. Hopkins, W.B. 1999. Introduction to Plant Physiology. 2nd Ed. John Wiley and Sons.
6. Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4th Edition. Sinnauers Publ. Co. Inc. Calif.
7. Journals / Periodicals: Pakistan Journal of Botany, Plant Physiology, PhysiologiaPlantarum, Planta, Annual Review of Plant Biology, Journal of Plant Physiology.

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Title of the course: Plant Anatomy

Course Code: BOT- 517 Credit hours: 3 (2+1)

Specific objectives of course: To provide the students understanding about anatomical features of vascular plants

Course Outline

1 Introduction: Definition, History, Economic aspects of applied plant anatomy. 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 Tissues: 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, Fruit

9 Anatomical adaptations: Anatomical adaptations of plants in different habitats.

10 Wood identification: Molecular markers in tree species used for wood identification.

Lab outline

- Free hand section cutting and permanent mounting.
- Study of organization of shoot and root meristem, different primary and secondary tissues from the living and preserved material in macerates and sections, hairs, glands and other secondary structures.
- Study of abnormal/unusual secondary growth.

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- Peel and ground sectioning and maceration of fresh and fossil material.
- Comparative study of wood structure of Gymnosperms and Angiosperms with the help of prepared slides.

Recommended Books

1. Anon. Manual of Microscopic Analysis of Feeding Stuffs. The American Association of feed Microscopists.
2. Cutler, D.F. 1969. Anatomy of the Monocotyledons. IV. Juncales. Clarendon Press, Oxford.
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. Tat Mac-Graw Hill 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. Vaughan, J.G. 1990. The structure and Utilization of Oil Seeds. Chapman and Hall Ltd. London.
8. Raymond, E.S. and E. Eichhorn. 2005. Esau's Plant Anatomy; Meristematic cells and tissues of plant body. John Willey Sons.
9. Journals / Periodicals: Pakistan Journal of Botany.

Title of the Course: Plant Biochemistry-I

Course Code: BOT- 518 Credit Hours: 3 (2+1)

Specific Objectives of course: To elucidate the structure and role of primary metabolites in plants, specifically focused on processes unique to photosynthetic organisms.

Course Outline

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

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

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

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

5. **Introduction to Enzymes:** Nature and functions, I.U.E. classification with examples of typical groups. Isozymes, ribozymes, abzymes. Enzyme specificity. Nature of active site and mode of action.Allosteric enzymes and feedback mechanism. Enzymes with multiple functions - mechanisms and evolution.Isoprenoid metabolism, Biosynthetic pathways, Monoterpenes, sesquiterpenes, phytosterols, diterpenes, Enzymes with multiple functions - mechanisms and evolution

Lab Outline

- Solutions, acids and bases. Electrolytes, non-electrolytes, buffers, pH. Chemical bonds.
- To determine the Rf value of monosaccharides on a paper Chromatogram.
- To estimate the amount of reducing and non-reducing sugars in plant material titrimetrically/spectrophotometrically.
- To determine the saponification number of fats.
- Analysis of various lipids by TLC methods.
- To estimate soluble proteins by Biuret or Lowry or Dye-binding method.
- To estimate the amount of total Nitrogen in plant material by Kjeldahl's method.
- To determine the Rf value of amino acids on a paper chromatogram.
- Extraction of Nucleic acids from plant material and their estimation by UV absorption or colour reactions.
- To estimate the catalytic property of enzyme catalase or peroxidase extracted from a plant source.

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Recommended Books

1. Abdes, R. H. Frey, P.A. and Jencks W.P. 2004, Biochemistry, Jones and Bartlet, London.
2. Campbell, M. K. and F. Shawn. 2008. Biochemistry 6th Edition.
3. Goodwin T.W. and Mercer, E.I. 1997. Introduction to Plant Biochemistry. Pergamon Press, Oxford.
4. Heldt, H-W. 2008. Plant Biochemistry. 3rd Edition, Academic Press, U.K.
5. Lea, P.J..andLeegood, R.C. 1993. Plant Biochemistry and Molecular Biology. Wiley and Sons, New York.
6. Lehninger, A L. 1998. Principles of Biochemistry. Worth Publishers Inc.

Title of the Course: Synecology of Plants

Course Code: BOT- 519 Credit Hours: 3 (2+1)

Specific Objectives of course: To provide comprehensive knowledge of community Ecology and its relevance to mankind.

Course Outline

Introduction: Definition and branches of synecology.

Species and Populations: Ecological characteristics of species and populations; relations of species to physical environment. Mutual relationships among the individuals of the same or of different species.

Plant Community: Definition, Clement's system of classification. Analytic characteristics of the community: Qualitative and quantitative characteristics; synthetic characteristics of the community.

Dynamics of Communities: Types of changes. Succession on wet (Hydrosere) and dry (Xerosere) habitats with local examples.

Major Vegetation types of Pakistan: Tropical, Subtropical, and temperature sub alpine and alpine zones with their characteristics species, climate and related factors.

Lab Outline

- Preparation of floristic list, life form and leaf size spectra.
- Demography and life history of local annual population.
- Study of community attributes. Sampling of vegetation including Quadrat and plot less methods. Determination of frequency, density, cover and importance values.
- Preparation of stratification diagram of a natural vegetation.

- Field trip to ecologically important sites/habitats and submission of Field report of the visit.
- Slide show of the vegetation of Pakistan.
- Slide show of the major formations of the world.
- Ecological plant collection: At least 25 plants, mounted, identified depicting some ecological features.

Recommended Books

1. Ahmad, M. and S. S. Shaukat. 2012. A Textbook of Vegetation Ecology. Publisher Abrar Sons New Urdu Bazar Karachi.
2. Barbour M. G. et al., 1999, Terrestrial Plant Ecology, the Benjamin-Cumming Publishing Co.
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. Hussain, F. 1989. Field and Laboratory Manual of Plant Ecology, National Academy of Higher Education. Islamabad
6. Moore P.D. and Chapman S. B. 1986. Methods in Plant Ecology, Blackwell Scientific Publication, Oxford.
7. Smith, R. L. 1998. Elements of Ecology by Harper & Row Publishers,
8. Townsend C.R. Begon. M and J.L. Harper 2002. Essentials of Ecology, Blackwell Publishing,
9. Journals / Periodicals: Ecology, Journal of Ecology, Journalof Applied Ecology, Oecologia, Oikos, Pakistan Journal of Botany

Title of the Course: Cell Biology

Course Code: BOT- 520 Credit Hours: 3 (2+1)

Specific Objectives of course: To examine the cellular biology and its importance

Course Outline

Introduction

Prokaryotic and Eukaryotic Cells. Animal and Plant cell structure.

Ultra-structure and function of cell organelles cytoskeleton (Microtubules and Microfilaments), Endoplasmic reticulum, Golgi complex, Mitochondria, Lysosomes, Ribosomes (80s, 70s, 55s), Plastids chloroplast), Nucleus, Nucleolus.

Plasma membrane and permeability: Membrane transport, receptor proteins and cell to cell interaction.

Chromosome: Morphology and molecular structure of prokaryotic and eukaryotic chromosomes. Significance of histones and high mobility protein in the packing of chromosome and gene expression.

Cell cycle.

Mitosis: General description of mitosis, Molecular organization and functional role of mitotic apparatus (Spindle, Kinetochore, Anaphasic movement, Cytokinesis).

Meiosis: Types of meiosis, the first meiotic division (leptonema, zygonema, pachynema, synaptonemal complex, diplomena, Diakinesis). Second meiotic division, Genetic consequences of meiosis, comparison of mitosis and meiosis.

Vesicular trafficking, cell migration, cell adhesion, cancer growth factors, disorders in cell cycle, apoptosis and gap junction.

Lab Outline

- Study of mitosis and meiosis in onion root tip and pollen grains
- Study of cell organelles in plant cell by compound microscope Measurement of cell size
- Study of chromosomes morphology and variation in chromosomes number.
- Counting of prokaryotic cells (bacteria) and blood cells by using haemocytometer.
- Extraction and estimation of carbohydrates, proteins and DNA from plant sources.

Books Recommended

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

6. Bruce Albert et al. 2009. Essential cell biology. Garland Sciences Publishers Lodish. H. 2001. Molecular Cell Biology. W. H. Freema

Title of the Course: Molecular Biology

Course Code: BOT- 521 Credit Hours: 3 (2+1)

Specific Objectives of course: To disseminate the knowledge of molecular basis of life

Course Outline:

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

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

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

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

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

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

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

Lab Outline:

- Following techniques will be used for the isolation and analysis of different components:
- Extraction of RNA, DNA and proteins.
- Electrophoreses: One and two dimensional
- Purification of proteins, RNA and DNA.
- Amplification using PCR.
- Northern, Western and Southern Blotting.

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Recommended Books:

1. Cullis, C. A. 2004. Plant Genomics and Proteomics. Wiley-Liss, New York.
2. Gibson, G. and S. V. Muse, 2002. A Premier of Genome Science, Sinauer Associates Inc. Massachusetts.
3. Gilmartin, P. M. and C. Bowler. 2002. Molecular Plant Biology. Vol. 1 & 2. Oxford University Press, UK.
4. Lodish, H. et al., 2004. Molecular Cell Biology.5th Edition. WH Freeman & Co., New York.
5. Ignacimuthu, S. 2005. Basic bioinformatics. Narosa Publishing House, India.
6. Weaver, R. F. 2005. Molecular Biology. McGraw-Hill, St. Louis.
7. Lehninger, A L. 2004. Principles of Biochemistry. Worth Publishers Inc.
8. David Figurski. 2013. Genetic manipulation of DNA and protein, example from current research. In Tech Publishers.
9. Bruce Alberts et al., 2007. Molecular biology of the cell. 5thEdition. Garland and Sons.
10. M. Madan Babu. 2013. Bacterial gene regulations and transcription network. Caister Publishers. Academic Publishers.

FOURTH YEAR

SEVENTH SEMESTER

Title of the Course: Plant Systematics

Course Code: BOT- 611 Credit Hours: 3 (2+1)

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

Course Outline

1. Introduction: Importance and relationship with other sciences, 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, Cronquist, Takhtajan, and Dahlgren.
9. General characteristics, distribution, evolutionary trends, phyletic relationships and economic importance of the following families of angiosperm:

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Monocotyledon

1. Arecaceae (Palmae), 2. Cyperaceae, 3. Juncaceae, 4. Poaceae (Gramineae)

Dicotyledon

1. Apiaceae (Umbelliferae), 2. Asclepiadaceae, 3. Asteraceae (Compositae), 4. Brassicaceae (Cruciferae), 5. Chenopodiaceae, 6. Convolvulaceae, 7. Cucurbitaceae, 8. Fabaceae (Leguminosae), 9. Magnoliaceae, 10. Malvaceae, 11. Rosaceae, 12. Solanaceae.

Lab Outline

- Technical description of plants of the local flora and their identification up to species level with the help of a regional/Flora of Pakistan.
- Preparation of indented and bracketed types of keys.
- Study of variation pattern in different taxa.
- Submission of properly mounted and fully identified 50 herbarium specimens at the time of examination.
- 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. 1992-2013 (-todate). Flora of Pakistan. Karachi Univ. Press, Karachi.
3. Bokhari, M.H. and T.Z. Bokhari. 2007. Illustrated Glossary of General Taxonomic Terms. Institute of Applied Biology, B.Z. University, Multan.
4. Nasir, E. and S. I. Ali. 1970-1989. Flora of Pakistan. Karachi Univ. Press, Karachi.
5. Takhtajan, A. 1986. Flowering Plant: Origin and Dispersa., Oliver and Boyd, Edinburgh
6. Simpson, M.G. 2006. Plant Systematics. Elsevier Academic Press.
7. Pullaiah, T. 2007 Taxonomy of Angiosperms 3rd Ed. Regency Publication, New Delhi.
8. Journals / Periodicals: Pakistan Journal Botany, Flora of Pakistan, Taxon, Botanical Journal of the Linnean Society.

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Title of the Course: Medicinal Plants (Pharmacognosy)

Course Code: BOT- 612 Credit Hours: 3 (2+1)

Specific Objectives of course: To provide comprehensive knowledge about the medicinal plants and their ecology and chemistry.

Course Outline

Introduction: Definition and historical background: Definition of pharmacognosy, drug, crude drug, official and unofficial drugs.

Cultivation etc. Cultivation, collection, curing, drying, preservation.

Drug: Evaluation, classification of drugs and Therpeutic classes.

Detailed study: Detail study of the following medicinal plants including valid scientific, synonyms, local names, botanical origin, distribution of plants, method of cultivation, macroscopic and microscopic characteristics of the drugs (histology and powdered drug of the part used). Chemical constituents, uses and adulterants with special reference Ethnopharmacognosy of the medicinal plants.

Gymnosperms

Ephedra (*Ephedra Sp.)* Ephedraceae.

Angiosperms

Dicotyledons

a. Roots/Rhizomes/Corm/bulbs

1. Root of Aconite: *Aconitum napellus*(Family Ranunculaceae).
2. Rhizome of Mandrake: *Podophyllumpeltatum*(FamilyPodophyllaceae).
3. Rhizome of Liquorice: *Glycyrrrizaglabra (*Family Papilonaceae).
4. Root bark of Berberis:*Berberis lyceum* (Family Berberidaceae).

Moncotyledons

5. Corm of Colchicum: *Colchicum autumnale* (Family Colchicaceae).
6. Rhizome of Zingiber: *Zingiberofficinale* (Family Zingibaeraceae).

b. Leaves

7. Leaves of Peppermint:*Menthapiperita* (Family Lamiaceae).
8. Leaves of *Thyme: Thymus Specie* (FamilyLamiaceae).
9. Leaves of Atropa: *Atropabelladomna* (Family Solanaceae).

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10. Leaves ofStramonium: Datura*stramonium* (Family Solanaceae).
11. Leaves of Henbane: *Hycocyamusniger*(Family Solanceae).
12. Leaves of Foxglove: *Kigitalespurpurea* (Family Scorphulariaceae).
13. Leaves of Euclyptus: *Euclyptusspp*, (Family Myrataceae).

c. Flowers/Florets

14. Flower of Clove: *Syzygiumaromaticum* (Family Myrtaceae).
15. Florets of Santonica: *Artemisia kurramensis*(Family Asteraceae).
16. Florets of Calendula: *Calendula officinalis* (FamilyAsteraceae).
17. Florets of Tarraxacum: *Tarraxacumofficinale* (Family Asteraceae).
18. Florets of Carthamus: *Carthamustinctorius* (Family Asteraceae).
19. Florets of*Gentiana: Gentianalutea* (Family Gentianaceae).

d. Fruits/Seeds

20. Fruits of Cassia: *Cassia fistula* (Family Caesalpinaceae).
21. Fruits of Fennel:*Foeniculum vulgare* (Family Apiaceae).
22. Seeds of Linum: *Linumusitatissumum*(Family Linaceae).

e. Others

23. Opium: *Papaver somniferum* (Family Papaveraceae).
24. Gum of acacia: *Acacia Senegal* (Family Mimosaceae).

f. Fungi

25. Ergot: *Clavicepspurpurea*(Family Cavicipitaceae).

Lab Out line

- Microscopical characters of the drugs.
- Microscopical characters of the drugs (T.S of the part used, powdered drugs).
- Properties of gums.
- Properties of different oils studied in theory.
- Identification tests for starch, Ca. Oxalate etc.
- Volatile and fixed oils, tannin, mucilage etc.
- The students are required to submit 25 properly identified and mounted medicinal plants on herbarium sheets and also the representative parts in bottles in dried or preserved form.

Recommended Books

1. Tyler, V.E.L.R. Brady and E.P. Clayse. 1970. Pharmacognosy. 6th Ed. Leimption London
2. Trease, G.E. and W. C. Evans. 1985. Pharmacognosy. 12 th Ed. English Language Soc. Baillere Tindall.
3. Wallis, T.E. 1981. A Textbook of Pharmacognosy. J. & A. Churchill Ltd. Glousester Palace, W.I. London.
4. Youngkin, H.W. 1950. A Textbook of Pharmacognosy. The Blackistasn Co. Toronto Philadelphia.
5. Jackson, B.P. and D.W. Snowdon 1992. Atlas of microscopy of medicinal plants. Culinary herbs and spices. Nazia printer Delhi India.
6. Said, H.M., 1996. Medicinal Herbal Vol. 1, Hamdard Foundation. Pakistan.

Title of the Course: Genetics -I

Course Code: BOT- 613 Credit Hours: 3 (2+1)

Specific Objectives of course: To understand the nature and function of genetic material

Course Outline

1. Extensions of Mendelian Analysis: Variations on dominance, multiple alleles, lethal alleles, several genes affecting the same character, penetrance and expressivity.

2. Linkage I: Basic Eukaryotic Chromosome Mapping : The discovery of linkage, recombination, linkage symbolism, linkage of genes on the X chromosome, linkage maps, three-point testcross, interference, linkage mapping by recombination in humans,

3. Linkage II: Special Eukaryotic Chromosome Mapping Techniques: Accurate calculation of large map distances, analysis of single meiosis, mitotic segregation and recombination, mapping human chromosomes.

4. Recombination in Bacteria and their Viruses: Bacterial chromosome, bacterial conjugation, bacterial recombination and mapping the *E.coli* chromosome, bacterial transformation, bacteriophage genetics, transduction, mapping of bacterial chromosomes, bacterial gene transfer.

5. The Structure of DNA: DNA: The genetic material, DNA replication in eukaryotes, DNA and the gene.

6. The Nature of the Gene: How genes work, gene- protein relationships, genetic observations explained by enzyme structure, genetic fine structure, mutational sites, complementation.

8. DNA Function: Transcription, translation, the genetic code, protein synthesis, universitality of genetic information transfer, eukaryotic RNA.

9. The ExtranuclearGenome: Variegation in leaves of higher plants, cytoplasmic inheritance in fungi, extranuclear genes in chlamydomonas, mitochrondrial genes in yeast, extragenomic plasmids in eukaryotes.

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

11. Population Genetics: Gene frequencies, conservation of gene frequencies, equilibrium, Hardy-Weinberg law, factors affecting gene equilibrium.

Lab Outline

Numerical problems

- Arrangement of genetic material:
- Linkage and recombination.
- Gene mapping in diploid.
- Recombination in Fungi.
- Recombination in bacteria.
- Recombination in viruses.
- Population Genetics:
- Gene frequencies and equilibrium.
- Changes in gene frequencies,
- Blood group and Rh-factor
- Drosophila : i. Culture technique ; ii. Salivary gland chromosome
- Fungal genetics: Sacchromyces culture techniques and study.
- Studies on variation in maize ear size and colour variation

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

Recommended Books

1. Pierca, B. A. 2005. Genetics. A conceptual approach, W. H. Freeman and Company, New York.
2. Klug, W.S. and Cummings, M.R. 1997. Concepts of Genetics, Prentice Hall International Inc.
3. Roth Well, N.V. 1997. Understanding Genetics, second edition, Oxford University Press Inc.
4. Ram J. Singh. 2011. Genetic resources, chromosome engineering and crop improvement. Medicinal plants. Vol. 6. CRC Press.
5. Ringo J, 2004. Fundamental Genetics, Cambridge University Press.
6. Snyder, L and Champness W, 2003, Molecular Genetics of Bacteria, ASM Press.
7. William S. Klug, Michael R. Cummings, Charlotte A. Spencer, Michael A. Palladino. 2011. Concepts of genetics. Pearson Educations.

Title of the Course: Plant Biochemistry-II

Course Code: BOT- 614 Credit Hours: 3 (2+1)

Specific Objectives of course: To explicit the fundamentals of metabolic energy, Metabolism and Plant constituents.

Course Outline

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

2. Metabolism:

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

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

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

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

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

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

Vitamins: General properties and role in metabolism.

Lab Outline

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

Recommended Books

1. Albert, L. Lehninger, 1998. Principles of Biochemistry. Worth Publishers Inc.
2. Campbell, M.K. and F. Shawn. 2008. Biochemistry 6th Edition.
3. Conn E. E. and P.K. Stumpf. 2002. Outlines of Biochemistry, John Wiley and Sons Inc. New York.
4. Goodwin T.W. and E. I. Mercer. 1997. Introduction to Plant Biochemistry. Pergamon Press, Oxford.
5. Heldt, H-W. 2008. Plant Biochemistry. 3rd Edition, Academic Press, U.K.
6. Smith; E L., R. L. Hill, R. I. Lehman, Lefkowits, R J. and H. Abraham.. Principles of Biochemistry, (General Aspects). White. International Student Edition. McGraw Hill International Book Company.
7. Zubay, G. 2003, Biochemistry. MacMillan Publishing Co., New York.
8. Journals / Periodicals: Plant Physiology & Biochemistry, Annual Review of Biochemistry, Biochemistry Journal, Critical Review in Biochemistry and Molecular Biology

Title of the Course: Research Methodology

Course Code: BOT- 615 Credit Hour: 3(3+0)

Course Outline

Introduction: Definition, the purpose of research, kinds of research

Format of thesis/ Dissertation: Differences between of thesis and Dissertation. Parts of thesis/ dissertation.Writing synopsis or research proposal.

How to write thesis or Dissertation: Preliminary pages, Pretext pages: Title page, approval page, List of table, List of figures etc. Main body of thesis/ dissertation: Title, abstract, introduction, material and methods, results, discussion (or results and discussion), conclusions, recommendations, acknowledgements, references, tables, figures, photos, appendices. Submission of thesis/ dissertation. Pagination of preliminary pages and main body of thesis/ dissertation.

Review of Literature: How to collect the relevant literature, how to extract the desired information, how to write in our own wards?

Citing of references in text and at the end: Different styles of writing references in the text. Different styles for wring complete references at the end under Cited References. Different options for formats such as Name-year system, Number sequence system or Number alphabetical list system.

Writing correct scientific names: Binomial nomenclature, writing generic, specific names, authority citatation, variety, cultivars, subspecies, and forma.Names above the generic level, names below the specific level.

Writing and submission of research paper: Parts of research paper, raw material, first, 2^{nd} and 3^{rd} draft, final draft. Submission to the suitable journal.

Writing reports: What is a report and parts of report? Submission of report.

Writing Lab Report: Parts of lab report and its submission.

Publication ethics: Duplication, authorship, copyright, permission to use other source, honesty.

CV writing: What is CV, biodata and how to write a good CV?

Recommended Book

1. Anderson, J., B.H. Dutston and M. Poole. 1992. Thesis and Assignment writing. Wiley Eastern Ltd. New Delhi, India.

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2. Andrew, C.O. 1993. Applied Agricultural Research: Foundation and Methodology. Westview Press.
3. Awan, J. A. 2003. Scientific presentation. Unitech communication, Faisalabad, Pakistan.
4. Gatner, E, S. M. and F. Cordasco. 1959. Research and report writing. Barnes and Noble, Inc. New York, USA.
5. Hussain, F. 1989. Laboratory and Field Manual of Plant Ecology. HEC, Islamabad.
6. Stapleton, P., A. Youdeowei, J. Mukanyange and H. V. Houten. 1995. Scientific Writing for Agricultural Research Scientists. WARDA/CTA

Title of Course: Research Thesis-I OR Elective (Optional) Paper-1

Course Code:Bot- 616 Credit Hours: 03 (03 for thesis) 3(2+1) for paper

There will be two plans of study:

Plan A: For research Thesis**.**

Plan B: Without research thesis.

The details are as follows:

Plan A: Research Thesis (Credit Hours 3 (3+0)

The students may option for research thesis. The student opting for thesis will be placed under the supervision of a teacher within the department. The student will carry out research on topic assigned to him by the supervisor under Course No. Bot-616 and Bot-617 in two consecutive semesters. The research carried under Course No. Bot-616 and Bot-617 will be evaluated by the research thesis evaluation committee headed by the Chairman of the Department. The final thesis including findings generated due to courses Bot-616 and Bot-617 will be submitted in the form of thesis in bound form, to the in charge of seminar. The thesis will be evaluated by the research thesis evaluation committee consist of Head of Department (Convenor) from main campus supervisor (concerned) and one member (In charge) from main campus. The supervisor will arrange seminar for research thesis in which the student present his research work.

Plan B: Elective (Optional) Papers (Credit Hours 3 (2+1)

The students may option for Plan B by selecting two Elective (Optional) papers under Course Nos. Bot-616 in Semester seven and Bot-617 in eighth semester in lieu of Research Thesis. In 7th

semester the student will select one of the following courses as Paper-I. Courses will be offered from the list of following papers depending upon the availability of teacher.

Bot-616: Elective (Optional) Paper-1

Bot-616 (i): Ecology of Salted and Waterlogged Habitats

Bot-616(ii): Applied Ethnobotany

Bot-616(iii): Microbiology

Bot-616(vi): Plant Propagation and Conservation

Bot-616(v): Plant Biotechnology

Bot-616(vi): Anatomy and Embryology

Bot-616(vii): Plant Breeding and Evolution

Bot-616(viii): Phytochemistry

Bot-616(viii): Advances in Genetics

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FOURTH YEAR

EIGHTH SEMESTER

Title of Course: Research thesis-II OR Elective (Optional) Paper-II

Course Code: Bot- 617 Credit Hours: 03 (03 for thesis) 3(2+1) for optional paper

As explained under Course No. 616, the two plans of study will continue: Plan A for research Thesis will continue as an extension of thesis. While students pursuing Plan B will select Paper-II from the following list of papers to be offered by the faculty.

Bot-617: Elective (Optional) Paper-II

Bot-617(i): Vegetation of Khyber Pakhtunkhwa

Bot-617(ii): Rangeland Ecology

Bot-617(iii): Plant Nutrition and Soil Fertility

Bot-617(iv): Economic Botany

Bot-617(v): Environmental Bacteriology

Bot-617 (vi): Biopesticides

Bot-617(vii): Cell Biology and Biometry

Title of Course: Plant Pathology

Course Code: BOT- 618 Credit Hours: 3 (2+1)

Specific Objectives of course: To introduce the students to Pathology and Diseases caused by Fungi virus, Bacteria and nematodes in plants.

Course Outline

History: History of plant pathology, Concept of Plant Pathology, symptoms, classification of symptoms, causes of plant diseases, disease, relationship, and establishment

Nature and classification of plant pathogens,

Epidemeology of diseases.

Dispersal of pathogens.

Physiology of Parasitism.

Pre-penetration, penetration and post- penetration, general methods of plant disease control and principles, Biochemical basis of disease resistance. Phytoalexins, elicitors and plant disease protection.

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Control of Plant diseases; Exclusion, eradication, protection, breeding resistant varieties, Major types of fungicides.

Influence of environmental factors on plant diseases; General account of non-parasitic diseases.

Important diseases: Important diseases of crops, plants and fruit trees in Pakistan such as Damping off (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. Red rot of sugarcane. Bacterial wilt of cucurbits, Tobacco Mosaic disease.

Lab Outline

- Identification of major plant pathogens under lab and field conditions, cultural studies of some important plant pathogenic fungi, application of Koch's postulates for confirmation of pathogenicity. Demonstration of control measures through chemotherapeutants.
- Basic plant pathological culture techniques
- Pathogenicity of a pathogen
- Effects of fungicides on spore germination
- Macroscopic and microscopic examination of diseases specimens of the types studied.
- Growth of aerial contaminants in culture
- Isolation of pathogenic fungi from soil waters and air
- Candidates will submit a collection of 20 properly preserved fungi or diseased specimen.

Recommended Books

1. Agrios, G.N., 2005. Plant Pathology, Academic Press, London.
2. Ahmad, I. and Bhutta, A.R., 2004. Textbook of Introductory Plant Pathology. Book Foundation, Pakistan.
3. Alexopoulos, C.J., Mims, C.W. and M. Blackwell. 1996. Introductory Mycology. 4th ed. John Wiley & Sons.
4. Khan, A.G. and R. Usman. 2005. Laboratory Manual in Mycology and Plant Pathology. Botany Department Arid Agriculture University, Rawalpindi.
5. Moore-Landecker, E. 1996. Fundamentals of Fungi. 4th ed. Prentice Hall Inc., New Jersey, USA.
6. Trigiano, R.N., Windham, M.T. and Windham, A.S., 2004. Plant Pathology: Concepts and Laboratory Exercises. CRC Press, LLC, N.Y.

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Title of the Course: Plant Genetics-II

Course Code: BOT- 619 Credit Hours: 3 (2+1)

Specific Objectives of course: To introduce students to recombination of genetic material at molecular levels with emphasis on introduction to biotechnology and genomics

Course Outline

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.

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

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.

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

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.

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

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

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

Bioethics: Moral, Religious and ethical concerns.

Lab Outline

- Problems relating to the theory
- Isolation and separation of DNA and protein on Gel electrophoresis.
- Bacterial chromosome, ii. Plasmid DNA (minipreps), iii. Plant DNA, iv. Protein.
- DNA Amplification by PCR.

Recommended Books

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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. Snyder, L and Champness W, 2003, Molecular Genetics of Bacteria, ASM Press,
10. Wilson, J. and Hunt, T. 2004. Molecular Biology of the cell – the problems book, Garland publishing Inc.
11. Journals / Periodicals: J. Genetics, Theoretical and Applied Genetics, Cytologia, Chromosoma, Genome.

Title of the Course: Environmental Biology

Course Code: BOT- 620 Credit Hours: 3 (2+1)

Specific Objectives of course: To provide updated knowledge of environmental problems and sustainable environmental management.

Course Outline

Environment: Introduction, scope.

Pollution: definition, classification and impact on habitats.

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.

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

Soil pollution: fungicide, pesticides, herbicide, major sources of soil pollution and its impact. Prevention, control remediation.Tanneries. Hospital waste. Treatments of polluted waters.

Noise pollution. Units of measurement, causes and effects, control measures.

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

Natural resources: Types and importance.

Ozone layer: Formation, Mechanism of depletion, Effects of ozone depletion.

Greenhouse effect: causes, impacts.

Phytoremediation: Definition, role of plants in phytoremidiation.

Human population explosion: Impacts on environment.

Lab Outline

- Examination of industrial waste water and Municipal sewage and sludge for various physical and chemical parameters such as colour, turbidity, total dissolved solids, pH, EC, BOD, COD, Chlorides, carbonate, and nitrates.
- Examination of water samples forms different sites for the presence and diversity of organisms.
- Effect of air and water pollutants on plants.
- Visits to environmentally compromised sites and evolution of remediation methods.

Recommended Books

1. Bazzaz, F.A. 2004. Plants in changing environments: Linking physiological, population, and community ecology. Cambridge Univ. Press.
2. Bush, M.B. 1997. Ecology of a changing planet. Prentice Hall, UK.
3. Eugene, E.D. and B. F. Smith. 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 C. L. Perez. 2000. Quantifying Sustainable Development. Academic Press, UK.

6. Marsh, M.W. and J.M. Grossa Jr., 1996 Environmental geography: Science, land use, and earth systems. John Wiley and Sons.
7. Mooney, H.A. and B. Saugier. 2000. Terrestrial Global Productivity. Academic Press, UK.
8. Newman, E.I. 2001. Applied Ecology. Blackwell Science. UK
9. Journals/Periodicals: Environmental Biology, Environment, Bioremediation

Title of the Course: Mycology

Course Code: BOT- 621 Credit Hours: 3 (2+1)

Specific objectives of course: To familiarize the students with the taxonomy, ecology, thallus diversity, and economic aspects of fungi.

Course Outline

Fungus body, Cell Structure, Reproduction in Fungi. Morphological and Physiological Heterothallism: Parasexual life cycle, Rules of nomenclature in fungi. Major systems of classification of fungi.

Mycot:

Study of the structure, characteristics and economic importance with respect to following groups.

Mastigomycotina: General characteristics classification reproduction (life cycle) and relationship with other classes of fungi, Classes – Chytridiomycetes. Oomycetes and plamodiophoromycetes. Further classification of Oomycetes into orders. Lagenidiales, Leptomitales, Saprolegenials

Zygomycotina: General characteristics classification reproduction (life cycle) and relationship with other classes of fungi, Class – Zygomycetes, order

Entomophthorles, Mucorales and Endogonales.Further classification of Mucorales into families (Mucoraceae, Pilobolaceae) with emphasis on sexual reproduction and Heterothallism.

Ascomycotina: General characteristics classification reproduction (life cycle) and relationship with other classes of fungi, Classes: Hemiascomycetes, Plectomycetes, Pyenomycetes (order; Erysiphales, Xylariales, Chaetomiales, Diaporthales, Hypocreales and Clavicipitales), Discomycetes (OperculataePezizales; Inoperculatae – Helotiales); Loculoascomycets (order: Myriangiales. Bothideales, Hystreriales, Pleosporales).

Basidiomycotina: General characteristics classification reproduction (life cycle) and relationship with other classes of fungi, Class: Ustilaginomycetes (smuts) Order: Malasseziales, Class: Urediniomycetes, Class: Tremellomycetes/Phragmobasidiomycetes, Order: Filobasidiales,*Filobasidiella*, Class: Dacrymycetes Order: DacrymycetalesClass: Agaricomycetes/Hymenomycetes (Order: Agaricales (gill fungi) *Coprinus, Lepiota* Order: Lycoperdales (puffballs) *Lycoperdon*(snuff) and Order: Porales

Deuteromycotina: General characteristics classification reproduction (life cycle) and relationship with other classes of fungi, Classes – class: Blastomycetes order: Cryptococcales,*Candida, Cryptococcus*, class: Hyphomycetes order: Moniliales*Alternaria, Bipolaris*, class: Coleomycetes class: Mycelia Sterilia

Lichens: General characteristics classification, reproduction (life cycle) of the major classes of Lichens

Mycorrhiza: General account. Types of mycorrhiza and their significance.

Economic Importance of fungi: Importance of fungi in human affairs with special reference to industry and agriculture.

Lab Outline

- Basic mycological techniques about collection preservation and identification.
- Effect of pH, temperature, light and darkness, and nutrients on the growth and sporulation of fungi.
- Isolation of soil fungi by different techniques (Dilution plates, Direct plate and Wet sieving and decanting techniques).
- Macroscopic and microscopic study of the common, locally available types representing various taxonomic groups.
- Assessment of VA mycorrihizal infections in plants.
- Submission of at least 20 mycological specimens properly preserved and identified.

Recommended Books

1. Agrios, G.N., 2005. Plant Pathology, Academic Press, London.
2. Ahmad, I. and Bhutta, A.R., 2004. Textbook of Introductory Plant Pathology. Book Foundation, Pakistan.

3. Alexopoulos, C.J., Mims, C.W. and M. Blackwell. 1996. Introductory Mycology, 4th ed. John Wiley & Sons.
4. Khan, A.G. and Usman, R., 2005. Laboratory Manual in Mycology and Plant Pathology. Botany Department Arid Agriculture University, Rawalpindi.
5. Mehrotra, R.S. and K.R. Aneja. 1990. An Introduction to Mycology. Wiley and Eastern Ltd., New Delhi, India.
6. Moore-Landecker, E.1996. Fundamentals of Fungi. 4th ed. Prentice Hall Inc., New Jersey, USA.

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DETAILS OF OPTIONAL COURSES UNDER COURSE CODE: BOT. 616

Title of Course: Ecology of Salted and Waterlogged Habitats

Course Code: BOT. 616 (i) Credit Hours: 3 (2+1)

Specific Objectives of course: To explicit the fundamentals of salinity and waterlogging, their implications and habitat ecology.

Course Outline

Salinity

Origin and causes for formation of salt affected soils. Extent and distribution of salt affected soils in Pakistan and worldwide.Nature and origin of salts. Various systems of classification of salt affected soils. Characteristics, measurement, and management of saline and sodic soils.Principals governing fertilization of saline and sodic soils (Ca, N, P, K, Zn, Fe, Mn, B).Inter-relations of water logging and salinity. Effects of soil salinity and sodicity on plant growth: i. Osmotic effect, ii. Specific ion effect and iii.Nutritional imbalance.

Mechanism of salt tolerance.Different methods of increasing salt tolerance in plants.Biotic approach and genetic engineering for improvement of salt tolerance in crops.Alternate strategies for management of saline and sodic soils (Reclamative role of plants for saline and sodic soils; afforestation of saline and sodic soils).Adaptation of halophytes with reference to local examples.

Classification, characteristics and quality criteria for irrigation water: Salinity hazard, sodicity hazard. Specific ion effects, Quality of irrigation water as function of its origin (rainwater, surface water, underground water, sea water). Water quality classification.Factors affecting suitability of water for irrigation.

Waterlogging

Origin and causes of water logging. Extent and distribution of water logged soils in Pakistan and worldwide. Physical and chemical characteristics of waterlogged soils.Measurement of soil redox potential, iron and manganese relations in water logged soils. Adaptations of plants to water logged soils. Mechanism of tolerance of plants to water logging. Management of water logged soils through physical and biological methods. Hydrosere with reference to local examples.Hydrophytes and their ecological adaptations.

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Lab Outline

- Measurement of electrical conductivity of soil saturation extract.
- Measurement of pH and EC of a waterlogged soil.
- Measurement of cation-exchange capacity of soil.
- Determination of the amounts of soluble calcium.
- Calculation of exchangeable sodium percentage of soil from its sodium adsorption ratio.
- Determination of the amounts of chlorides and sulphates in a soil saturation extract.
- Analysis of irrigation water for the following: Electrical Conductivity, sodium adsorption Ratio, chlorides, sulphates, carbonates, bicarbonates, total dissolved salts, nitrates fluorides, iron and silica.
- Classification of irrigation water from the viewpoint of its salinity and sodium hazard.
- Effects of salinized media on seed germination of seed of different crop plants.
- Experimental investigation to test the salt tolerance of difference crop plants.
- Quantitative studies of halophytes in the field.
- Study of the morphological, anatomical and physiological adaptation of locally available plants of salted and waterlogged habitats.
- Field trips to saline and waterlogged areas of Pakistan.
- Students will present 25 properly dried and preserved halophytes/hydrophytes at the final term examination.

Recommended Books

1. Armstrong, W., 1973. Water-logged Soils. In Environment and Plant Ecology (Hetherington, J.R.) John Wiley and Sons, London.
2. Chapman, V.J., 1971. Salt Marshes and Salt Deserts of the World.
3. FAO, 1975. Quality of Water in Agriculture. Bulletin 29, Irrigation and Drainage Series.
4. Richards, L.A. (ed) 1954. Diagnosis and Improvement of Saline and Alkali Soils Handbook 60, USDA, Washington, D.C.
5. Waisel Y., 1972. Biology of Halophytes.
6. UNESCO, 1973. Irrigation Drainage and Salinity.

Title of Course: Applied Ethnobotany

Course Code: BOT- 616 (ii) Credit Hours: 3 (2+1)

Specific Objectives of course: To know the applied aspects of ethnobotany and its interaction in the human society. To exploit the methods in ethnobotanical work.

Course Outline

1. Definition, ethnobotany and its related fields. Scope of ethnobotany. Some useful terminology.
2. Data Collection and hypothesis collection: Types of approaches, rapid appraisal, long term projects, description of sites, ethnobotanical data. Hypothesis testing and theory.
3. Botanical collection: Collection of reference plants, development of ethnobotanical herbarium, identification and preservation of ethno botanically important plant specimen.
4. Ethno pharmacology and related aspects: Screening and phytochemical analysis. Collection, drying and preparing plants for phytochemical analysis.
5. Anthropology: Talking with the local community to extract ethnobotanical knowledge, information. Surveys and analytical tools.
6. Ecology: Analysis of the habitat along with their plant resources. Qualitative and quantitative methods.
7. Economics: Economics and ethnobotany. The value of environment, forest products. Survey of community and house hold economy. Local markets and flow of ethnobotanical products.
8. Linguistics: Learning and importance of local language. Free listing. Systematic survey of local plant knowledge. Types of ethnobotanical classification based on local uses.
9. Ethnobotany as a tool for conservation and community development: Application of traditional knowledge. Ethnobotanical research and community development.Conservation of forests, endangered useful plants. Education and awareness.Protected areas and their importance.Local perspective on ethnobotanical research.

Lab Outline

- Collection of information from locally learned persons.
- Collection of ethnobotanically important plants.
- Collection of local products made from plants.
- Field trips to local communities in various areas of Pakistan.

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- Students will present 25 properly dried and preserved ethnobotanically important plants at the final term examination.

Recommended Books

1. Jain, S. K. (Editor). 1995. A Manual of Ethnobotany. 2nd Edition. Scientific Publications, Jodhpur.
2. Larid, S.A. (Editor). 2006. Biodiversity and Traditional Knowledge. Earthscane Pub. Ltd., London.
3. Martin, G.J. 2004. Ethnobotany: A method manual. Earthscan Pub.
4. Rastogi, A., A. Godbole and P. Shengji. 1998. Applied ethnobotany in natural resource management- Traditional Home Gardens. ICIMOD, Kathmandu, Nepal.
5. Shengji, P., S. Young-ge, L. Chun-Lin etal. 1991. The Challenges of ethnobotany in 21st Century. Proc. 2nd Internat. Congress on Ethnobotany. Yunnan Science & Technology Press.
6. Toledo, V.M. 1992. What is ethnoecology? Origins, scope and implication of rising discipline. Etnooecologia, 1(1): 5-21

Title of Course: MICROBIOLOGY

Course Code: BOT- 616 (iii) Credit Hours: 3 (2+1)

Specific Objectives of course: To explicit the microbiology, and its significance to plants and human welfare.

Course Outline

History of Microbiology.Origin of Micro-organisms.Classification of bateria.Ultra-structure of bacterial cell; Reproduction in bacteria.Natural distribution of micro-organisms.

Isolation methods for obtaining pure cultures of bacteria.Morphology of bacteria.Simple and differential stains.Microscopic methods for the study of bacteria, light microscope.

Bacterial growth, growth curves. Growth on soil media and liquid media.Batch and continuous cultures; nutritional requirements of bacteria.Such as carbon, N2, vitamins, amino acids, purines and pyridines, etc.Effect of temperature pH, Oxygen.Surface tension, Osmotic pressure, nutrition.Ultraviolet radiation on the growth of bacteria.

Metabolic pathways in bacteria, Tricarboxylic acid cycle, Pentose phosphate pathway, etc; yeast alcohol Fermentation. Bacterial alcohol fermentation.Bacterial alcohol fermentation. Catabolic re-oppression and feedback inhibition.

Introduction to immunology.Specific and non-specific immunity.Immunization in the prevention and treatment of infection.Allergy and other forms of sensitivity. Serological tests such as agglutination. Haemagglutination.Neutralization, Complement fixation etc.

Microbiology of water, foods mild and dairy products, air and soil. Some important bacterial genera and diseases, mycobacterium (TB) brucella (Brucellosis), shigella (Shigellosis), Salmonella (salmonellosis), streptococci (septic sore throat), staphylococci (mylitis), pasterella (pasterrlellosis), vibrio (vibriosis). Industrial application of bacteria.

General characteristics of viruses, Multiplication and chemical composition of viruses; techniques for the cultivation of viruses viral diseases such as, polio, rabies, influenza, mumps, measles. Bacteriophages.

Lab Outline

- Preparation and sterilization of culture media, solid media, semi-solid media, liquid media.
- Inoculation techniques for bacterial isolation.
- Gram staining; acid fast staining; capsule and spore staining.
- Isolation of bacteria from throat, faces, pus, urine.
- Enumeration of the number of bacteria from water, air, soil, foods.
- Growth of bacteria in batch culture.
- Influence of temperature, pH, and carbon source on the growth of bacteria in batch cultures.
- Growth in continuous culture.
- Slide and tube agglutination tests.
- Bacteriophage isolation.

Books Recommended

1. Burdons and Williams 1980. Microbiology. 6th Ed. MacMillan Company, Textbook.
2. Fundamental of Microbiology. Frobisher, Hindsdall, Crabtre, Goodheart. Textbook, Topan Company, Tokyo, Japan, 9th Edition.

3. Anderson and C.V. Sobieski, 1980. Introduction to Microbiology. Mosby Company, Textbook St. Louis, Toronto, London.
4. Alice Lorrance Smith, C.V. Microbes. Mosby Company, London.
5. A.J. Salle, Laboratory Manual of Fundamental Principles of Bacteriology. 7th Ed. McGraw Hill Book Co.
6. Color Atlas and Textbook of DiagnositicMicrobiiology, Koneman, Allen, Sommers. J.B. Lippincott Company, 1979.
7. Topleys and Wilson's Principles of Bacteriology. Virology and Immunology. Wilson and Miles, Butler and Tomer Ltd., 1975.
8. Cruickshank, et al., Medical Microbiology, Churchill Livingston, Edinburgh.
9. Viruses of vertebrates, The Williams and Wilkins Co. Baltimore, Maryland.

Title of Course: Plant Propagation and Conservation

Course Code: BOT- 616 (iv) Credit Hours: 3 (2+1)

Specific Objectives of course: To educate the students about various methods of propagation and various means of conservation.

Course Outline

1. Introduction: Definition, types of propagation, cellular basis for propagation, plant propagation organization.

2. Propagation structure: Green house, plastic covered green houses, polyethylene, fiber glass, lath houses

3. Media for propagation: soil, sand, peat, sphagnum moss, pumice, perlite, compost

4. Pretreatments: Heat treatment, fumigation, formaldehyde.

5. Growth media and containers: Various growth media, containers such as flats, clay pots, plastic pots, fiber pots etc.

6. Seed germination: types of seeds, methods of breaking seed dormancy. Environmental factors affecting seed germination.

7. Propagation by cuttings: importance of propagation by cuttings, types of cutting, treatment with growth regulators, cold storage of rooted and unrooted leafy cuttings.

8. Grafting and budding: Terminology, reason for grafting and budding. Formation of graft union. Polarity in grafting. Techniques of grafting. Techniques in budding.

9. Layering: Factors affecting layering, Techniques in layering.
10. Propagation by specialized stems and roots: bulbs, corms, tubers, tubercles, tuberous roots and stems, rhizomes, runners, suckers, pseudo bulbs, bulbils.
11. Micro propagation and Tissue culture: Definition of micro propagation and tissue culture, methods in tissue culture. Media for tissue culture.

Lab Outline

- Various experiments on germination of selected plants. Methods of breaking dormancy.
- Vegetative propagation through stem cuttings, root separation, bulbs etc.
- Experiments on tissue culture.
- Grafting, budding in plants.

Books Recommended

1. Hartmann, H.T. and D.E. Kester. 1989. Plant propagation. Latest edition. Prentice Hall of India, New Delhi.

Title of Course: Plant Biotechnology

Course Code: BOT-616 (v) Credit Hours: 3 (2+1)

Specific Objectives of course: To know the various aspects and techniques in plant biotechnology and its relevance to human welfare.

Course Outline

1. Introduction: Definition, scope and importance.
2. Plant Tissue culture: Definition, micro propagation, embryo rescue, production of haploid plants, phytochemicals from plant cell cultures, storage of germplasm, plant gene transfer by protoplast fusion.
3. Genetic engineering: Definition, Features related to genetic engineering and its importance.
4. Architecture of plant genome: structure of plant gene, organization of plant chromatin, c-value paradox.
5. Regulation of gene expression: Transcriptional regulation, post-transcriptional regulation, translation and its control.
6. Transposable elements (Transposons): Transposons as tool in plant genetic engineering.
7. The chloroplast genome: Genetic engineering of chloroplast.

8. Mitochondrial genome: Genome organization, mitochondrial plasmids, mitochondrial genes, cytoplasmic male sterility and mitochondria.
9. Methods in genetic engineering in plant cells: Agrobacterium T1 plasmid vectors, direct transformation of plants by electrophoresis and particle gun bombardment.
10. Manipulation of phenotypic traits: Herbicide resistance, male sterility, virus resistance, pest resistance, resistance to fungal pathogens, used of genetic engineering in extending shelf life of fruits, starch biosynthesis, quality of seed storage proteins.

Lab Outline

- Simple experiments related to the theory to be conducted.

Recommended Books

1. Balasubramanian, D., C.F.A. Bryce, K. Dharmalingam, J. Green and K. Jayaraman. 1996. Concepts in Biotechnology. COSTED-IBN, University Press India.
2. Mukhopadhyay, S.N. 2001. Process Biotechnology Fundamentals. Viva Book Pvt, Chennai, India.
3. William, R. 2006. Nano Biotechnology. Anmole Publication Pvt. New Delhi, India.

Title of Course: Anatomy and Embryology

Course Code: BOT-616 (vi) Credit Hours: 3 (2+1)

Objectives

1. To impart knowledge about the various components and characters of wood.
2. To study the basic principles of embryo.

ANATOMY

1. Tissues - Definition, Types - Simple permanent - Parenchyma,
2. Collenchyma, Sclerenchyma. Fibres and Sclereids - Structure and functions;

Complex permanent tissues - Xylem and Phloem.Meristems - Classifications.

Vegetative shoot apex and Root apex.

3. Nodal Anatomy-unilacunar, trilacunar and multilacunar. The stem -

Primary and Secondary structure of dicotyledonous and monocotyledonous stems. The Root - Primary and Secondary structure of dicotyledonous and

Monocotyledonous roots. Leaf - Anatomy of monocot and dicot.

4. Wood Anatomy – secondary xylem, Physical and Chemical propertiesof wood. Classification of wood.Commercial wood species of Pakistan.

EMBRYOLOGY

1. Microsporangium, Microsporogenesis - Development of malegametophyte. Megasporangium, Megasporogenesis. Development of femalegametophyte - Monosporic (Polygonum), bisporic (Allium), tetrasporic(Peperomia)
2. Double fertilization. Triple fusion. Development of dicot embryo-

Capsella, Development of monocot embryo - Luzula. Endosperm –Definition.

Apomixes – types and significance, Polyembryony, Parthenogenesis and their significance.

Recommended Book(s):

1. Pandey B.P. 2007. Plant Anatomy, S. Chand & Co. De, New Delhi.
2. Bhojwani, SS. & Bhatnagar, SP. 1994. Embryology of Angiosperms,Vikas Publishing House (P) Ltd., New Delhi.
3. HP Brown, AJ Panshin& CC. Farsaith, 1981. Text book of Wood Technology, Mc Graw Hill Inc. New York.
3. Maheshwari, P. 1950. An introduction to the embryology ofAngiosperms. McGraw Hill, New York.

Title of Course: Plant Breeding and Evolution

Course Code: BOT- 616 (vii) Credit Hours: 3 (2+1)

OBJECTIVES

1. Objectives of plant breeding, conventional methods – introductionand selection (mass, pure and clonal). Hybridization techniques and types.Heterosis – mechanism and the basis. Breeding for disease resistance and drought tolerance.
2. Evolution – Origin of life, theories of evolution of life forms: Lamarkism,Darwinism and Speciation. Variations - Definition, causes and types,Mutations (Principles of Hugo de’veries), Role of mutations in speciation.Evolution through ages and human evolution. Evidences for evolution,Adaptive radiation, Biological evolution. Population genetics: Hardy-Weinberg principle; gene frequencies; and the factors that change it.

Title of the Course: Phytochemistry

Course No. Bot. 616(viii) Credit Hours: 3 (2+1)

Specific Objectives of course: To provide comprehensive knowledge about the phytochistry of plants and their biological significance.

Course Outline

Metabolic pathways in plants: Primary and secondary metabolites

Important secondary metabolites in plants: occurrence, chemical nature, Main action on the body as nutrition and medicine.

Biosynthetic pathways of formation, identification, assay and therapeutic significance of

Organic acids, Tannins, lignins, salicylates, coumarins, quinones, glycocides, alkaloids, flavonoids, terpenoids, saponins, phytosterols, essential and fixed oils and resins.

Nitrogen containing natural compounds: alkaloids, peptides, proteins, toxins (their chemistry, biochemistry, pharmaceutica and medicinal utilization)

Phytochemicals as dietary constituents: Macro and micro nutrients

Analytical methods and quality indicators: chromatography, spectroscopy and NMR

Industrial processes of extract preparation and standardization.

Natural product analysis: general methods and practical application.

Lab Outline

- The qualitative and quantitative determination of various chemical within the plant body.

Recommended Books

1. Campbell, L., D. Durek and B. Barun. 1987. (1st ed). Introduction to instrumental Analysis.Mc Graw Hill International editions. Chemistry series.
2. Kenkel, J. 1994. (2nd ed). Analytical chemistry for technicians.Lewis Publishers, Bocaraton.
3. Wilson, K. and J. Walker. 1994. (3rd ed). Principle and techniques of practical biochemistry. Cambridge University press, Cambridge.

Title of Course Advances in Genetics

Course Code: Bot-616(viii): Credit Hours: 3 (2+1)

1. Introduction to Genetics, Concept related to Genes
2. Brief history of genetics
3. Scope and importance of genetics
4. What is DNA, RNA
5. DNA organization, Different proteins involved in DNA organization
6. Importance concept related to heterochromatin and Euchromatin
7. Nature of Gene (heredity material), Genetic code
8. Chromosomes and chromatin remodeling, different mechanism involved with chromatin remodeling (Methylation, Acetylation, phosphorylation etc)
9. Gene Mutation, types of gene mutation (spontaneous mutations, induced mutations), Mutagens
10. Different Biological DNA repair mechanisms and its regulation at molecular level
11. Receptors and intracellular signaling
12. Cell cycle (Interphase and Cell division)
13. Restriction enzymes
14. Concepts related to Transposable elements (Transposons)

DETAILS OF OPTIONAL COURSES UNDER COURSE CODE: BOT. 617

Title of Course: Vegetation of Khyber Pakhtunkhwa

Course Code: BOT-617 (i) Credit Hours: 3 (2+1)

Specific Objectives of course: To know the various vegetation types of Khyber Pakhtunkhwa.

Course Outline

Introduction to Khyber Pakhtunkhwa: Location, area, climate, soils and hydrology.

Major vegetation zones and their ecological classification.

Detailed study of tropical deciduous zone, subtropical zone, temperate zone, sub alpine and alpine zone regarding its distribution, floristics and structure.

Lab Outline

- Visits to various ecological zones. Collection and identification of characteristic plants. Mapping of vegetation. Phytosociological analysis of representative vegetation types.

Recommended Books

1. Champion, G, S. K. Seth and G.M. Khattak. 1965. Forest Types of Pakistan.
2. Hussain, F., and I. Ilahi. 1991. Ecology and vegetation of Lesser Himalayas.
3. Hussain, F. 2014. Synecology.

Title of Course: Rangeland Ecology

Course Code: BOT. 617(ii) Credit Hours: 3 (2+1)

Specific Objectives of course: To know the various aspects of rangeland ecology and its Significance in national economy.

Course Outline

Definition, types and importance of rangelands.

Classification and distribution of rangelands in Pakistan. The characteristics of rangeland and their managements. Palatability of plants. Grazing types and its management. Impact of overgrazing on vegetation, soil and species diversity.

Lab Out line

- Visit to various types of rangelands in Pakistan. Investigation of their flora and fauna. Measurement of their productivity.

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Title of Course: Plant Nutrition and Soil Fertility

Course Code: BOT. 617 (iii) Credit Hours: 3 (2+1)

Specific Objectives of course: To explain the role of nutritional elements in the soil and its impact on plant growth and productivity.

Course Outline

Introduction, Scope and history of mineral plant nutrition.

The inorganic components of plants; Water; dry matter, mineral competition; Essential and other mineral elements, macronutrient and micronutrient elements; Comparative elemental requirements of higher plants; Deficiencies and tissue analysis: Deficiency symptoms of individual elements.

The media of plant nutrition. The variety of nutrient media: Soil; solution culture; Chemical composition of nutrient solutions; Modified solution culture; Culture solutions compared with soil solutions.

The acquisition of nitrogen. Absorption of nitrate and ammonium ions; Nitrogen fixation. Physiology of formation of root nodules. Physiology of symbiotic nitrogen fixation.

Mineral metabolism.The functions of nutrients, nutrient elements as constituents of metabolites and complexes. Nutrient elements as activators, cofactors or regulators of enzymes, nutrient elements in physiological processes.

Ecological aspects of plant nutrition. Phenotypicplasticity. The concept of the ecotype. Role of mineral elements in plant ecology. Interplay between plants and their mineral media.

Soil fertility evaluation. Soil and fertilizer NPK Ca, Mg, S and trace elements. Liming and use of Gypsum. Fertilizers and efficient use of water.

Lab Outline

- Sand and water culture methods.
- Study of deficiency symptoms and micronutrient elements.
- Phenotypic adaptations of plants to nutrients, deficiency and methods of growth analysis.
- Plant tissue analysis for principle inorganic ions.
- Determination of P, Ca and Mg content of soil.
- Preparation of fertilizer mixtures.
- Preparation of standard acid, alkali and indicator solutions.

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Books Recommended

1. Epstein, F. 1972. Mineral Nutrition of Plants. Principles and Perspectives. John Wiley and Sons, Inc.
2. Treshow, M. 1970. Environment and Plant Response, McGraw Hill.
3. Wallace, T. 1961. The diagnosis of Mineral Deficiencies in Plants. Her Majesty's, Office, London.
4. Tisdale, S. and W. Nelson, 1975. Soil Fertility and Fertilizers. 3rdMcMillans

Title of Course: Economic Botany

Course Code. BOT. 617 (iv) Credit Hours: 3 (2+1)

Specific Objectives of course: To study the classification, agronomy and ecology of Important crops of Pakistan.

Course Outline

The study of classification, agronomy and varieties of the following crops with reference to Pakistan.

Wheat, maize, tobacco, sugar cane, rice and cotton.

Lab Outline

Study tips to different part of the country to study local crops.

Title of Course: Environmental Bacteriology

Course Code: BOT.617(v) Credit Hours: 3 (2+1)

Specific Objectives of course: To know the various aspects of environmental bacteriology and its importance to environment and mankind.

Course Outline

Introduction.

Methods of Microbiology: Pure culture techniques, sterilization, culture media, selective media, light microscopy, electron microscopy.

Bacterial morphology, cell structure and reproduction. Bacterial growth. Basis of classification and major groups of bacteria. Effects of environmental factors on bacterial growth. Microbial transport of toxic metals. Molecular approaches to environmental management. Bioremediation

of organic contaminants in subsurface. The importance of genetic exchange in degradation of xenobiotic chemicals.

Lab Outline

- Staining techniques: Simple staining, negative staining, gram stain, acid-fast stain, spore stain, capsule stain.
- Cultural techniques: Culture transfer techniques' isolation of pure cultures, cultural characteristics of bacteria, serial dilution-agar plating procedures to quantitative viable cells.
- Cultivation of Bacteria: Nutritional requirement, routine and selective media effect of temperature and pH on the growth of bacteria, bacterial growth curves.
- Biochemical activity: Starch hydrolysis, Casein Bacteri; hydrolysis of test, oxidase, indole production test, nitrate reduction test, catalase test, oxidase test.
- Spray plate technique for testing the degradation ability of bacteria.
- Bioremediation from culture by metal resistant bacteria.

Books Recommended

1. Bergey's Manual of Determinative Bacteriology. Ninth Ed. William and Wilkins.
2. Cappuccino, J.G. and N. Sherman, 1992. Microbiology, A. Laboratory Manual, 3ard Ed. The Banjamin/Cummings Publishing Company Inc.
3. Edwards, C. 1990. Microbiology of Extreme Environments. (Environmental Biotechnology) McGraw Hill.
4. Holt,J.G., N.R. Kuleg, P.H.A. Sneath, J.T. Staley and S.T. Williams, 1994.
5. Mitchell, R. 1990. New Concepts in Environmental Microbiology. Alan R. Liss.
6. Mitchell, R. 1992. Environmental Microbiology, Wiley-Liss, A. John Wiley and Sos, Inc. Publication.
7. Pelczar, M.J., E.C.S., Chan, N.R. Krieg, 1986. Microbiology. 5th Ed. McGraw Hill.
8. Volk, W.A. 1992. Basic Microbiology. 7th Ed. Harper Collin Publishers.

Title of Course: Biopesticides

Course Code: BOT. 617 (vi) Credit Hours: 3 (2+1)

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OBJECTIVES

1. To know the principles, types and mode of action of Biopesticides.
2. To develop skill in crop protection using environmentally safe technology.

Biological control of Insect Pests: Scope and principles, factorsaffecting biological control. Bio pesticides: Introduction, importance andclassification – living creatures to control pests – weeds for controlling pest.

Botanical pesticides: Present status and future prospects; opportunities for botanical pesticides in crop rotation; multiple cropping forcontrolling pests. Plants as a source of natural pesticides: Mustard,Chrysanthemum, Pepper, Garlic, Turmeric and Citronella as biopesticides.

Biocontrol agents: Isolation, identification, mode of action and massproduction of Pseudomonas fluorescence (bacterial agent), Trichodermaviride (fungal agent); application against seed borne and soil borne diseases.

Biological Pesticides: Isolation, identification, Bacterium as biopesticide: Bacillus thuringiensis: Fungus as biopesticide(entomophagous); Beauveriabassiana and Trichoderma. Insect a biopesticide: Trichogramma. Virus as biopesticide: Baculovirus-NPV.

Production methods of biopesticides: Liquid culture fermentation andsolid state fermentation – Types of biopesticide formulations; Dry inoculum,Granules, Pellets, Capsules, Wettable powder and Liquid formulations.Genetic engineering and pest resistant plants (outline only)

Recommended Book(s):

1. Ghosh G K, 2000, Biopesticide and Integrated pest Management, A

P H Publishing Corporation, New Delhi.

2. Subba Rao N S, 1982, Advances in Agricultural Microbiology, Oxford& IBH Publishing Company, Chennai.

Title of Course: Cell Biology and Biometry

Course Code: BOT-617 (vii) Credit Hours: 3 (2+1)

Specific Objectives of course: To examine the cellular biology and its importance. To study various statistical techniques in and their application in biological problems.

Course Outline

A. Cell Biology

Introduction.

Prokaryotic and Eukaryotic Cells.

Ultra-structure and function of cell organelles cytoskeleton (Microtubules and Microfilaments), Endoplasmic reticulum, Golgi complex, Mitochondria, Lysosomes, Ribosomes (80s, 70s, 55s), Plastids chloroplast), Nucleus, Nucleolus.

Plasma membrane and permeability: Membrane transport, receptor proteins and cell to cell interaction.

Chromosome: Morphology and molecular structure of prokaryotic and eukaryotic chromosomes. Significance of histones and high mobility protein in the packing of chromosome and gene expression.

Cell cycle.

Mitosis: General description of mitosis, Molecular organization and functional role of mitotic apparatus (Spindle, Kinetochore, Anaphasic movement, Cytokinesis).

Meiosis: Types of meiosis, the first meiotic division (leptonema, zygonema, pachynema, synaptonemal complex, diplomena, Diakinesis). Second meiotic division, Genetic consequences of meiosis, comparison of mitosis and meiosis.

B. Biometry

Introduction and Scope: Definition, characteristics, importance and limitations, Population and samples.

Frequency distribution and Probabilities: Formation of frequency table from raw data, histograms, Application of probability to simple events.

Measures of Central Tendencies and Dispersions: Arithmetic mean, median, mode, range, variance and standard deviation, mean deviation, semi-interquartile range.

Standard Distributions: Binomial, Poison and Normal distributions, their properties and application.

Tests of significance:

Correlation and Linear Regression.

Lab out Line

A. Cell Biology

Cell structure in the staminal hair of *Tradescantia*.

Microchemical detection of following in the section of the plant: Protein, carbohydrate, cellulose, cutin (subrin) pectin.

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Incharge Curriculum

Dr.TabassumYaseen
Head of Botany Department

Mitosis: Smear preparation of onion roots.

Meiosis: Smear preparation from anthers of plants such as *Avena,* Onion, wheat, maize.

Testing fertility/viability of pollen grains of various plants.

Germination of pollen grains of various vascular plants.

B. Biometry

- Probability of simple events.
- Data collection, arrangement of data in frequency tables.
- Calculation of means from group and ungrouped data.
- Calculation of variance and standard deviation from grouped and ungrouped data.
- Binomial distribution.
- t-Test.
- Poison distribution.
- X^2-Test.
- Correlation.
- Linear Regression.

Books Recommended

1. Alberts, B., D. Bray, J. Lewis, M.Raff, K., Roberts and J.D., Watson. 1994. Molecular Biology of the Cell, Garland Publishing Inc. N.Y.
2. Bailey, N.T.J., 1994. Statistical Methods in Biology. Cambridge University Press.
3. Clarke, G.M. and D. Cook. 1981. A Basic Course in Statistics. Edward Arnold.
4. Darnell, Jr. J., H. Lodisch and D. Balimore. 1990. Molecular Cell Biology. Scientific American Inc. N.Y.

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