



**UNIVERSITY OF THE POONCH RAWALAKOT
AZAD JAMMU AND KASHMIR**

**SCHEME OF STUDIES FOR BS 4 YEAR (8 SEMESTERS) PROGRAM IN BOTANY W.E.F. FALL 2019
& ONWARD**

BS Botany

Duration: 8-10 Semester
 Courses & Labs: 124 Credits
 Thesis/Elective Courses: 6 Credits
 Comprehensive Oral Examination: S/U Basis
Total Credit Hours: 130 Credits

**Year-I
Semester-I (Cr. 16)**

Course Code	Course Title	Lecture Credit's
BOT-3101	Diversity of Plants	4(3-1)
ENG-3101	English-I	3(3-0)
COM-3102	Introduction to Computer	2(1-1)
MAT-3103	Mathematics-I	2(2-0)
CHM-3101	Foundation Chemistry	3(3-0)
ZOO-3106	Principles of Animal Life-I	3(2-1)
Total Credit Hour's		17

Semester-II (Cr. 16)

Course Code	Course Title	Lecture Credit's
BOT-3201	Plant Systematics, Anatomy and Development	4(3-1)
ENG-3201	English-II	3(3-0)
ISL-3202	Islamic Studies/Ethics	2(2-0)
CHM-3201	Organic Chemistry	3(2-1)
ZOO-3206	Principles of Animal Life-II	3(2-1)
STA-3203	Introduction to Statistics	2(2-0)
Total Credit Hour's		17

Year-II
SEMESTER-III (Cr. 15)

Course Code	Course Title	Lecture Credit's
BOT-4301	Cell Biology, Genetics and Evolution	4(3-1)
PKS-4301	Pakistan Studies	2(2-0)
ENG-4302	Report writing	3(3-0)
CHM-4301	Physical Chemistry	3(2-1)
ZOO-4305	Animal Diversity-I	3(2-1)
Total Credit Hour's		15

SEMESTER-IV (Cr. 16)

Course Code	Course Title	Lecture Credit's
BOT-4401	Plant Physiology and Ecology	4(3-1)
BOT-4402	Environmental Biology	3(2-1)
ARB-4401	Arabic	3(3-0)
ZOO-4404	Animal Diversity-II	3(2-1)
CHM-4401	Inorganic Chemistry	3(2-1)
Total Credit Hour's		16

Year-III
Semester-V (Cr. 16)

Course Code	Course Title	Lecture Credit's
BOT-5501	Bacteriology and Virology	3(2-1)
BOT-5502	Diversity of Vascular Plants	3(2-1)
BOT-5503	Phycology and Bryology	3(2-1)
BOT-5504	Mycology and Plant Pathology	3(2-1)
BOT-5505	Cell Biology	3(2-1)
BOT-5506	Field Botany-I	1(0-1)
Total Credit Hour's		16

Semester-VI (Cr. 16)

Course Code	Course Title	Lecture Credit's
BOT-5601	Plant Ecology-1	3(2-1)
BOT-5602	Plant Systematics	3(2-1)
BOT-5603	Plant Biochemistry-I	3(2-1)
BOT-5604	Plant Physiology- I	3(2-1)
BOT-5605	Biostatistics	3(2-1)
BOT-5606	Field Botany-II	1(0-1)
Total Credit Hour's		16

**Year-IV
Semester-VII (Cr. 18)**

Course Code	Course Title	Lecture Credit's
BOT-6701	Plant Ecology-II	3(2-1)
BOT-6702	Genetics-I	3(2-1)
BOT-6703	Research Methodology	3(2-1)
BOT-6704	Plant Biochemistry-II	3(2-1)
BOT-6705	Plant Physiology-II	3(2-1)
BOT-6706	Thesis/Optional Paper	3(3-0)
Total Credit Hour's		18

**Year-IV
Semester-VIII (Cr. 15)**

Course Code	Course Title	Lecture Credit's
BOT-6801	Principals of Biotechnology	3(2-1)
BOT-6802	Plant Anatomy	3(2-1)
BOT-6803	Biodiversity and Conservation	3(2-1)
BOT-6804	Genetics-II	3(2-1)
BOT-6706	Thesis/Optional Paper	3(3-0)
Total Credit Hour's		15

6. Andrew, H. N. 1961. Studies in Paleobotany. John Willey and Sons.
7. Ingrouille , M. 1992. Diversity and Evolution of Land Plants. Chapman & Hall .
8. Mauseth, J.D. 2003. Botany: An Introduction to Plant Biology 3rd ed., Jones and Bartlett Pub. UK
9. Marti.J.Ingrouille & Plant: Diversity and Evolution. 2006 CUP
10. Taylor, T.N. & Taylor, E.D. 2000. Biology and Evolution of Fossil Plants. Prentice Hall. N.Y.

ENG-3101

English I

3(3-0)

Objectives

Enhance language skills and develop critical thinking.

Course Contents

Basics of Grammar in detail, Parts of speech and use of articles in detail, Sentence structure, active and passive voice, Practice in unified sentence, Analysis of phrase, clause and sentence structure, Transitive and intransitive verbs, Punctuation and spelling

Comprehension

Answers to questions on a given text

Discussion

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

Listening

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

Translation skills:

Urdu to English

Paragraph writing

Topics to be chosen at the discretion of the teacher

Presentation skills

Introduction

Note: Extensive reading is required for vocabulary building

Recommended books

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492
2. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506.
3. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7, Pages 20-27 and 35-41.
4. Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 45340.

COM-3102

Introduction to Computer

2(1-1)

Aims and Objectives

The course is designed to aim at imparting a basic level appreciation program for students. After completing the course, the students must be able to the use the computer for basic purposes of preparing their

personnel reports, presentation letters, viewing information on Internet (the web), sending mails, receiving mail, using internet etc.

Course Outlines

History, classification, basic components, CPU, memory, peripheral devices, storage media and devices, machine cycle, Computer Bus, Data Bus, Address Bus, Control Bus, programs and software, system software, application software, operating systems, types of programming languages, compilation and interpretation, basic concept of computer networks, LAN, MAN, WAN, client /server network, peer to peer network, network topology and it types.

Lab Outline

Networking devices, Introduction to office tools (Microsoft word, excel and power point) , Introduction to various operating systems, Use of internet, viewing information on internet, sending and receiving emails, searching topics on internet.

Recommended Books

1. Brian Williams and Stacey Sawyer, Using Information Technology, Latest Edition, McGraw-Hill, ISBN: 0072260718.
2. Behrouz A. Forouzan, Data Communication and Networking, Latest Edition, Alan R. Apt, ISBN:13 978-0-07-296775-3.
3. William Stallings, Computer Organization and Architecture: Designing for Performance, Latest Edition, Prentice Hall, ISBN: 0131856448

MATH-3103

Mathematics I

2(2-0)

Specific Objectives of the Course

To prepare the students, not majoring in mathematics, with the essential tools of algebra to apply the concepts and the techniques in their respective disciplines.

Course Outline

Preliminaries: Real-number system, complex numbers, introduction to sets, set operations, functions, types of functions. **Matrices:** Introduction to matrices, types, matrix inverse, determinants, system of linear equations, Cramer's rule. **Quadratic Equations:** Solution of quadratic equations, qualitative analysis of roots of a quadratic equations, equations reducible to quadratic equations, cube roots of unity, relation between roots and coefficients of quadratic equations. **Sequences and Series:** Arithmetic progression, geometric progression, harmonic progression. **Trigonometry:** Fundamentals of trigonometry, trigonometric identities.

Recommended Books

1. Dolciani M. P, Wooton W, Beckenback E F, Sharron S, Algebra 2 and Trigonometry, 1978, Houghton & Mifflin, Boston
2. Boston (suggested text)
3. Kaufmann J. E, College Algebra and Trigonometry, 1987, PWS-Kent Company, Boston
4. Swokowski E. W., Fundamentals of Algebra and Trigonometry (6th edition), 1986, PWS-Kent Company, Boston

1. Introduction to Inorganic Chemistry

History and development of Inorganic chemistry

2. The Periodic Law and Periodicity

Modern Periodic Table; Classification of elements based on *s*, *p*, *d* and *f* orbitals; group trends, and periodic properties in *s*, *p*, *d* and *f* block elements, i.e. atomic radii, ionic radii, ionization potential, electron affinities, electronegativities and redox potential; anomalies in group trends and periodic properties, the uniqueness principle, the diagonal effect and the inert pair effect

3. Introduction to Classes and Nomenclature of Organic Compounds

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

4. Chemical Bond

Localized and delocalized chemical bonding; concept of hybridization leading to bond angles, bond lengths, bond energies and shapes of organic molecules.

5. Introduction to Biochemistry

Applications of Biochemistry, disciplines related to Biochemistry, biochemistry of the cell. Introduction to biomolecules, classification, composition and biological roles of nucleic acids, proteins, carbohydrates, lipids, vitamins and minerals

6. Introduction to Physical Chemistry

Introduction; physical states of matter.

Recommended Books

1. Mingos D. M. P. "Essential Trends in Inorganic Chemistry" Oxford University Press, First Indian Edition, 2004.
2. Madan R. D. "Satya Prakash's Modern Inorganic Chemistry" S. Chand and Company Limited, 2011.
3. Rodgers G. E. "Introduction to Coordination, Solid State and Descriptive Inorganic Chemistry" McGraw-Hill, Inc.

Aims and Objectives

The course aims to impart knowledge and understanding of:

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

Course Contents

Scope of Zoology: Introduction; significance and applications of zoology; animal diversity; the scientific method; environment and world resources. **The Chemical Basis of Animal Life:** Brief introduction to biomolecules; carbohydrates, lipids, proteins, and nucleic acids. **Cellular Organization:** Structure of animal cells, cell membrane, cytoplasm and its organelles: ribosomes, endoplasmic reticulum, Golgi apparatus, lysosomes, mitochondria, cytoskeleton, cilia and flagella, centrioles and microtubules, and vacuoles; ribosomes, endoplasmic reticulum, the nucleus: nuclear envelope, chromosomes and nucleolus. **Animal tissues:** Types: epithelial, connective, muscle and nervous tissue; organs and organ systems. **Enzymes:** Structure, types; function and factors affecting their activity; cofactors and coenzymes. **Energy Harvesting:**

Aerobic and anaerobic respiration: glycolysis, citric acid cycle and electron transport chain; fermentation, the major source of ATP. **Reproduction and Development:** Types; asexual and sexual, gametogenesis, fertilization, metamorphosis, zygote and early development. **Ecological Concepts:** Individuals and Populations: Animals and their abiotic environment; populations and limiting factors; Communities and Ecosystems: Community structure and diversity; interspecific interactions. Ecosystem, types, homeostasis, biomes, food chain, food web, energy flow and thermodynamics; biogeochemical cycles; Ecological problems; human population growth, pollution, resource depletion and biodiversity.

Practical

1. Tests for different carbohydrates, proteins and lipids.
Note: Emphasis on the concept that tests materials have been ultimately obtained from living organisms and constituted their body.
Study of the prepared slides of epithelial tissue (squamous, cuboidal, columnar), connective tissue (adipose, cartilage, bone, blood), nervous tissue and muscle tissue (skeletal, smooth and cardiac).
Note: Prepared microscopic and/or projection slides and/or CD ROM computer projections must be used.
2. Preparation of blood smears.
3. Plasmolysis and deplasmolysis in blood.
4. Protein digestion by pepsin.
5. Ecological notes on animals of a few model habitats.
6. Field observation and report writing on animals in their ecosystem (a terrestrial and an aquatic ecosystem study).

Recommended Books

1. Hickman, C.P., Roberts, L.S. and Larson, A. Integrated Principles of Zoology, 12th Edition (International), 2004. Singapore: McGraw Hill.
2. Miller, S.A. and Harley, J.B. Zoology, 6th Edition (International), 2005. Singapore: McGraw Hill.
3. Campbell, N.A. Biology, 6th Edition. 2002. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.
4. Miller, S.A. General Zoology Laboratory Manual. 5th Edition (International), 2002. Singapore: McGraw Hill.
5. Hickman, C.P. and Kats, H.L., Laboratory Studies In Integrated Principles Of Zoology. 2000. Singapore: McGraw Hill.
6. Molles, M.C. Ecology: Concepts and Applications. 6th Edition. 2005. McGraw Hill, New York, USA.
7. Odum, E. P. Fundamentals of Ecology. 3rd Edition. 1994. W.B. Saunders. Philadelphia.

Practicals

Anatomy

1. Study of stomata, epidermis,
2. Tissues of primary body of plant
3. Study of xylem 3-dimensional plane of wood.
4. T.S of angiosperm stem and leaf.

Taxonomy

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

Recommended Books:

1. Mauseth, J.D. 1998. An Introduction to Plant Biology: Multimedia Enhanced. Jones and Bartlett Pub. UK
2. Moore, R.C., W.D. Clarke and Vodopich, D.S. 1998. Botany. McGraw Hill Company, U.S.A.
3. Raven, P.H., Evert, R.E. and Eichhorn, S.E. 1999. Biology of Plants. W.H. Freeman and Company Worth Publishers.
4. Stuessy, T.F. 1990. Plant Taxonomy. Columbia University Press, USA.
5. Lawrence, G.H.M. 1951 Taxonomy of Vascular Plants. MacMillan & Co. New York.
6. Panday, B.P. 2004. A textbook of Botany (Angiosperms). S. Chand and Co. New Delhi.
7. Raymond E, S. E. Eichhorn. 2005. Esau's Plant Anatomy. Meristems cells and tissues of the plant body, 3rd ed. John Wiley & Sons. Inc.
8. Fahn, A. 1990. Plant Anatomy. Pergamon Press, Oxford.
9. Esau, K. 1960. Anatomy of Seed Plants. John Wiley, New York.
10. Maheshwari, P.1971. Embryology of Angiosperms, McGraw Hill. New York.
11. Eames A.J. and L.H Mac Daniels. 2002. An Introduction to Plant Anatomy. Tata-Mac Graw-Hill Publishing Company, Limited New Delhi.
12. Pullaiah, T. 2007. Taxonomy of Angiosperms. 3rd Edition Regency Publications, New Delhi.
13. Naik, V.N. 2005 Taxonomy of Angiosperms. 20th Reprint. Tata-Mac Graw-Hill Publishing Company, Limited New Delhi.

ENG-3201

English II

3(3-0)

Objectives:

Enable the students to meet their real life communication needs.

Course Contents

Paragraph writing: Practice in writing a good, unified and coherent paragraph, **Essay writing:** Introduction, **CV and job application:** Translation skills, Urdu to English, **Study skills:** Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension, **Academic skills:** Letter/memo writing, minutes of meetings, use of library and internet, **Presentation skills:** Personality development (emphasis on content, style and pronunciation)

Note: Documentaries to be shown for discussion and review

Communication Skills

- a) Grammar

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. 3rd Edition. Oxford University Press 1986. ISBN 0 19 431350 6.

b) Writing

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 019 435405 7 Pages 45-53 (note taking).
2. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).

c) Reading

1. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 4534030.
2. Reading and Study Skills by John Langan
3. Study Skills by Richard York.

ISL-3202

Islamic Studies / Ethics

2(2-0)

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

Basic Concepts of Quran, History of Quran, Uloom-ul –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), 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), Verses of Surah Al-Saf Related to Tafakar, Tadabar (Verse No-1,14), 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, 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, Basic Concepts of Hadith, History of Hadith, Kinds of Hadith, Uloom-ul-Hadith, Sunnah & Hadith, Legal Position of Sunnah, 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, Basic Concepts of Islamic Culture & Civilization, Historical Development of Islamic Culture & Civilization, Characteristics of Islamic Culture & Civilization, Islamic Culture & Civilization and Contemporary Issues, Basic Concepts of Islam & Science, Contributions of Muslims in the Development of Science, Quranic & Science, Basic Concepts of Islamic Economic System, Means of Distribution of wealth in Islamic Economics, Islamic Concept of Riba, Islamic Ways of Trade & Commerce, Basic Concepts of Islamic Political System, Islamic Concept of Sovereignty, Basic Institutions of Govt. in Islam, Period of Khlaft-E-Rashida, Period of Ummayyads, Period of Abbasids, Basic Concepts of Social System of Islam, Elements of Family, Ethical Values of Islam.

Reference Books:

- 1) Hameed ullah Muhammad, "Emergence of Islam", IRI, Islamabad
- 2) Hameed ullah Muhammad, "Muslim Conduct of State"
- 3) Hameed ullah Muhammad, 'Introduction to Islam

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

CHM-3201

Organic Chemistry

3(2-1)

Properties 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.

Hydrocarbons

Discussion on the preparation, properties and reactions of alkanes, alkenes, alkynes and aromatics.

Oxygenated Hydrocarbons

Discussion on the preparation, properties and reactions of alcohols (phenols), ethers, aldehydes, ketones, carboxylic acids and derivatives.

Introductory Organic Spectroscopy

Introduction to IR, UV, ¹H-NMR and Mass spectrometric methods, and their usage for structure elucidation of some simple organic compounds.

Practicals:

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

Books Recommended:

- 1) Furniss, B. S., Hannaford, A. J., Smith, P. W. G., Tatchell, A. R., Vogel's Textbook of Practical Organic Chemistry, 5th ed., Longman, UK, (1989).
- 2) Pavia, D. L., Kriz, G. S., Lampman, G. M. and Engel, R. G., A Microscale Approach to Organic Laboratory Techniques, 5th ed., Brooks/ Cole Cengage Learning, (2013).
- 3) Mayo, D. W., Pike, R. M. and Forbes, D. C., Microscale Organic to Laboratory with Multistep and Multisacle Syntheses, 5th ed., John-Wiley & Sons, Inc., (2011).
- 4) Gilbert, J. C. and Martin, S. F., Experimental Organic Chemistry: A Miniscale and Microscale Approach, 5th ed., Brooks/ Cole Cengage Learning, (2010).
- 5) Brown, W. H., Fotte, C. S., Iverson, B. L. and Anslyn, E. V., Organic Chemistry, 6th ed., Brooks/ Cole Cengage Learning, (2012).

ZOO-3206

Principles of Animal Life-II

3(2-1)

Aims and Objectives

The course will impart knowledge and understanding of:

1. Cell division and its significance in cell cycle.
2. Concepts and mechanisms of inheritance pattern, chromosome and gene linkage and molecular basics of genetics.
3. Animal behaviour and communication.

4. Theories of evolution, gene flow and mechanism of evolution with reference to animals and diversity.

Course Contents

Cell Division: Cell cycles: Mitosis and meiosis; control of the cell cycle. **Inheritance Patterns:** Mendelian genetics; inheritance patterns; gene, structure, chemical composition and types. **Chromosomes and Gene Linkage:** Eukaryotic chromosomes; linkage and crossing over; chromosomal aberrations. **Molecular Genetics: Cellular Control: DNA:** the genetic material; DNA replication in prokaryotes and eukaryotes; control of gene expression in eukaryotes; gene mutation; recombinant DNA and applications of genetic technologies. **Animal Behaviour:** Behaviour and its types, proximate and ultimate causes; anthropomorphism; development of behavior; learning; factors controlling animal behavior; communication; behavioral ecology; social behavior. **Evolution:** A Historical Perspective: Theories of evolution: Lamarckism and natural selection, neo lamarckism, Darwinism, and neo Darwinian. **Evolution and Gene Frequencies:** Hardy-Weinberg principle; evolutionary mechanisms: population size, genetic drift, gene flow, de Vries mutation theory and rates of evolution, polymorphism; species and speciation; molecular evolution; mosaic evolution.

Recommended Books

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. 2000. New York: McGraw Hill.
5. Campbell, N.A. Biology, 6th Edition. Menlo Park, California: 2002. Benjamin/Cummings Publishing Company, Inc.

Practicals

1. Study of mitosis in onion root tip.
1. Study of meiosis in grasshopper testis (students should prepare the slide).
2. Problem based study of Mendelian ratio in animals.
3. Multiple alleles study in blood groups.
4. Survey study of a genetic factor in population and its frequency.
5. Study of karyotypes of *Drosophila*, mosquito.
6. Study of cytochemical detection of DNA in protozoa and avian blood cell.
7. Study to demonstrate nervous or endocrine basis of behaviour (conditioned reflex or aggression or parental behavior).
8. Study to demonstrate social behaviour (documentary film be shown, honey bee, monkey group in a zoo).

Note for 1-2: Prepared microscopic and/or projection slides and/or CD ROM computer projections must be used).

Recommended Books

1. Miller, S.A. General Zoology Laboratory Manual. 5th Edition (International), 2002. Singapore: McGraw Hill.
2. Hickman, C.P. and Kats, H.L. Laboratory Studies In Integrated Principles Of Zoology. 2000. Singapore: McGraw Hill.

STA-3203

Introduction to Statistics

2 (2-0)

What is Statistics?

Definition of Statistics, Population, Observations, Data, Discrete and continuous variables, Errors of measurement, Significant digits, Rounding of a Number, Collection of primary and secondary data, Sources, Editing of Data.

Presentation of Data

Introduction, basic principles of classification and Tabulation, Graphs and their Construction, Bar charts, Pie chart, Histogram, Frequency polygon and Frequency curve, Cumulative Frequency Polygon or Ogive, Histogram, Ogive for Discrete Variable. Types of frequency curves.

Measures of Central Tendency

Introduction, Different types of Averages, Quantiles, The Mode, Empirical Relation between Mean, Median and mode, Relative Merits and Demerits of various Averages. Properties of Good Average, Box and Whisker Plot, Stem and Leaf Display, definition of outliers and their detection. Exercises.

Sampling and Sampling Distributions

Introduction, sample design and sampling frame, bias, sampling and non-sampling errors, sampling with and without replacement, probability and non-probability sampling, Sampling distributions for single mean and proportion, Difference of means and proportions.

Hypothesis Testing

Introduction, Statistical problem, null and alternative hypothesis, Type-I and Type-II errors, level of significance, Test statistics, general procedure for testing of hypothesis.

Recommended Books:

1. Walpole, R. E. 1982. "Introduction to Statistics", 3rd Ed., Macmillan Publishing Co., Inc. New York.
2. Muhammad, F. 2005. "Statistical Methods and Data Analysis", Kitab Markaz, Bhawana Bazar Faisalabad.

COURSE CONTENTS OF COMPULSORY/GENERAL FACULTY COURSES FOR BS-4 YEAR PROGRAM IN BOTANY

Year-II SEMESTER-III (Cr. 15)

Course Code	Course Title	Lecture Credit's
BOT-4301	Cell Biology, Genetics and Evolution	4(3-1)
PKS-4301	Pakistan Studies	2(2-0)
ENG-4302	Report writing	3(3-0)
CHM-4301	Physical Chemistry	3(2-1)
ZOO-4305	Animal Diversity-I	3(2-1)
Total Credit Hour's		15

Note: The course contents of courses other than Botany will be adopted as prescribed by the relevant departments/University/HEC.

Aims and Objectives

To understand

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

Course Contents**a) Cell biology**

1. Structures and Functions of Bio-molecules
Carbohydrates, Lipids, Proteins, Nucleic Acids
2. Cell: Physico-chemical nature of plasma membrane and cytoplasm.
3. Ultrastructure of plant cell with a brief description and functions of the following organelles
Cell wall, Endoplasmic reticulum, Plastids, Mitochondria, Ribosomes, Dictyosomes, Vacuole, Microbodies (Glyoxysomes and Peroxisomes)
4. Nucleus: Nuclear membrane, nucleolus, ultrastructure and morphology of chromosomes, karyotype analysis
5. Reproduction in somatic and embryogenic cell, mitosis and meiosis, cell cycle
6. Chromosomal aberrations; Changes in the number of chromosomes. Aneuploidy and euploidy. Changes in the structure of chromosomes, deficiency, duplication, inversion and translocation.

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. Transmission of genetic material in Bacteria: Conjugation and gene recombination in *E.coli*, transduction and transformation.
6. Principles of genetic engineering / biotechnology; Basic genetic engineering techniques.
7. Application of genetics in plant improvement: Induction of genetic variability (gene mutation, recombination), physical and chemical mutagens, selection, hybridization and plant breeding techniques. Development and release of new varieties.
8. Introduction to germplasm conservation

c) Evolution

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

Practical

Study of cell structure using compound microscope and elucidation of ultrastructure from electron microphotographs

1. Measurement of cell size.
2. Study of mitosis and meiosis by smear/squash method and from prepared slides.
3. Study of chromosome morphology and variation in chromosome number.
4. Extraction and estimation of carbohydrate, protein, RNA and DNA from plant sources

Genetics

1. Genetical problems related to transmission and distribution of genetic material.
2. Identification of DNA in plant material. Carmine/orcein staining.
3. Study of salivary gland chromosomes of *Drosophila*.

Recommended Books:

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

PKS-4301

Pakistan Studies

2(2-0)

Introduction/Objectives:

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 Outlines:

1. Historical Perspective

Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam M. Ali Jinnah. Factors leading to Muslim separatism. PEOPLE AND LAND: Indus Civilization, Muslim advent, Location and geo-physical features. GOVERNMENT AND POLITICS IN PAKISTAN: Political and constitutional phases, 1947-58, 1958-71, 1971-77, 1977-88, 1988-99 and 1999 onward, CONTEMPORARY PAKISTAN: Economic institutions and issues, Society and social structure, Ethnicity, Foreign policy of Pakistan and challenges, Futuristic outlook of Pakistan

Books Recommended:

1. Burki, Shahid Javed. State & Society in Pakistan, The Macmillan Press Ltd 1980.
2. Akbar, S. Zaidi. Issue in Pakistan's Economy. Karachi: Oxford University Press, 2000.
3. S.M. Burke and Lawrence Ziring. Pakistan's Foreign policy: An Historical analysis. Karachi: Oxford University Press, 1993.
4. Mehmood, Safdar. Pakistan Political Roots & Development. Lahore, 1994.
5. Wilcox, Wayne. The Emergence of Bangladesh., Washington: American Enterprise, Institute of Public Policy Research, 1972.

6. Mehmood, Safdar. Pakistan Kayyun Toota, Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.
7. Amin, Tahir. Ethno - National Movement in Pakistan, Islamabad: Institute of Policy Studies, Islamabad.
8. Ziring, Lawrence. Enigma of Political Development. Kent England: WmDawson & sons Ltd, 1980.
9. Zahid, Ansar. History & Culture of Sindh. Karachi: Royal Book Company, 1980.
10. Afzal, M. Rafique. Political Parties in Pakistan, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.
11. Sayeed, Khalid Bin. The Political System of Pakistan. Boston: Houghton Mifflin, 1967.
12. Aziz, K.K. Party, Politics in Pakistan, Islamabad: National Commission on Historical and Cultural Research, 1976.
13. Muhammad Waseem, Pakistan Under Martial Law, Lahore: Vanguard, 1987.
14. Haq, Noor ul. Making of Pakistan: The Military Perspective. Islamabad: National Commission on Historical and Cultural Research, 1993.
15. Amin, Tahir. *Ethno - National Movement in Pakistan*, Islamabad: Institute of Policy Studies, Islamabad.

ENG-4302

Report writing

3(3-0)

Objectives:

Enhance language skills and develop critical thinking

COURSE CONTENTS: PRESENTATION SKILLS: ESSAY WRITING: Descriptive, narrative, discursive, argumentative, ACADEMIC WRITING: How to write a proposal for research paper/term paper. How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency), TECHNICAL REPORT WRITING: PROGRESS REPORT WRITING. Extensive reading is required for vocabulary building.

Recommended Books:

Technical Writing and Presentation Skills

a) Essay Writing and Academic Writing

1. Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 435407 3 (particularly suitable for discursive, descriptive, argumentative and report writing).
2. College Writing Skills by John Langan. McGraw-Hill Higher Education. 2004.
3. Patterns of College Writing (4th edition) by Laurie G. Kirszner and Stephen R. Mandell. St. Martin's Press.

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

CHM-4301

Physical Chemistry

3(2-1)

Quantum theory and structure of atom

Bohr's atomic model, defects of Bohr's atomic model, classical mechanics, failure of classical mechanics, quantum mechanics, dual nature of matter, de-Broglie's equation, Heisenberg's uncertainty principle, limitation of Heisenberg's uncertainty principle, concept of atomic orbitals, quantum numbers, Pauli exclusion principle, electronic distribution of elements.

Physical states of matter

1. Gases

General characteristics of gases, Gay Lussac's law, ideal gas equation, kinetic molecular theory of gases, molecular velocities (average velocity, mean square velocity, root mean square velocity, most probable velocity), ideal and real gases, deviation of gas from ideality, derivation of kinetic gas equation, molecular collisions, collision diameter, critical phenomenon of gases, liquefaction of gases, mean free path, Vander Waal's equation for real gases.

2. Liquid

General characteristics of liquids, physical properties like surface tension, viscosity, parachor value, rheochor value and their applications, refractive index, specific and molar refraction and their applications, optical activity, specific rotation, dipole moment and molecular structure.

3. Solids

General characteristics of solids, types of solids, isotropy and anisotropy, habit of a crystal, crystal lattice and unit cell, crystal systems and Bravis lattices.

Chemical Thermodynamics

Introduction, thermodynamic terms like system, surrounding, boundary of system, states and state function, internal energy, extensive and intensive properties, first law of thermodynamics, enthalpy of a system, relationship between free energy change and enthalpy change, heat capacity of gases at constant volume and at constant pressure, , heat capacities relationship, 2nd law of thermodynamics, change in free energy and equilibrium constant.

Chemical Kinetics

Introduction, concept of rate of chemical reaction, rate law, velocity constant, elementary and complex reaction, order and molecularity of reaction, zero, first and second order reactions, derivation of kinetic equation for first order and 2nd order reaction when initial concentration of both reactants is same, various methods for determining the rate of chemical reaction, Arrhenius equation, Lindemann's theory for unimolecular reaction, introduction to transition state theory, transition state theory for bimolecular reaction.

Basic Electrochemistry

Introduction, conductors and insulators, electrolytic and electronic conduction, specific conductance, measurement of specific conductance, cell constant and its determination, Ostwald's dilution law (dependence of degree of dissociation constant on dilution), electrochemical cells, types of cells, EMF and its measurement.

Solutions

Introduction, types of solution, concentration units, ideal and non-ideal solutions, Raoult's law, molecular interactions in solution, colligative properties (lowering of vapour pressure, elevation of boiling point, depression of freezing point, osmotic pressure and their determination), concept of zeotropic and azeotropic mixture.

Surface Chemistry

Absorption and adsorption, types of adsorption, characteristics and factors which affect adsorption, applications of adsorption, catalysis, types of catalysis, enzyme catalysis, characteristics of catalysis.

Practicals:

- Determination of viscosity and parachor values of liquids.
- Determination of percent composition of liquid solutions viscometrically.
- Determination of refractive index and molar refractivity.
- Determination of percent composition of liquid solutions by refractive index measurements.
- Determination of molecular weight of a compound by elevation of boiling point (ebullioscopic method).
- Determination of molecular weight of a compound by lowering of freezing point (cryoscopic method).
- Determination of heat of solution by solubility method.

Recommended Books

1. Hickman, C.P., Roberts, L.S. and Larson, A. Integrated Principles Of Zoology, 15th Edition (International), 2011. Singapore: McGraw Hill.
2. Miller, S.A. and Harley, J.B. Zoology, 8th Edition (International), 2011. Singapore: McGraw Hill.
3. Pechenik, J.A. Biology Of Invertebrates, 4th Edition (International), 2000. Singapore: McGraw Hill.
4. Campbell, N.A. Biology, 6th Edition. 2002. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.

Practicals

1. Museum study of representative phyla, permanent slide preparations
2. Study of *Euglena*, *Amoeba*, *Entamoeba*, *Plasmodium*, *Trypanosoma*,
3. *Paramecium* as representative of animal like protists. (Prepared slides).
4. Study of sponges and their various body forms.
5. Study of principal representative classes of phylum Coelenterata.
6. Study of principal representative classes of phylum Platyhelminthes.
7. Study of representative of phylum Rotifera, phylum Nematoda.
8. Study of principal representative classes of phylum Mollusca.
9. Study of principal representative classes of phylum Annelida.
10. Study of principal representative classes of groups of phylum Arthropoda.
11. Brief notes on medical/economic importance of the following:
12. *Plasmodium*, *Entamoeba histolytica*, *Leishmania*, Liverfluke, Tapeworm, Earthworm,
13. Silkworm, Citrus butterfly.

Recommended Books

1. Hickman, C.P. and Kats, H.L. Laboratory Studies In Integrated Principles Of Zoology. 2000. Singapore: McGraw Hill.
2. Miller, S.A., General Zoology Laboratory Manual. 5th Edition (International), 2002. Singapore: McGraw Hill.

**COURSE CONTENTS OF COMPULSORY/GENERAL FACULTY COURSES FOR BS-4 YEAR
PROGRAM IN BOTANY**

**Year-II
SEMESTER-IV (Cr. 16)**

Course Code	Course Title	Lecture Credit's
BOT-4401	Plant Physiology and Ecology	4(3-1)
BOT-4402	Environmental Biology	3(2-1)
ARB-4401	Arabic	3(3-0)
ZOO-4404	Animal Diversity-II	3(2-1)
CHM-4401	Inorganic Chemistry	3(2-1)
Total Credit Hour's		16

Note: The course contents of courses other than Botany will be adopted as prescribed by the relevant departments/University/HEC.

BOT-4401 Plant Physiology and Ecology

4(3-1)

Aims and objectives

1. To provide comprehensive knowledge of functioning of organs, organelles and biomolecules,
2. To enable the students to assess the effects of various environmental factors on plant growth and development.

Course Contents

a. Plant Physiology

1. Water relations (water potential, osmotic potential, pressure potential, matric potential). Absorption and translocation of water. Stomatal regulation.
2. Mineral nutrition: Soil as a source of minerals. Passive and active transport of nutrients. Essential mineral elements, role and deficiency symptoms of macronutrients.
3. Photosynthesis: Introduction, Oxygenic and non-oxygenic photosynthesis Mechanism: light reactions (electron transport and photophosphorylation) and dark reactions(Calvin cycle). Differences between C₃ and C₄ plants. Factors affecting this process, Products of photosynthesis.
4. Respiration: Definition and respiratory substrates. Mechanism-Glycolysis, Krebs cycle. Electron transport and oxidative phosphorylation. Anaerobic respiration. Energy balance in aerobic and anaerobic respiration, Respiratory quotients.

b. Ecology

1. Introduction, aims and applications of ecology.
2. Soil: Physical and Chemical properties of soil (soil formation, texture. pH, EC, organism and organic matter etc) and their relationships to plants.
3. Light and Temperature. Quality of light, diurnal and seasonal variations. Ecophysiological responses.
4. Water: Field capacity and soil water holding capacity. Characteristics of xerophytes and hydrophytes. Effect of precipitation on distribution of plants.
5. Wind: Wind as an ecological factor and its importance.

Practical:**a. Plant Physiology.**

1. Determination of uptake of water by swelling seeds when placed in sodium chloride solution of different concentrations.
2. Determination of the temperature at which beet root cells lose their permeability.
3. Determination of the effects of environmental factors on the rate of transpiration of a leafy shoot by means of a porometer/by cobalt chloride paper method.
4. Extraction of chlorophyll from the leaves and separation of component pigments on a paper chromatogram. Study of absorption spectra using spectrophotometer.
5. Estimation of oxygen utilized by a respiring plant by Winkler's method.
6. Measurement of carbon dioxide evolution during respiration of germinating seeds by the titration method.
7. Effect of light and temperature on seed germination.

b. Ecology

1. Determination of physical and Chemical characteristics of soil.
2. Field trips to ecologically diverse habitats.
3. Measurements of wind velocity.

Recommended Books:

1. Ihsan Illahi 1995. Plant Physiology, Biochemical Processes in Plants, UGC Press.
2. Witham and Devlin. 1986 Exercises in Plant Physiology, AWS Publishers, Boston.
3. Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4th. Ed. Sinauers Publ. Co. Inc. Calif.
4. Salisbury F.B. and Ross C.B. 1992. Plant Physiology. 5th Edition. Wadsworth Publishing Co. Belmont CA.
5. Hopkins, W.B. 1999. Introduction to Plant Physiology. 2nd Ed. John Wiley and Sons. New York
6. Schultz, J.C. 2005. Plant Ecology. Springer-Verlag, Berlin.
7. Ricklefs, R.E. 2000. Ecology. W.H. Freeman and Co., UK.
8. Ricklefs, R.E. 2001. The Economy of Nature. W.H. Freeman and Co., UK.

BOT-4402 Environmental Biology**3(2-1)****Aims and Objectives**

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

Course Contents

1. Environment: Introduction, scope, pressure
2. Pollution: definition, classification and impact on habitats
 - i. Air pollution: Sources and effect of various pollutants (inorganic, organic) on plants, prevention, control, remediation. Photochemical smog. Smog. Acid rain: 1. Theory of acid rain, 2. Adverse effects of acid rains. Chlorofluorocarbons and its effects.
 - ii. Water pollution: Major sources of water pollution and its impact on vegetation. Prevention, control remediation, eutrophication, thermal pollution.
 - iii. Sediments pollution: fungicide, pesticides, herbicide, major sources of soil pollution and its impact. Prevention, control remediation. Heavy metal pollution. Tanneries. Hospital waste. Treatments of sewage, sludge, and polluted waters.
 - iv. Noise pollution.

- v. Radiation pollution (including nuclear): Measurement, classification and effects, Principle of radiation protection, waste disposal
3. Environmental Buffers. Forest: importance, deforestation, desertification and conservation
4. Ozone layer:
 - i. Formation
 - ii. Mechanism of depletion
 - iii. Effects of ozone depletion
5. Greenhouse effect: causes, impacts.
6. Range management: Types of rangelands, potential threats, sustainable management.

Practical

1. Examination of industrial waste water and Municipal sewage and sludge for
 - i. Total dissolved solids.
 - ii. pH and EC.
 - iii. BOD/COD.
 - iv. Chlorides, carbonate, and Nitrates.
3. Examination of water samples forms different sites for the presence and diversity of organisms.
4. Effect of air pollutants on plants.
5. Visits to environmentally compromised sites and evolution of remediation methods.

Books Recommended:

1. Newman, E.I. 2001. Applied Ecology. Blackwell Science. UK
2. Mooney, H.A. and Saugier, B. 2000. Terrestrial Global Productivity. Academic Press, UK.
3. Eugene, E.D. and Smith, B.F. 2000. Environmental Science: A study of interrelationships. McGraw Hill. USA.
4. French, H. 2000. Vanishing Borders: Protecting the Planet in the Age of Globalization. W.W. Norton and Company, NY.
5. Hall, C.A.S. and Perez, C.L. 2000. Quantifying Sustainable Development. Academic Press, UK.
6. Bazzaz, F.A. 2004. Plants in changing environments: Linking physiological, population, and community ecology. Cambridge Univ. Press.
7. Bush, M.B. 1997. Ecology of a changing planet. Prentice Hall, UK.
8. Marsh, M.W. and Grossa Jr., J.M. 1996 Environmental geography: Science, land use, and earth systems. John Wiley and Sons.
9. Lambers, H., T. L. Pons and F. Stuart. 2008. Plant Physiological Ecology.

اللغة العربية . I

الف) القواعد

تدرس في هذه المرحلة القواعد الأساسية للغة العربية ، التي تكون وسيلة لتقويم اللسان و صحة الكلام في القراءة والكتابة والتحدث . كما يلرب الطلاب على الترجمة من العربية إلى الأردية وبالعكس .

١- الأهداف :

- الف. تنمية قدرات الطلاب على ضبط إعراب الكلمات
 - ب. توسيع مادة الطلاب اللغوية و تلمينهم على كيفية الاشتقاق
 - ج. تعريفهم ما لؤدبه العوامل اللفظية والمعوية في أواخر الكلمة
 - د. تلمينهم على الترجمة من العربية إلى الأردية وبالعكس
- ٢- يراعى في تدريس هذه المادة :
- الف. أن العناية بالتطبيق هي أعظم وسيلة لترسيخ القاعدة في أذهان الطلاب
 - ب. أن يتخذ الملمس من دروس القراءة والإنشاء مجالات يستغلها لتطبيق . و تلمين الطلاب على القواعد التي درسوها .
- ٣- الموضوعات :

أنواع الكلمة : اسم و فعل و حرف . المذكر والمؤنث . أنواع الفعل . الإعراب . الجملة الاسمية والفعلية . المبتدأ والخبر . الفعل والفاعل . المفعول به . إعراب الفعل المضارع . أهم حروف الجر . المركب : الإضافي والتوصيفي . كان وأخواتها . إن وأخواتها . أدوات الاستفهام . المفرد والمثنى والجمع .

(ب) القراءة والتعبير

القراءة طريق للتعلم على جودة النطق وحسن الأداء والعرض على تطبيق القواعد ومخارج الحروف ومقاطع الجمل وسرعة إدراك المعاني ودقة الفهم بواسطتها .

يراعى في القراءة :

✧ أن يالش المعلم للاميد على الانتباه وحسن الإصغاء والإحاطة بالمعاني وإدراك المناقشات التي تلوز في القراءة .

✧ أن ينظم المعلم القراءة بحيث يقرأ كل طالب بعد الآخر قراءة متصلة ، و يرشد التلاميذ إلى صحة القراءة أو إصلاح النطق والأخطاء النحوية .

✧ أن يقدم المفردات الجديدة مع مراعات اختيار الكلمات من ذوات المعنى الحسي الذي يمكن إيضاحه بالصورة .

والتعبير هو الإفصاح عما في النفس من أفكار ومشاعر بالكتابة والمحادثة . ينقسم التعبير إلى تحريري و شفوي .

يراعى في التعبير :

- ✧ أن يصوب التلاميذ الجمل الخاطئة ✧ أن يملأوا الفراغ بكلمات مناسبة
- ✧ أن يربوا الكلمات غير مرتبة حتى تكون جملة مفيدة ✧ أن يتمرروا على الأساليب العالوفة
- ✧ أن يجيبوا على الأسئلة بالعربية .

الكتب المقررة :

- ١- عبدالستار عربي كما معلم الجزء الأول
- ٢- علي الجارم ومصطفى أمين النحو الواضح في قواعد اللغة العربية ، الجزء الأول
- ٣- د. ف. عبدالرحيم دروس اللغة العربية ، الجزء الأول
- ٤- بهو الحسن علي البدوي قصص السبين ، الجزء الأول
- ٥- تدريبات على كتاب قصص السبين

Objectives

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

Hemichordates and Invertebrate Chordates: Evolutionary Perspective: Phylogenetic Relationships; Classification up to subphylum or class where applicable; Further Phylogenetic Considerations. **Fishes:** Vertebrate Success in Water: Evolutionary perspective: phylogenetic relationships; survey of super class agnatha and gnathostomata; evolutionary pressures: adaptations in locomotion, nutrition and the digestive system, circulation, gas exchange, nervous and sensory functions, excretion and osmoregulation, reproduction and development; further phylogenetic considerations. **Amphibians:** The First Terrestrial Vertebrates Evolutionary perspective: phylogenetic relationships; survey of order caudata, gymnophiona, and anura. Evolutionary pressures: 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. **Reptiles:** The First Amniotes Evolutionary perspective: cladistic interpretation of the amniotic lineage; survey of order testudines or chelonia, rhychocephalia, 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. **Birds:** Feathers, Flight, and Endothermy Evolutionary perspective: phylogenetic relationships; 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 regulation, nervous and sensory systems, excretion and osmoregulation, reproduction and development; migration and navigation. **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, behavior, reproduction and development.

Recommended Books

1. Hickman, C.P., Roberts, L.S. and Larson, A. Integrated Principles Of Zoology, 15th Edition (International), 2011. Singapore: McGraw Hill.
2. Miller, S.A. and Harley, J.B. Zoology, 8th Edition (International) 2010. Singapore: McGraw Hill.
3. Kent, G.C. and Miller, S. Comparative Anatomy Of Vertebrates. Latest Edition 200?. New York: McGraw Hill.
4. Campbell, N.A. BIOLOGY, 9th Edition. 2011. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.

Practicals:

1. Museum study of representative phyla.
2. Study of a representative of Hemichordate and Chordate.
3. Study of representative groups of class Fishes.
4. Study of representative groups of class Amphibia.
5. Study of representative groups of class Reptilia.
6. Study of representative groups of class Aves.
7. Study of representative groups of class Mammalia.
8. Field trips to study animal diversity in an ecosystem.

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

Recommended Books

1. Hickman, C.P. and Kats, H.L. Laboratory Studies In Integrated Principles of Zoology. 2000. Singapore: McGraw Hill.
2. Miller, S.A. General Zoology Laboratory Manual. 5th Edition (International), 2002. Singapore: McGraw Hill.

CHM-4401

Inorganic Chemistry

3(2-1)

1. Introduction to Chemical Bonding

Attainment of a stable configuration, types of bonds (ionic bonds, covalent bonds, coordinate bonds), oxidation number and formal oxidation number. The localized bonding approach (Introduction to valence bond theory and hybridization. The delocalized bonding approach (MOT applied to homonuclear diatomic molecules).

2. Acids and Bases

Concepts of acids and bases (Arrhenius, Lowry-Bronsted, Lewis and SHAB concept), relative strength of acids and bases. pH, pKa, pKb and buffer solutions and their significance. Theory of Indicators, solubility, solubility product, common ion effect and their applications.

3. Chemistry of p-block Elements

General characteristics of the following group of p-block elements with reference to the aspects given against each:

Boron and Aluminum

Gradation of the characteristic properties within the group. Structures, properties and applications of electron deficient molecules such as boron hydrides and aluminium hydrides.

Carbon and Silicon

Gradation of the characteristic properties within the group). Production of pure silicon for solar energy and silicon chips. Structural aspects of ortho and metasilicates and their industrial applications.

Nitrogen and Phosphorus

Gradation of the characteristic properties within the group. Oxides of nitrogen (NO and NO₂) and their role in air pollution, oxyacids (HNO₂ and HNO₃) of nitrogen. Industrial preparation of urea and superphosphate fertilizers.

Oxygen and Sulfur 26 Gradation of the characteristic properties within the group. Role of sulphur dioxide in air pollution. Thionic acids (H₂SO₃ and H₂SO₄) and uses of hypo in photography.

The Halogens

Gradation of the characteristic properties within the group, anomalous behaviour of fluorine. Preparation of oxyacids of halogens (HClO₃ and HClO₄) and their uses. Interhalogens, pseudohalogens.

The Noble Gases

Preparation, properties and uses of xenon fluorides; Commercial uses of noble gases.

4. Chemistry of d-block Elements

Electronic configuration and general characteristics of d-block elements. Industrial applications of transition metals. Werner's concept and nomenclature of coordination compounds.

5. Introduction to Modern Materials

Liquid crystals, engineering ceramics, fiber glass and thin films.

Practicals

1. Laboratory Ethics and safety measures

Awareness about the toxic nature of chemicals and their handling, cleaning of glassware, safe laboratory operations

2. Qualitative analysis

Analysis of four ions (two anions and two cations) from mixture of salts

3. Quantitative analysis

a. Acid-Base Titrations (minimum 02)

b. Redox Titrations (minimum 02)

c. Complexometric Titrations (minimum 02)

4. Inorganic Preparations

a. Preparation of Ferrous sulphate

b. Preparation of Ferric alum

c. Preparation of Barium sulphate

Recommended Books

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

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

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

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

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

6. Cartmell E. and Fowles G. W. A. "Valency and Molecular Structure" Adlard and Sons Limited 3rd Edition (1966)

7. Douglas B., McDaniel D. and Alexander J. "Concepts and Models of Inorganic Chemistry" John Wiley & Sons, Inc. 3rd Edition (1994)

8. Harvey K. B. and Porter G. B. "Introduction to Inorganic Physical Chemistry" Addison-Wesley Publishing Company, Inc. (1963)

9. Hill J. W. and Petrucci R. H. "General Chemistry" Prentice-Hall, Inc. (1996)

10. Marr G. and Rockett B. W. "Practical Inorganic Chemistry" Van Nostrand Reinhold Company. (1972)

11. Miessler G. L. and Tarr Donald A. "Inorganic Chemistry" Prentice-Hall International, Inc. Prentice-Hall International Edition (1991)

12. Moody B. "Comparative Inorganic Chemistry" Routledge, Chapman and Hall, Inc. 3rd Edition (1991)

13. Kennedy, Friedlander, "Nuclear and Radiochemistry" (latest edition).

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

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

**COURSE CONTENTS OF COMPULSORY/GENERAL FACULTY COURSES FOR BS (5TH SEMESTER)
PROGRAM IN BOTANY**

**Year-III
SEMESTER-V (Cr. 16)**

Course Code	Course Title	Lecture Credit's
BOT-5501	Bacteriology and Virology	3(2-1)
BOT-5502	Diversity of Vascular Plants	3(2-1)
BOT-5503	Phycology and Bryology	3(2-1)
BOT-5504	Mycology and Plant Pathology	3(2-1)
BOT-5505	Cell Biology	3(2-1)
BOT-5506	Field Botany-I	1(0-1)
Total Credit Hour's		16

BOT-5601

Bacteriology and Virology

3(2-1)

Aims and objectives

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

Course Contents

a. Viruses

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

b. Bacteria

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

Practical:

a. Viruses

Observation of symptoms of some viral infected plant specimens.

b. Bacteria, Actinomycetes and Cyanobacteria

1. Methods of sterilization of glassware and media etc.
2. Preparation of nutrient medium and inoculation.
3. Preparation of slides for the study of various forms, capsule/slime layer, spores, flagella and Gram-staining.

4. Growth of bacteria, subculturing and identification of bacteria on morphological and biochemical basis (using available techniques).
5. Microscopic study of representative genera of Actinomycetes and Cyanobacteria from fresh collections and prepared slides.

Recommended Books:

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

BOT-5602

Diversity of Vascular Plants

3(2-1)

Aims and objectives

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

Course Contents:

a. Pteridophytes

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

b. Origin and Evolution of seed habit

c. Gymnosperms:

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

d. Angiosperms:

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

e. Palynology:

1. An introduction to Neopalynology and Paleopalynology, its applications in botany, geology, archaeology, criminology, medicines, honey and oil and gas exploration.
2. Basic information about the nomenclature, morphology and classification of living and fossil pollen and spores.

Practicals:

1. To study the morphological and reproductive features of available genera.
2. Study trips to different parts of Pakistan for the collection and identification of important pteridophytes, gymnosperms and angiosperms.

Recommended Books

1. Beck, C.B. 1992. Origin and Evolution of Gymnosperms. Vol-1&II, Columbia University Press, New York,
2. Foster, A.S. and Gifford, E. M. Jr. 1998. Comparative Morphology of Vascular Plants. W. H. Freeman and Co.
3. Jones, D. 1983. Cycadales of the World, Washington, DC.
4. Mauseth, J.D. 1998. An Introduction to Plant Biology, Multimedia Enhanced, Jones and Bartlett Pub. UK.

5. Moore, R.c., W.d. Clarke and Vodopich, D.S. 1998. Botany McGraw Hill Company, USA
6. Raven, P.H. Evert, R.E. and Eichhorn, S.E. 1999. Biology of Plants, W.H. Freeman and Company Worth Publishers.
7. Ray, P.M. Steeves, T.A. and Fultz, T.A. 1998. Botany Saunders College Publishing, USA.
8. Taylor, T.N. and Taylor, E.D. 2000. The Biology and Evolution of Fossil Plants, Prentice Hall.
9. Stewart, W. N. and Rothwell, G.W. 1993. Paleobotany and the Evolution of Plants, University Press, Cambridge.
10. Faegri, K., P.E. Kaland & K. Krzywinski 1989. Text Book of Pollen Analysis, Jhon Wiley & Sons. N.Y.

BOT-5603 Phycology and Bryology

3(2-1)

Aims and objectives

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

Course Contents

a. **Phycology**

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

b. **Bryology**

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

Practical:

a. **Phycology:**

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

b. **Bryology**

Study of the following genera:

Pellia, Porella, Anthoceros and Polytrichum.

Recommended Books

1. Bold, H. C. and M.J. Wynne 1985. Introduction to Algae: structure and reproduction. Prentice Hall Inc. Engle Wood Cliffs
2. Lee. R.E. 1999. Phycology. Cambridge University Press, U.K.
3. Dawson, E.Y., Halt. 1966. Marine Botany. Reinhart and Winstan, New York.
4. Chapman, V.J. and D.J. Chapman. 1983. Sea weed and their uses. McMillan and Co. Ltd. London.
5. Vashishta. B. R. 1991. Botany for degree students. Bryophytes 8th ed. S. Chand and Co. Ltd. Delhi.
6. Schofield, W.B. 1985. Introduction to Bryology. Macmillan Publishing Co. London.
7. Hussain, F. and I. Ilahi. 2004. A text book of Botany. Department of Botany, University of Peshawar.

Aims and objectives

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

Course Contents**a. Mycology**

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

b. Pathology

1. Introduction and classification of plant diseases.
2. Symptoms, causes and development of plant diseases
3. Loss assessment and disease control
4. Epidemiology and disease forecast
5. Important diseases of crop plants and fruit trees in Pakistan caused by fungi, e.g. damping off, mildews, rusts, smuts, shisham dieback etc.

Practical:**a. Mycology**

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

b. Pathology

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

Recommended Books:

1. Agrios, G.N., 2005. Plant Pathology, Academic Press, London.
2. Ahmad, I. and Bhutta, A.R., 2004. Textbook of Introductory Plant Pathology. Book Foundation, Pakistan.
3. Alexopoulos, C.J., Mims, C.W. and Blackwell, M., 1996. Introductory Mycology, 4th ed. John Wiley & Sons.
4. Khan, A.G. and Usman, R., 2005. Laboratory Manual in Mycology and Plant Pathology. Botany Department Arid Agriculture University, Rawalpindi.
5. Mehrotra, R.S. and Aneja, K.R., 1990. An Introduction to Mycology. Wiley and Eastern Ltd., New Delhi, India.
6. Moore-Landecker, E., 1996. Fundamentals of Fungi. 4th edn. Prentice Hall Inc., New Jersey, USA.
7. Trigliano, R.N., Windham, M.T. and Windham, A.S., 2004. Plant Pathology: Concepts and Laboratory Exercises. CRC Press, LLC, N.Y.

Aims and Objectives

To understand the structure and functions of cell and main functions of all of the major organelles in eukaryotic cells

Course outline:

1. **Introduction:** cell theory, structure of plant cell, prokaryotes and Eukaryotes cell
2. **Cell:** Physio-chemical nature of plasma membrane and cytoplasm.
3. **Ultrastructure of plant cell** with a brief description and functions of the following organelles
 - a. Cell wall
 - b. Endoplasmic reticulum
 - c. Plastids
 - d. Mitochondria
 - e. Ribosomes
 - f. Dictyosomes
 - g. Vacuole
 - h. Microbodies (Glyoxysomes and Peroxisomes)
4. **Nucleus:** Nuclear membrane, nucleolus, ultrastructure and morphology of chromosomes, karyotype analysis.
5. **Chromosomes:** Morphology and molecular structure of prokaryotic and eukaryotic chromosome, significance of histones and high mobility proteins in packing of chromosome and gene expression.
6. **Reproduction in somatic and embryogenic cell:** general description of mitosis, cytokinesis and significance of Mitosis, types of meiosis, the first meiotic division, genetic consequences of meiosis, cell cycle.

Practical

1. Cell structure in the staminal hair of *Tradescantia*.
2. Measurement of cell size
3. Microchemical detection of following in the structure of the plant cell. Protein, carbohydrate, cellulose, cutin, pectin.
4. Plastids in various plants. *Spirogyra*, *Hydrilla*, *Tradescantia*, *Daucus carota*, *Arisaema*, *Solanum tuberosum*, *Lycopersicon esculentum*, and *Citrus*.
5. Mitosis: Smear / squash preparation of onion roots.
6. Meiosis: Smear / squash preparation from anthers of plants such as oat, onion, wheat, maize etc.
7. Germination of pollen grains of various vascular plants.
8. Demonstration of cell structure through photograph of electron microscope

Books Recommended

1. De. Robertis, E.P. and De. Robertis, E.M.F. Cell and Molecular Biology, 8th Edition, 2001, Holt Lea and Febiger, New York.
2. Lodish, H. Baltimore, D. Berk, A. Zipurshy, S.L. Matsudaira, P. Darnell, J. 2001. Molecular Biology of the Cell. Scientific American Books, W.H. Freeman and Company, New York.
3. Alberts, B., Bray, D. Lewis, J. Raff, M., Roberts, K and Watson, J.D 1994, Molecular Biology of the cell, Garland Publishing Inc. New York.
4. Darnell, Jr. J. Lodisch, H. and Baltimore, D. 1990. Molecular Biology of the cells, Scientific American Inc. N.Y.
5. Swanson, C.P., Merz, T. and Young, W.J. 1990 (second edition) Cytogenetics: The chromosome in division, inheritance and evolution. Prentice-Hall Inc.

BOT-5606**Field Botany-I****1(0-1)****Aims and Objectives**

The basic objective of this course is to acquaint the students with natural flora and fauna in various regions through field trips.

Teaching Methodology

It will involve organizing botanical excursions and visits to various locations pertaining to the courses being taught in 1st semester. The students will have to go for field study trip to the place of the choice of the course incharge(s) and prepare a field report. The team of accompanying teachers will evaluate the level of academic interest, team-spirit, cooperativeness, discipline and other non-scholastic attributes, apart from the Field Report submitted by the students. The senior most teacher in the group will act as Convener of this course and will be responsible to submit the final award to departmental examination committee.

**COURSE CONTENTS OF COMPULSORY/GENERAL FACULTY COURSES FOR BS (6TH SEMESTER)
PROGRAM IN BOTANY**

**Year-III
SEMESTER-VI (Cr. 16)**

Course Code	Course Title	Lecture Credit's
BOT-5601	Plant Ecology-1	3(2-1)
BOT-5602	Plant Systematics	3(2-1)
BOT-5603	Plant Biochemistry-I	3(2-1)
BOT-5604	Plant Physiology- I	3(2-1)
BOT-5605	Biostatistics	3(2-1)
BOT-5606	Field Botany-II	1(0-1)
Total Credit Hour's		16

BOT-5601**Plant Ecology I****3(2-1)****Aims and objectives:**

To understand the role and interaction of plants with their environment.

Course Contents:

1. Introduction: history and recent developments in ecology
2. Soil: Nature and properties of soil (Physical and Chemical). Water in the soil-plant-atmosphere continuum. The ionic environment and plant ionic relations, Nutrient cycling. Physiology and ecology of N, S, P and K nutrition. Heavy metals (brief description), Salt and drought stress and osmoregulation. Soil erosion
3. Light and temperature: Nature of light, Factors affecting the variation in light and temperature, Responses of plants to light and temperature, Adaptation to temperature extremes,
4. Carbon dioxide: Stomatal responses, water loss and CO₂-assimilation rates of plants in contrasting environments. Ecophysiological effects of changing atmospheric CO₂ concentration. Functional significance of different pathways of CO₂ fixation. Productivity: response of photosynthesis to environmental factors, C and N balance

5. Water: Water as an environmental factor, Role of water in the growth, adaptation and distribution of plants, Water status in soil. Water and stomatal regulation, Transpiration of leaves and canopies.
6. Oxygen deficiency: Energy metabolism of plants under oxygen deficiency, Morpho-anatomical changes during oxygen deficiency, Post-anoxic stress
7. Wind as an ecological factor.
8. Fire as an ecological factor.

Practical:

1. Determination of physico-chemical properties of soil and water.
2. Measurements of light and temperature under different ecological conditions.
3. Measurements of wind velocity.
4. Measurement of CO₂ and O₂ concentration of air and water.
5. Effect of light, temperature, moisture, salinity and soil type on germination and growth of plants.
6. Measurement of ions, stomatal conductance, osmotic potential, water potential, xylem pressure potential, leaf area and rate of CO₂ exchange in plants in relation to various environmental conditions.

Recommended Books:

1. Schultz, J. C. 2005. Plant Ecology, Springer-Verlag
2. Bazzaz, F.A. 2004. Plants in Changing Environments: Linking Physiological, Population, and Community Ecology, Cambridge University Press
3. Chapin, F.S. et al. 2002. Principle of Terrestrial Plant Ecology, Springer-Verlag
4. Lambers, H. et al. 2002. Plant Physiological Ecology, Springer-Verlag
5. Larcher, W. 2003., Physiological Plant Ecology: Ecophysiology and Stress Physiology of Function Groups - Springer-Verlag
6. Nobel, P.S 1999, Physico-chemical and Environmental Plant Physiology, Academic Press.
7. Lambers, H., T. L. Pons and F. Stuart. 2008. Plant Physiological Ecology.
8. Smith, R. L. 2004. Ecology and field Biology. Addison Wesley Longman, Inc., New York.
9. Barbour, M.G., Burke, J.H and Pitts, W.D. 2004 Terrestrial Plant Ecology, The Benjamin, Cumming Publishing C. Palo Alto, California, USA.
10. Smith R.L. 1998 Elements of Ecology. Harper & Row Publishing.
11. Townsend. C.R. Begon. M and J.L Harper. 2002 Essentials of ecology. Blackwell Publishing.
12. Gurevitch. J. Scheiner, S.M. and G.A Fox. 2006 The Ecology of Plants\ Sinaur Assocate Inc.
13. Hussain. F. 1989 Field and Laboratory Manual of Plant Ecology, National Academy of Higher Education, Islamabad.
14. Hussain. S.S. 1989 Pakistan Manual of Plant Ecology. National Book Foundation Islamabad.

BOT-5602

Plant Systematics

3(2-1)

Aims and objectives

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

Course Contents

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, Clonal variation.
5. Systematics and Genecology / Biosystematics: Introduction and importance, Methodology of conducting biosystematics studies, various biosystematics categories such as ecophene, ecotype, ecospecies, coenospecies and comparium.
6. Taxonomic Evidence: Importance and types of taxonomic evidences: anatomical, cytological, chemical, molecular, palynological, geographical and embryological.
7. Nomenclature : Important rules of botanical nomenclature including effective and valid publication, typification, principles of priority and its limitations, author citation, rank of main taxonomic categories, conditions for rejecting names.
8. Classification: Why classification is necessary? Importance of predictive value. Brief history, Different systems of classification with at least one example of each (Linnaeus, Bentham and Hooker, Engler and Prantl, Bessey, Cronquist, Takhtajan, and Dahlgren).
9. Brief introduction of Numerical taxonomy.
10. General characteristics, distribution, evolutionary trends, phyletic relationships and economic importance of the following families of angiosperm:
 Apiaceae (Umbelliferae), Juncaceae, Arecaceae (Palmae), Lamiaceae (Labiatae), Asclepiadaceae, Liliaceae, Asteraceae (Compositae), Magnoliaceae, Boraginaceae, Malvaceae, Brassicaceae (Cruciferae), Myrtaceae, Cannaceae, Orchidaceae
 Capparidaceae, Papaveraceae, Caryophyllaceae, Poaceae (Gramineae), Casuarinaceae, Ranunculaceae, Chenopodiaceae, Rosaceae, Convolvulaceae, Salicaceae, Cucurbitaceae, Scrophulariaceae, Cyperaceae, Solanaceae, Euphorbiaceae, Trochodendraceae, Fabaceae (Leguminosae), Winteraceae.

Practical:

1. Technical description of plants of the local flora and their identification up to species level with the help of a regional/Flora of Pakistan
2. Preparation of indented and bracketed types of keys
3. Preparation of permanent slides of pollen grains by acetolysis method and study of different pollen characters.
4. Study of variation pattern in different taxa.
5. Submission of properly mounted and fully identified hundred herbarium specimens at the time of examination
6. Field trips shall be undertaken to study and collect plants from different ecological zones of Pakistan.

Recommended Books:

1. Ali, S.I. and Nasir, Y. 1990-92. Flora of Pakistan. Karachi Univ. Press, Karachi
2. Ali, S.I. and Qaiser, M. 1992-2007 -todate. Flora of Pakistan. Karachi Univ. Press, Karachi.
3. Greuter,W., McNeill, J., Barrie, F.R., Burdet, H. M., Demoulin, V., Filguerras, T.S., Niclson, D.H. Silva, P.C., Skog, J.E., Trehane, P., Turland, N.J. & Hawksworth, D.L.,(eds.) 2000. International code of botanical nomenclature (Saint Louis Code) adopted by the Sixteenth International botanical congress St. Louis Missouri, July –August 1999. Koeltz, Konigstein. (Regnum Veg.138.)
4. Davis, P.H. & Heywood, V.H. 1963. Principles of Angiosperm Taxonomy. Oliver & Boyd, London
5. Ingrouille, M. 1992. Diversity and Evolution of Land Plants, Chapman & Hall. London
6. Nasir, E. & Ali, S.I. 1970-89. Flora of Pakistan. Karachi Univ. Press, Karachi.
7. Stace, C. (1992). Plant Taxonomy and Biosystematics, Edward Arnold..
8. Takhtajan, A. (1986). Flowering Plant: Origin and Dispersal, Oliver and Boyd, Edinburgh

9. Jones, S. B. and Luchsinger, A.E. 1987. Plant Systematics. McGraw Hill, Inc. New York.
10. Naik, V.N. 2005. Taxonomy of Angiosperms. Tata McGraw Hill Publishing Company, New Delhi.

BOT-5603

Plant Biochemistry-I

3(2-1)

Aims and objectives:

To elucidate the structure and role of primary metabolites in plants

Course Contents:

Carbohydrates:

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

Lipids:

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

Proteins:

Amino acids and their structure. Electro chemical properties and reactions of amino acids. Classification of proteins. Primary, secondary, tertiary and quaternary structure of proteins. Protein targeting. Protein folding and unfolding. Transport, storage, regulatory and receptor proteins. Protein purification. Protein sequencing. Biological role.

Nucleic Acids:

General introduction. Purine and pyrimidine bases, nucleosides, nucleotides. Structure and properties of DNA and RNA. Types and functions of RNA. Chemical synthesis of oligonucleotides and DNA sequencing. DNA restriction enzymes. Properties of DNA polymerase I, II and III.

Enzymes:

Nature and functions, I.U.E. classification with examples of typical groups. Isozymes, ribozymes, abzymes. Enzyme specificity. Enzyme kinetics. Nature of active site and mode of action. Allosteric enzymes and feedback mechanism.

Practical:

1. Solutions, acids and bases. Electrolytes, non-electrolytes, buffers, pH. Chemical bonds.
2. To determine the R_f value of monosaccharides on a paper Chromatogram.
3. To estimate the amount of reducing and non-reducing sugars in plant material titrimetrically/spectrophotometrically.
4. To determine the saponification number of fats.
5. To extract and estimate oil from plant material using soxhlet apparatus.
6. Analysis of various lipids by TLC methods.
7. To estimate soluble proteins by Biuret or Lowry or Dye-binding method.
8. To estimate the amount of total Nitrogen in plant material by Kjeldahl's method.
9. To determine the R_f value of amino acids on a paper chromatogram.
10. Extraction of Nucleic acids from plant material and their estimation by UV absorption or colour reactions.
11. To estimate the catalytic property of enzyme catalase or peroxidase extracted from a plant source.
12. To determine the PK_a and isoelectric point of an amino acid.

Recommended Books:

1. Conn E E. and Stumpf P.K., 2002. Outlines of Biochemistry, John Wiley and Sons Inc. New York.
2. Lehninger, A L. 1998. Principles of Biochemistry. Worth Publishers Inc.
3. Voet, D., Voet J.G. and Pratt, C.W. 1998. Fundamentals of Biochemistry, John Wiley and Sons, New York.
4. Dey, P.M. and Harborne, J.B. 1997. Plant Biochemistry. Harcourt Asia PTE Ltd. Singapore.
5. Smith, E. L., Hill, R L, Lehman, R I., Lefkowitz, R J. Handler and Abraham. 2003, Principles of Biochemistry, (General Aspects). White. International Student Edition. McGraw Hill International Book Company.
6. Zubay G .2003, Biochemistry, MacMillan Publishing Co., New York.
7. Chesworth, J.M., Strichbury T. and Scaife., J. R. 1998. An introduction to agricultural biochemistry. Chapman and Hall, London.
8. Mckee, T. and Mckee, J.R. 1999. Biochemistry – An Introduction. WCB/McGraw-Hill, New York, Boston, USA.
9. Lea, P.J. and Leegood, R.C. 1993. Plant Biochemistry and Molecular Biology. Wiley and Sons, New York.
10. Abdes, R.H. Frey, P.A. and Jencks W.P. 2004, Biochemistry, Jones and Bartlet, London.
11. Goodwin T.W. and Mercer, E.I. 1997. Introduction to Plant Biochemistry. Pergamon Press, Oxford.
12. Heldt, H-W. 2008. Plant Biochemistry. 3rd Edition, Academic Press, U.K.
13. Bowsher, C. 2008. Plant Biochemistry. Campbell, M.K. and F. Shawn. 2008. Biochemistry 6th Edition.

BOT-5604

Plant Physiology-I

3(2-1)

Aims and objectives

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

Course Contents

1. **Photosynthesis:** History of photosynthesis. Nature and units of light. Determination of oxygenic and anoxygenic photosynthesis. Ultrastructure of thylakoid vesicle. Various pigments and photosynthetic activity. Ultrastructure and composition of photosystem-I and II. Absorption and action spectra of different pigments. Mechanism of photosynthesis - light absorption, charge separation or oxidation of water (water oxidizing clock), electron and proton transport through thylakoid protein-pigment complexes. Photophosphorylation and its mechanism. CO₂ reduction (dark reactions) - C₃ pathway and Photorespiration, Regulation of C₃ pathway, C₄ pathway and its different forms, C₃-C₄ intermediates, CAM pathway. Methods of measurement of photosynthesis.
2. **Respiration:** Synthesis of hexose sugars from reserve carbohydrates. Mechanism of respiration- Glycolysis, Differences between cytosolic and chloroplastidic glycolysis, Oxidative decarboxylation, Krebs cycle, Regulation of glycolysis and Krebs cycle, Electron transport and oxidative phosphorylation. Aerobic and anaerobic respiration. Energetics of respiration. Pentose phosphate pathway. Glyoxylate cycle. Cyanide resistant respiration.
3. **Translocation of Food:** Pathway of translocation, source and sink interaction, materials translocated, mechanism of phloem transport, loading and unloading.
4. **Leaves and Atmosphere:** Gaseous exchange, mechanism of stomatal regulation. Factors affecting stomatal regulation.
5. **Assimilation of Nitrogen, Sulphur and Phosphorus:** The nitrogen cycle. Nitrogen fixation. Pathways of assimilation of nitrate and ammonium ions. Assimilation of sulphur and phosphorus.

Practical:

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

Recommended Books:

1. Dennis, D.T., Turpin, D.H., Lefebvre, D.D. and Layzell, D.B. 1997. Plant Metabolism. 2nd Edition. Longman Group, U.K.
2. Dey, P.M. and Harborne, J.B. 1997. Plant Biochemistry. Harcourt Asia PTE Ltd. Singapore.
3. Fitter, A. and Hay, R.K.M. 2001. Environmental Physiology of Plants. Academic Press, UK.
4. Heldt, H-W. 2004. Plant Biochemistry. 3rd Edition, Academic Press, U.K.
5. Ihsan Illahi, 1991. Plant Growth, UGC Press, Islamabad.
6. Ihsan Illahi, 1995. Plant Physiology, Biochemical Processes in Plants, UGC Press.
7. Nobel, P.S. 1999. Physicochemical and Environmental Plant Physiology. Academic Press, UK.
8. Press, M.C., Barker, M.G., and Scholes, J.D. 2000. Physiological Plant Ecology, British Ecological Society Symposium, Volume 39, Blackwell Science, UK.
9. Salisbury F.B. and Ross C.B. 1992. Plant Physiology. 5th Edition. Wadsworth Publishing Co. Belmont CA.
10. Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4th Edition. Sinauer's Publ. Co. Inc. Calif.
11. W.B. Hopkins. 1999. Introduction to Plant Physiology. 2nd Ed. John Wiley and Sons. New York.
12. Epstein, E. and Bloom, A.J. 2004. Mineral Nutrition of Plants: Principles and Perspectives. 2nd Edition. Sinauer Associates, California, USA.
13. Kirkham, M.B. 2004. Principles of Soil and Plant Water Relations. Elsevier, Amsterdam, Netherlands.
14. Barton, w. 2007. Recent Advances in Plant Physiology

BOT-5605**Biostatistics****3(2-1)****Aims and Objectives**

The objective of this course is to equip the students with statistical concepts and methods: The emphasis will be on learning how to collect, summarize, analyze, and interpret real-world data in a practical manner.

Course Contents

1. **Introduction and scope:** Definition: Characteristics, importance and limitations, population and samples.
2. **Frequency distribution and probabilities:** Formation of frequency table from raw data, histograms. Applications of probabilities to simple events.
3. **Measures of central tendencies and dispersion:** Arithmetic mean, median, mode, range, variance and standard deviation, standard error of the mean, mean deviation, semi-interquartile range.
4. **Tests of significance:** Introduction:
 - 1- t-test: Basic idea, confidence limits of means, significant difference of means.
 - 2- X² – test: Basic idea, testing goodness of fit to a ratio, testing association (contingency table).

- 3- F-test: Introduction and application in analysis of variance.
- 4- L.S. D. test, Dancunn Multiple Range Test (for comparison of individual means).
5. **Design of experiment:** Concept of design, principles of experiment, planning of an experiment, replication and randomization, Field plot technique, Layout and analysis of completely randomized design, randomized complete block design, Latin square, factorial design, treatment comparison.
6. **Correlation and regression:** Brief account of correlation and regression.

Lab Outlines:

1. Probability of simple events.
2. Data collection, arrangement of data in frequency table.
3. Calculation of mean from group and ungrouped data.
4. Calculation of variance and standard deviation from grouped and ungrouped data.
5. T-test.
6. X² – test.
7. Analysis of variance – one factor design
8. Analysis of variance – two way analysis
9. Analysis of variance – for latin square
10. Analysis of variance – for factorial design.
11. Correlation.
12. Linear Regression.

Books Recommended

1- Bailey. N.T.J. 1994. Statistical Methods in Biology, Cambridge University Press. 2- Quinn, G. 2002. Experimental Design and Data Analysis for Biologists. Cambridge University Press. 3- Wonnacott, T.H. and Wonnacott, R.J. 1990. Introductory Statistics, John Willey and Sons.

BOT-5606

Field Botany-II

1(1-0)

Aims and objective

The basic objective of this course is to acquaint the students with natural flora and fauna in various regions through field trips.

Teaching Methodology:

It will involve organizing botanical excursions and visits to various locations pertaining to the courses being taught in 2nd semester. The students will have to go for field study trip to the place of the choice of the course incharge(s) and prepare a field report. The team of accompanying teachers will evaluate the level of academic interest, team-spirit, cooperativeness, discipline and other non-scholastic attributes, apart from the Field Report submitted by the students. The senior most teacher in the group will act as Convener of this course and will be responsible to submit the final award to departmental examination committee.

**COURSE CONTENTS OF COMPULSORY/GENERAL FACULTY COURSES FOR BS (7TH SEMESTER)
YEAR PROGRAM IN BOTANY**

**Year-IV
SEMESTER-VII (Cr. 18)**

Course Code	Course Title	Lecture Credit's
BOT-6701	Plant Ecology-II	3(2-1)
BOT-6702	Genetics-I	3(2-1)
BOT-6703	Research Methodology	3(2-1)
BOT-6704	Plant Biochemistry-II	3(2-1)
BOT-6705	Plant Physiology-II	3(2-1)
BOT-6706	Thesis/Optional Paper	3(3-0)
Total Credit Hour's		18

BOT-6701

Plant Ecology -II

3(2-1)

Aims and Objectives

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

Course Contents

1. The plant community: discrete and continuum concepts with modern synthesis.
2. Community attributes: leaf Spectra, life form distribution pattern, Periodicity, Phenology, Fidelity, Constancy, Raunkiaer law of frequency, Homogeneity and Heterogeneity, age class etc.
3. Species diversity concepts.
4. Plant community structure.
5. Plant community dynamics (succession):
6. Method of sampling of plant community: quadrat, line intercept, Point centered quarter methods.
7. Quantitative community description: Gradients analysis, ordination techniques and classification.
8. Productivity, measurement, energy flow and efficiency.
9. Flora of Azad Jammu and Kashmir.

Practical

1. Measurement of plant biomass and net primary productivity.
2. Measurement of water relation components: conductance.
3. Measurement of radiation, temperature, humidity and wind velocity.
4. Soil texture and structure. Measurement of plant biomass and net primary productivity.
5. Seed dispersal, seed bank, germination and reproductive allocations.
6. Community attributes.
7. Reconnaissance survey of different local communities.
8. Detailed sampling of local vegetation including gradient, ordination, and classification.
9. Study of local ecosystem.

Books Recommended:

1. Schultz J.C. 2005. Plant Ecology, Springer-Verlag .
2. Townsend C.R. Begon. M and J.L. Harper 2002. Essentials of Ecology, Blackwell Publishing,
3. Chapin, F.S. et al. 2002. Principle of Terrestrial Plant Ecology, Springer-Verlag
4. Gurevitch, et al., 2002. The Ecology of Plants, Sinauer Associates, Inc.

5. Barbour M. G. et al., 1999, Terrestrial Plant Ecology, the Benjamin-Cumming Publishing Co.
6. Smith, R. L. 1998. Elements of Ecology by Harper & Row Publishers,
7. Moore P.D. and Chapman S. B. 1986. Methods in Plant Ecology, Blackwell Scientific Publication, Oxford.
8. Hussain, S. Pakistan Manual of Plant Ecology,
9. Hussain, F. 1989. Field and Laboratory Manual of Plant Ecology, National Academy of Higher Education. Islamabad
10. Lambers, H., T. L. Pons and F. Stuart. 2008. Plant Physiological Ecology.
11. Larcher. W. 2003 Physiological Plant Ecology. Ecophysiology and Stress Physiology of Function Groups. Springer- Verlag.

BOT-6702

Genetics-I

3(2-1)

Aims and objectives

To understand the nature and function of genetic material.

Course Contents

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. Gene Mutation: Somatic versus germinal mutation, mutant types, the occurrence of mutations, mutation and cancer, mutagens in genetic disorder, mutation breeding. Evolutionary significance of mutation.
5. 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.
6. The Structure of DNA: DNA: The genetic material, DNA replication in eukaryotes, DNA and the gene.
7. 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, universality of genetic information transfer, eukaryotic RNA.
9. The Extranuclear Genome: Variegation in leaves of higher plants, cytoplasmic inheritance in fungi, extranuclear genes in chlamydomonas, mitochondrial 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.

Practical:

1. Numerical problems

- a. Arrangement of genetic material:
 - i. Linkage and recombination.
 - ii. Gene mapping in diploid.
 - iii. Recombination in Fungi.

- iv. Recombination in bacteria.
- v. Recombination in viruses.
- b. Population Genetics:
 - i. Gene frequencies and equilibrium.
 - ii. Changes in gene frequencies,

2. Blood group and Rh-factor

3. Drosophila

- i. Culture technique
- ii. Salivary gland chromosome

4. Fungal genetics

Sacchromyces culture techniques and study.

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

6. Bacterial Genetics.

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

Recommended Books:

1. Gelvin, S.B. 2000. Plant Molecular Biology Manual. Kluwer Academic Publishers.
2. Pierca, B.A. 2005. Genetics. A conceptual approach, W. H. Freeman and Company, New York.
3. Synder, L, and Champness, W. 2004. Molecular Genetics of Bacteria. ASM Press, Washington D.C.
4. Klug, W.S. and Cummings, M.R. 1997. Concepts of Genetics, Prentice Hall International Inc.
5. Roth Well, N.V. 1997. Understanding Genetics, second edition, Oxford University Press Inc.
6. Gardner, E.J., 2004. Principles of Genetics, John Willey and Sons, New York.
7. Ringo J, 2004. Fundamental Genetics, Cambridge University Press.
8. Griffiths A.J.F: Wessler, S.R; Lewontin, R.C, Gelbart, W.M; Suzuki, D.T. and Miller, J.H., 2005, Introduction to Genetic Analysis, W.H. Freeman and Company.
9. Snyder, L and Champness W, 2003, Molecular Genetics of Bacteria, ASM Press.
10. Hartl, D.L. and Jones, E.W. 2005, Genetics - Analysis of Genes and Genomes, Jones and Bartlett Publishers. Sudbary, USA.
11. Hedrick, P.W. 2005. Genetics of Population. Jones and Bartlett Publisher, Sudbury, USA.

BOT-6703

Research Methodology

3(2-1)

Aims and Objectives

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

Course Contents

Research Methods (planning research, various methods, analyzing results, giving reports, etc.). Research process including: formulating research questions; sampling (probability and no-probability). **Measurement (surveys, scaling, qualitative, unobtrusive).** Research design (experimental and quasi-experimental). **Data analysis; and writing the research paper.** The Major theoretical and philosophical underpinnings of research including: the idea of validity in research; reliability of measures; and ethics

Recommended Books

1. Brizuela, B.M., Stewart, J.P., Carrilo, R.G., and Berger, J.G. 2000. Acts of Inquiry in Qualitative Research. Harvard Education Press, Cambridge.
2. Leedy, P.D., and Ormond, J. E. 2004. Practical Research: Planning and Design. 8th Edition. Prentice Hall, Inc., London.

3. Shank, G.D. 2001. Qualitative Research: A Personal Skills Approach. 2nd Edition. Pearson Education Inc., New York.
4. Brandret, M., Mchille, L., and Peterson, L. 1996. Practical Methods in Mycorrhizal Research. Mycologue Publications, University of Guelph, Guelph, Ontario.
5. Harley, J.L., and Smith, S.E. 1983. Mycorrhizal Symbiosis. Academic Press, London.
6. Kendrick, B. 2001. The Fifth Kingdom. 3rd Edition. Focus Publishing/R. Pullins Company, Massachusetts.
7. Schenk, N.C. 1982. Methods and Principles of Mycorrhizal Research. The American Phytopathological Society. St. Paul, Minnesota.

BOT-6704

Plant Biochemistry-II

3(2-1)

Aims and Objectives

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

Course Outline

1. Bioenergetics: Energy, laws about energy changes. Oxidation and reduction in living systems.
2. Metabolism:
 - i. Biosynthesis, degradation and regulation of sucrose and starch. Breakdown of fats with special reference to beta-oxidation and its energy balance. Biosynthesis of fats.
 - ii. Replication of DNA. Reverse transcription. Biosynthesis of DNA and RNA.
 - iii. Components of protein synthesis. Genetic code, protein synthesis: initiation, elongation and termination.
3. Alkaloids: Occurrence, physiological effects, chemical nature with special reference to solanine, nicotine, morphine, theine and caffeine. Aflatoxins, their nature and role.
4. Terpenoids: Classification: monoterpenes, sesquiterpenes, diterpenes, triterpenes, tetraterpenes, polyterpenes and their chemical constitution and biosynthesis.
5. Vitamins: General properties and role in metabolism.

Practical:

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

Recommended Books:

1. Conn E. E. and Stumpf, P.K. 2002. Outlines of Biochemistry, John Wiley and Sons Inc. New York.
2. Albert L. Lehninger, 1998. Principles of Biochemistry. Worth Publishers Inc.
3. Voet, D. Voet J.G. and Pratt, C.W. 1998. Fundamentals of Biochemistry, John Wiley and Sons, New York.
4. Dey, P.M. and Harborne, J.B. 1997. Plant Biochemistry. Harcourt Asia PTE Ltd. Singapore.
5. Smith; E L., Hill; R. L., Lehman; R. I., Lefkowitz, R J. and Abraham. H. Principles of Biochemistry, (General Aspects). White. International Student Edition. McGraw Hill International Book Company.
6. Zubay. G. 2003, Biochemistry, MacMillan Publishing Co., New York.
7. Chesworth, J.M., Strichbury T. and Scaife, J. R. 1998. An introduction to agricultural biochemistry. Chapman and Hall, London.
8. Goodwin T.W. and Mercer, E.I. 1997. Introduction to Plant Biochemistry. Pergamon Press, Oxford.
9. Heldt, H-W. 2008. Plant Biochemistry. 3rd Edition, Academic Press, U.K.
10. Campbell, M.K. and F. Shawn. 2008. Biochemistry 6th Edition.

Aims and Objective

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

Course Contents

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, Brassinosteroids, Jasmonates, and Salicylic acid.
2. Water Relations: The soil-plant-atmosphere continuum - an overview. Structure of water. Physico-chemical properties of water. Water in the soil and its potentials. Water in cell components. Absorption of water in plants (pathways and driving forces, Aquaporins, -their structure and types). Cell water relations terminology. Hofler diagram - analysis of change in turgor, water and osmotic potential with changes in cell volume. Modulus of elasticity coefficient; Hydraulic conductivity. Osmoregulation, Methods for measurement of water, osmotic and turgor potentials- Pressure chamber, psychrometry, pressure probe, pressure volume curve.
3. Plant Mineral Nutrition: Inorganic composition of plant and soil. Absorption of mineral nutrients - roots, mycorrhizae. Effect of soil pH on nutrient availability. Ion traffic into root. The nature of membrane carriers, channels and electrogenic pumps. Passive and active (primary and secondary) transports and their energetics. Essential and beneficial elements-their functions and deficiency symptoms in plants. Fertilizers and their significance in Agriculture.
4. Phytochromes: Discovery of phytochromes and cryptochromes. Physical and chemical properties of phytochromes. Distribution of phytochromes among species, cells and tissues and their role in biological processes. Phytochromes and gene expression.
5. Control of Flowering: Autonomous versus environmental regulation. Circadian rhythms. Classification of plants according to photoperiodic reaction, photoperiodic induction, locus of photoperiodic reaction and dark periods in photoperiodism. Role of photoperiodism in flowering. Biochemical signaling involved in flowering. Vernalization and its effect on flowering. Floral meristem and floral organ development. Floral organ identity genes and the ABC model.
6. Gene Regulation and Signal Transduction: Genome size and organization. Gene regulation in prokaryotes and eukaryotes. Signal transduction in prokaryotes and eukaryotes.

Practical

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

Recommended Books

1. Press, M.C., Barker, M.G., and Scholes, J.D. 2000. Physiological Plant Ecology, British Ecological Society Symposium, Volume 39, Blackwell Science, UK.
2. Salisbury F.B. and Ross C.B. 1992. Plant Physiology. 5th Edition. Wadsworth Publishing Co. Belmont CA.

3. Taiz, L. and Zeiger, E. 2002. Plant Physiology. 3rd Edition. Sinauers Publ. Co. Inc. Calif.
4. W.B. Hopkins. 1999. Introduction to Plant Physiology. 2nd Ed. John Wiley and Sons. New York.
5. Epstein, E. and Bloom, A.J. 2004. Mineral Nutrition of Plants: Principles and Perspectives. 2nd Edition. Sinauer Associates, California, USA.
6. Kirkham, M.B. 2004. Principles of Soil and Plant Water Relations. Elsevier, Amsterdam, Netherlands.
7. Barton, w. 2007. Recent Advances in Plant Physiol

LIST OF ELECTIVE COURSES FOR BS (7TH SEMESTER) PROGRAM IN BOTANY

Course code	Course Title	Credit Hrs.
BOT-6707	Biological techniques	3(2-1)
BOT-6708	General Biotechnology	3(2-1)
BOT-6709	Plant Pathology	3(2-1)
BOT-6710	Industrial and Microbial Biotechnology	3(2-1)
BOT-6711	Energy Plantation and Bio-fuels	3(2-1)
BOT-6712	Biodiversity and Climate Change	3(2-1)
BOT-6713	Principles and Applications of Bioremediation	3(3-0)
BOT-6714	Bioinformatics	3(1-2)
BOT-6715	Agriculture Biotechnology	3(3-0)
BOT-6716	Molecular Biology	3(2-1)

BOT-6707

Biological Techniques

3(2-1)

Aims and Objectives

1. To familiarize with the basic tools and techniques of scientific study with emphasis on biological sciences
2. Scientific drawing -Purpose and principle, Basic understanding on principle and uses of the following:

Course Contents

Microscopy: Principles of light microscopy. Magnification, Resolution, Contrast. Types of microscopy, Bright field (Compound Microscope), Scanning microscopy, Eyepiece micrometers, Camera Lucida Phase Contrast Dark field Interference microscope, Electron microscope. **Micrometry and Morphometry:** Use of stage and ocular micrometer. Calibration of ocular micrometer. Size measurement (length, width, diameter). **Standard system for weight, length, volume :** Calculations and related conversions of each:- Metric system- length; surface; weight - Square measures- Cubic measures (volumetric)- Circular or angular measure- Concentrations- percent volume; ppt; ppm - Chemical molarity, normality - Temperature- Celsius, centigrade, Fahrenheit. Preparation of stock solutions of various strengths. **Specimen preparation for optical microscopy: Microtomy:** Fixation, embedding, Section cutting (transverse, longitudinal section, mounting and staining. Sections in paraffin and cryosections. **Extraction techniques:** Centrifugation, Ultra centrifugation, cell fractionation, filtration, Distillation, Use of Soxhlet and Rotary evaporator for extraction. **Separation Techniques:** Chromatography: Principle, applications, types, thin layer, paper, column, gas, ion exchange chromatography. Electrophoresis: Principle, applications, types. **Spectrophotometry:** Principle, applications, types, visible spectrum, UV spectrum, atomic absorption. **Basic principles of Sampling and Preservation:** Sampling soil organisms, Invertebrates, Aquatic animals,

Mammals, Estimation of population size, Preservation of dry and wet specimens. Preservation techniques – Taxidermy - Rearing techniques, Laboratory and field.

Recommended Books

1. Dean, J. R. Extraction methods for environmental analysis. 1999. John Wiley And Sons Ltd. UK.
2. Curos, M. Environmental sampling and analysis: Lab Manual. 1997. Crc Press LlC. USA. 38
3. Curos, M. Environmental sampling and analysis: For Technician. 1997. CRC Press LLC. USA.
4. Cheesbrough, M. District laboratory practice in tropical countries. Part i. 1998. University Press Cambridge, UK.
5. Cheesbrough, M. District laboratory practice in tropical countries. Part ii. 1998. University Press Cambridge, UK.
6. Slingsby, D. and Cock, C. Practical ecology. 1986. Mcmillan Education Ltd. London.

BOT-6708

General Biotechnology

3(2-1)

Aims and Objectives

To understand the basic techniques and principles of tissue culture and DNA Recombinant Technology

Course Contents

Restriction and modification system: Types, Enzyme, classification, Nomenclature, Genetics and applications. Cloning Vectors: Plasmids (Bacterial and yeast), Viruses (Ca, MV, SV40, BPV) phages (Lambda, Mu, M13). Cosmids and phagmids. Cutting and joining of DNA: Isolation and purification of DNA, Ligation of DNA molecules, blunt ends and cohesive termini. Cloning Strategies; selection and characterization molecules, verification and amplification of desired genes, Gene Banks, PCR, RFLP, DNA sequencing techniques, DNA cloning, Southern blotting, Northern blotting, western blotting, site specific mutagenesis. Protein engineering. Applications of recombinant DNA technology with comprehensive theoretical know-how macromolecules of desired characters for transgenic.

Practical

1. Isolation of plasmids and chromosomal DNA from bacteria and yeast.
2. Screening of bacteria for plasmids by electrophoresis of total cell lysate.
3. Gel electrophoresis of plasmids DNA chromosomal DNA & RNA.
4. Comparing plasmids of different molecular weights using Molecular Weights markers.

Recommended Books

1. Rehm, J.J. 1998. Fundamentals of Biotechnology, VCH Publishers, N.Y.
2. Lee, B.H. 1996. Fundamentals of Food Biotechnology, VCH Publishers, N.Y.
3. Pirt, J.B. 1975. Microbes and Cell Cultivation, Blackwell Scientific Publishers, London.
4. Bailey, J.E. and Ollis, D. F., 1986. Biochemical Engineering Fundamentals, McGraw Hills.
5. Watson, J.D., Tooze, J. and Kurta, D.T. 1983. Recombinant DNA-A short Course, Scientific American Books, New York.
6. Old, R.W. and Primrose, S.B. 1989. Principles of gene manipulation. 4th edition, Blackwell Scientific Publishers, London.
7. Molecular cloning, 1989. A Laboratory manual, 2nd edition, Cold spring Harbor Laboratory.
8. Higgins, I.J., Best, D.J. and Jones, J. 1988. Biotechnology Principles and Applications. Blackwell Scientific Publishers, London.
9. Rehm, J.J. 1988. Biotechnology: Special Microbial Process, Vol. 6 (b), VCH Publishers, N.Y.

BOT-6709

Plant Pathology

3(2-1)

Aims and Objectives

1. To study selected microbial plant diseases and their importance for economy.
2. To identify fungal and bacterial diseases of plant.
3. To develop the strategies for the control of plant diseases.

Course contents

Study of major microbial plant diseases. □ Importance of plant diseases in Pakistan. Nature and classification of plant diseases. Etiology and symptoms of plant diseases of field crops, fruits and vegetables. Fungal diseases: Rusts, Smuts, Wilts and Rot rots. □ Bacterial diseases: Blights, Cankers, Leaf spots and Rots. □ Viral diseases: Mosaics, Dwarfs, Stunts, Yellows, Leaf curl, Witches Broom, Ring spots and Wilts' □ Quarantine, eradication and International Plant Protection. □ Cultural practices in disease control, chemical control. Resistant varieties. Future problems and prospects of Plant Microbiology.

Practical

1. Sample collection, isolation and identification of plant pathogen (farms, orchards, nurseries).
2. Field trips.

Recommended Books

1. Nautiyal , C.S., Dion, P., (Editor), V. L. Chopra , V.L., 208. Molecular Mechanisms of Plant and Microbe Coexistence. 1st Editon. Springer- Verlag New York, LC.
2. Aneja K. R. 209. Experiment in Microbiology: Plant Pathology & Biotechnology. New Age Int. Pvt. Ltd.74
3. Narayanasamy, P., 2010. Molecular Biology in Plant Pathogenesis and Disease Management: Microbial Plant Pathogens. 1st Editon. Springer-Verlag New York, LC
4. Chen, J., 201. Experimental Plant Virology. 1st Editon. Springer- Verlag New York, LC
5. Van Regenmortel M. H. V. and Fraenkel-Conrat H. 2013 The Plant Viruses. Springer.

BOT-6710

Industrial and Microbial Biotechnology

3(2-1)

Aims and Objectives

To make students familiar with the applications of biotechnology in the practical field to enhance the productivity at industrial side.

Course Contents

Application of biotechnology in industry; biotechnology of raw ore processing (bioleaching of sulphides, carbonates, silicates etc.) accumulation of metals by microbial cells, biopulping, biofuels, microbial enhanced oil recovery; application in agriculture, food and livestock products; biofertilization; production of cheese, probiotics, bread, single cell protein, citric acid, amino acid, acetic acid, production in drinks; microbial enzymes in industry, enzyme immobilization. Significance of Industrial Microbiology, Classification of microorganisms, fermentation principles, Culture techniques, Measurement and control of microbial processes, Introduction of probiotics. Introduction to industrial biotechnology, Biotechnology in textile, Chemical, Food, Pharmaceuticals, Agricultural industries, Industrial biocatalysts, Industrial waste, Industrial strain improvement, Screening for new metabolites, Recombinant DNA technology, Substrates for industrial fermentation, Regulation of primary and secondary metabolism, Design and development of industrial bioreactors, Problems and possibilities in fermentation scale up procedure, Bioreactors, Fermentors and controls, Bioenergy and Biofuels, Product recovery and refinement.

Practical

Screening of enzymes of industrial significance, enzyme immobilization; Production of cheese, yogurt, citric acid, amino acid and acetic acid.

Recommended Books

1. Old R.W. and S. B. Primrose. Principles of Gene Manipulation, An introduction to Genetic engineering (4th Edition). Blackwell Scientific Publications. 1994.
2. Setlow J. K., Genetic engineering; Principles and methods. Kluwer Academic Publishers 2000.
3. Nicholl. D. S.T., An introduction to Genetic Engineering, Cambridge University Press, 2000.
4. Yount L., Genetic Engineering, Gale group, 2002.
5. Sambrook J., D. W. Russell, J. Sambrook, Molecular Cloning: A laboratory Manual 93-Volume Set), Cold Spring Harbor Laboratory press, 2002.
6. Brown T.A., An introduction to Gene Cloning and DNA analysis: 4th Edition Blackwell Science Inc. 2001.

BOT-6711

Energy Plantation and Bio-Fuels

3(2-1)

Aims and Objectives

To develop understanding regarding the prospects and possibilities of raising bioenergy plantations, bio-fuel production, and conversion technologies.

Course Contents

Introduction and advantages of energy plantations. Global overview of energy and biomass consumption patterns. Energy and biomass consumption patterns in Pakistan. Environmental impacts of biomass energy. Basic concepts of forest production ecology; the biomass production potential of a forest ecosystem; production of energy wood at special short-rotation plantations; use of residual biomass from traditional forestry operations for energy; harvesting and transportation logistics of energy wood production. A brief introduction to bio-energy conversion technologies; utilization of bio-energy with reference to the global carbon cycle and climatic change, especially with regard to CO₂ emissions and carbon storage; and the role of bio-energy in Pakistan and other countries, especially its potential for the development of rural areas. Assessment of bio-energy programs in Pakistan. Power generation from energy plantation, biomass gasification-producer gas. High Density Energy Plantations (HDEP). Land and biomass availability for sustainable bio energy. Bio-fuels introduction, Tree Born Oils (TBO's), potentials and advantages, bio-diesel trans-esterification, important bio-fuel species and their silvicultural management. Overview of the markets for wood biomass for energy production globally and within the Pakistan this includes the supply, quantity, demand, and consumption as well as consumer market aspects. Fundamentals of the policies that have impacts on the supply and consumption of the energy wood; wood based fuels; and/ or bio-energy and bio-fuels' markets , Need for research and development on environment friendly and socio economically relevant technologies. Energy from plants-problems and prospects. Petro-crops. Criteria for evaluation of different species for energy plantation. Advanced energy technologies in the production of bio-fuels

Practical

Identification of important fuel woods and petro-crops. Study of different properties of bio fuels used in Pakistan. Determination of calorific value, moisture and ash content in biomass. Study of energy consumption pattern in rural and urban areas through survey. Visit to nearby Bio-energy units.

Recommended Books

1. Donald L. Klass. 2010. Biomass for Renewable Energy, Fuels, and Chemicals. Amazon Publishers
2. Snelder, D.J. & Lasco. R. 2008. Small Holder Tree Growing for Rural Development and Environmental Services. Springer Publisher.
3. Kumar V. 1999. *Nursery and Plantation Practice in Forestry*. Scientific Publications.
4. Luna RK. 1989. *Plantation Forestry in India*. International Book Distributors.
5. Chaturvedi AN. 1994. *Technology of Forest Nurseries*. Khanna Bandhu
6. William, B. R. & Gowen. 1994. Forest Resources and Wood based biomass. Oxford and IBH New Delhi.

BOT-6712

Biodiversity and Climate Change

3(2-1)

Aims and Objectives

To equip the students with knowledge and importance of biodiversity and climate change and learn skills and techniques to conserve biodiversity and mitigate global warming and climate change.

Course Contents

Definition of biodiversity and its scope. Factors affecting biodiversity of flora and fauna (human population, industrialization and unsustainable land uses). Biodiversity status of flora and fauna in various zones/regions. Threatened and endangered mammals, birds, and plant species in Pakistan. Biodiversity rich areas and hotspots. Conservation and management strategy for biodiversity in Pakistan. Ecosystem based adaptation. The concept of climate change and its harmful effects. Causes of climate change. Climate change assessment and predictions. Recommended actions to reduce global warming and climate change.

Practical:

Field: Visit different sites to assess the status of biodiversity.

Filed: Visit to biodiversity conservation projects.

Field: learning various methods to reduce global warming.

Recommended Books:

1. IUCN (1996): Sarhad Provincial Conservation Strategy, Government of NWFP.
2. Khattak, A.K. (2006): Resource Management Plan for Palas Forests, Lower Kohistan Forest Division, NWFP Forest Department.

BOT-6713

Principles & Applications of Bioremediation

3(2-1)

Aims and Objectives

To equip the students with the knowledge of biological techniques to overcome different types of environmental pollution

Course Contents

Introduction to biodegradation and bioremediation. Types and nature of recalcitrant, xenobiotics. Types and mechanisms of biodegradation and bioremediation. Bioremediation of organic pollutants (hydrocarbons, PCBs, PAHs, halogenated compounds, plastics, dyes, herbicides and pesticides). Bioremediation of heavy metals. Various methods and technologies used for remediation. Role of enzymes in bioremediation. Factors effecting bioremediation. Aerobic and anaerobic degradation pathways of contaminants. Microbial ecology and metabolism. Microbial community dynamics during bioremediation. Molecular strategies used to explore the role of microbes in bioremediation.

Recommended Books:

1. Environmental Microbiology, 2nd Edition, Mitchel, T., G. J-Dong. John Wiley & Sons, Inc., Hoboken, New Jersey (2010).
2. Bioremediation: Aplied Microbial Solutions for Real-World Environment Cleanup by Ronald M. Atlas and Jim Philp (205).
3. Environmental Biotechnology. Concepts and Applications. Jordening H.-J., J. Winter. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim (205).
4. Biodegradation and Bioremediation- Vol 2. Singh and Ajay Springer- Verlang Berlin and Heidelberg GmbH & Co. Kg, Germany (204).
5. Biodegradation and Biocatalysts. Wacket, L. P., C. D Hershberger. ASM Pres, American Society for Microbiology, N. W. Washington, DC (201).

BOT-6714

Bioinformatics

3(2-1)

Aims and Objectives

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

Course Contents

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

Recommended Books

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

Recommended Books:

1. Claverie JM and Notredame C, 206. Bioinformatics for Dummies. 2nd Editon; Wiley Publishing.
2. Xiong J, 206. Eserial Bioinformatics. 1 st Editon; Cambridge University Pres.
3. Xia X, 207. Bioinformatics and the Cel: Modern Computational Aproaches in Genomics, Proteomics and Transcriptomics. 1st Editon. Springer31
4. Mathura V and Kanguene P, 209. Bioinformatics: A Concept-Based Introduction. Springer
5. Mount DW, 204. Bioinformatics Sequence and Genome Analysis. 2nd Editon; Cold Spring Harbor Laboratory Pres.
6. Sperschneider V, 208. Bioinformatics: Problem Solving Paradigms. Springer.

BOT-6715

Agriculture Biotechnology

3(3-0)

Aims and Objectives

To acquaint students with techniques and skills employed for producing transgenic crops.

Course Contents

Agriculture biotechnology and its applications in crop improvements; cell and plant tissue culture methodology; improvement of plants via plant cell culture; plant molecular biomarkers; direct and indirect methods of plant and animal transformation: gene gun method of transformation, Agrobacterium mediated transformation, chloroplast transformation and polyethylene glycol (PEG) mediated transformation; transgenic crops with herbicide, biotic and abiotic stress resistance; problems related to transgenic plants; genetically modified organisms (GMOs); field evaluation and commercialization of GMOs; possible effects of releasing GMOs into the environment; bio-fertilizers, bio-pesticides and their types; non-symbiotic nitrogen fixers; present and future prospects of biofertilizers.

Practical

Preparation of Murashige and Skog medium and stocks of macronutrients, micronutrients, and hormones; selection of ex-plant, medium preparation and callus induction; culturing Agrobacterium and using it to infect plant callus; selection of trans formant's; regeneration of plantlets and acclimatization; plant DNA extraction and PCR for detecting introduction of foreign DNA into plants.

Recommended Books

1. Qaim M, 2010. Agricultural Biotechnology in Developing Countries: Towards Optimizing Benefits for Por. Springer
2. Kemp Ken F, 2010. Genetic Modification of Plants: Agriculture, Horticulture and Forestry (Biotechnology in Agriculture and Forestry). Springer.

3. Heren RV, 2012. Introduction to Agricultural Biotechnology. 2nd Edition; Delmar Cengage Learning.
4. Slater A, 208. Plant Biotechnology: The Genetic Manipulation of Plants. 2nd Edition; Oxford University Pres, USA
5. Altman A, 201. Plant Biotechnology and Agriculture: Prospects for the 21st Century. 1 st Edition; Academic Pres.

BOT-6716

Molecular biology

3(2-1)

Aims and Objectives

To disseminate the knowledge of molecular basis of life.

Course Contents:

1. Nucleic Acids: DNA-circular and super helical DNA. Renaturation, hybridization, sequencing of nucleic acids, synthesis of DNA
2. Proteins: Basic features of protein molecules. Folding of polypeptide chain, α -helical and β -secondary structures. Protein purification and sequencing.
3. Transcription: Enzymatic synthesis of RNA, transcriptional signals Translation: The genetic code. The Wobbling, polycistronic and monocistronic RNA. Overlapping genes.
4. Gene regulation in Eukaryotes: Differences in genetic organization and prokaryotes and eukaryotes. Regulation of transcription, initiation, regulation of RNA processing, regulation of nucleocytoplasmic mRNA transport, regulation of mRNA stability, regulation of translation, regulation of protein activity.
5. Plant Omics: Transcriptomics; DNA libraries, their construction, screening and application. Microarray of gene technology and its application in functional genomics.
6. Proteomics; structural and functional proteomics. Methods to study proteomics
7. Metabolomics; methods to study metabolomics; importance and application of metabolomics.
8. Bioinformatics and computational biology. Levels, scope, potential and industrial application of bioinformatics and computational biology.

Practical:

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.

Recommended Books:

1. Cullis, C.A. 2004. Plant Genomics and Proteomics. Wiley-Liss, New York.
2. Gibson, G. and S.V. Muse, 2002. A Premier of Genome Science, Sinauer Associates Inc. Massachusetts.
3. Gilmartin, P.M. and C. Bowler. 2002. Molecular Plant Biology. Vol. 1 & 2. Oxford University Press, UK.
4. Lodish, H. et al., 2004. Molecular Cell Biology. 5th Edition. W.H. Freeman & Co., New York.
5. Malacinski, G. M. 2003. Essentials of Molecular Biology, 4th edition. Jones and Bartlett Publishers, Massachusetts.
6. Watson, J.D. et al. 2004. Molecular Biology of the Gene. Peason Education, Singapore.
7. Ignacimuthu, S. 2005. Basic bioinformatics. Narosa Publishing House, India.
8. Weaver, R.F. 2005. Molecular Biology. McJGraw Hill, St. Louis.

Aims and Objectives:

To provide comprehensive knowledge about internal organization and anatomy of vascular plants.

Course Contents

1. The plant body and its development: fundamental parts of the plant body, internal organization, different tissue systems of primary and secondary body.
2. Meristematic tissues: classification, cytohistological characteristics, initials and their derivatives.
3. Apical meristem: Delimitation, different growth zones, evolution of the concept of apical organization. Shoot and root apices.
4. Leaf: types, origin, internal organization, development of different tissues with special reference to mesophyll, venation, bundle-sheaths and bundle-sheath extensions. Enlargement of epidermal cells.
5. Vascular cambium: Origin, structure, storied and non-storied cell types, types of divisions: additive and multiplicative; cytoplasmic characteristics, seasonal activity and its role in the secondary growth of root and stem. Abnormal secondary growth.
6. Origin, structure, development, functional and evolutionary specialization of the following tissues: Epidermis and epidermal emergences, Parenchyma, Collenchyma, Sclerenchyma, Xylem, Phloem with special emphasis on different types of woods, Periderm.
7. Secretory tissues: Laticifers (classification, distribution, development, structural characteristics, functions) and Resin Canals.
8. Anatomy of reproductive parts:
 - Flower
 - Seed
 - Fruit
9. Economic aspects of applied plant anatomy
10. Anatomical adaptations
11. Molecular markers in tree species used for wood identification.

Practical:

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

Recommended Books:

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

11. Raymond, E.S. and E. Eichhorn. 2005. Esau's Plant Anatomy; Meristematic cells and tissues of plant body. John Willey Sons.
12. Eames, A.J. and L.H. Mac Daniels. 2002. An introduction to Plant Anatomy. Tat Mac-Graw Hill Publishing Company Limited, New Delhi.

BOT-6803

Biodiversity and Conservation

3(2-1)

Aims and Objectives

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

Course Contents

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

Practical

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

Books Recommended

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

BOT-6804

Genetics II

3(2-1)

Aims and Objectives

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

Course Contents

1. Recombinant DNA :Recombinant DNA Technology – Introduction, Basic Techniques, PCR and Rt PCR, Restriction enzymes, Plasmids, Bacteriophages as tools, the formation of recombinant DNA, recombinant DNA methodology, recombinant DNA and social responsibility, Site directed Mutagenesis, DNA sequencing.
2. Application of Recombinant DNA: Applications of recombinant DNA technology using prokaryotes, recombinant DNA technology in eukaryotes: An overview, transgenic yeast, transgenic plants, transgenic animals, screening for genetic diseases, identifying disease genes, DNA typing, gene therapy, genetically modified organisms and apprehensions.
3. Control of Gene Expression: Discovery of the *lac* system: negative control, catabolite repression of the *lac* operon: positive control, transcription: gene regulation in eukaryotes - an overview.
4. Mechanisms of Genetic Change I: Gene Mutation: The molecular basis of gene mutations, spontaneous mutations, induced mutations, reversion analysis mutagens and carcinogens, biological repair mechanisms.
5. Mechanisms of Genetic Change II: Recombination: General homologous recombination, the holiday model, enzymatic mechanism of recombination, site-specific recombination, recombination and chromosomal rearrangements.
6. Mechanisms of Genetic Change III: Transposable Genetic Elements: Insertion sequences, transposons, rearrangements mediated by transposable elements, review of transposable elements in prokaryotes, controlling elements in maize.
7. Human Genome Project: Strategies and application, achievement and future prospects.
8. Plant Genome Projects: Arabidopsis, achievement and future prospects. Other plant genome projects
9. Bioinformatics : Application of computational tests to the analysis of genome and their gene products
10. Bioethics : Moral, Religious and ethical concerns

Practical

Problems relating to the theory

1. Isolation and separation of DNA and protein on Gel electrophoresis.
 - i. Bacterial chromosome
 - ii. Plasmid DNA (minipreps)
 - iii. Plant DNA
 - iv. Protein
2. DNA Amplification by PCR

Recommended Books

1. Trun, N and Trempey J., 2004, Fundamental Bacterial Genetics, Blackwell Publishing House.
2. Winnacker, E.L.2003, From Gene to Clones – Introduction to Gene Technology, Panima Publishing Corporation, New Delhi.
3. Beaycgamp T.L. and Walters L., Contemporary Issues in Bioethics, Wadsworth Publishing Company.
4. Brown, T.A., 2002 Genomes, Bios Scientific Publishers Ltd.
5. The Genome of Homo Sapiens, 2003, Cold Spring Harbor Laboratory Press.
6. Ignacimuthu, S. 2005, Basic Bioinformatics, Narosa Publishing House, India,.
7. Lwein, B. 2004, Gene VIII, Pearson Education Int..
8. Miglani, 2003, Advanced Genetics, Narosa Publishing House, India,.
9. Hartt, D. L, and Jones, E.W. 2005. Genetics, Analysis of Gene and Genomes. Jones and Bartlett Publishers, Sudbury, USA
10. Gelvin, S,B. 2000. Plant Molecular Biology Manual. Kluwer Academic Publishers.

6. Biodegradation and Remediation, 1999. Martin Alexander Academic Press Inc.

BOT-6806

Environmental Issues

3(2-1)

Aims and Objectives

This course is designed to provide students with an appreciation for the complexity of environmental issues and an awareness of the tools that can be applied to understand and solve problems involving the environment.

Course Contents

Life a factor of rapid change in the environment, Population increase of diversified life in an ecosystem, Population system in an ecosystem balance; Mechanisms inter-playing in balance, consequences of imbalance, Endangering and extinction of species, decline of biodiversity, consequences of losing biodiversity. Human population: Main actor in an environment, Human population explosion, Technologies in sustaining population and affluence, addressing population problem, population and development. Poverty; integrated approach to alleviate poverty, Life style: Urban sprawl, consequences of ex-urban migration, Health in life style; Environment and health. Food production (Crops and livestock). Land for cultivation and farming. Food production, its distribution, economics and politics, Hunger, malnutrition and famine, Soil, irrigation, Stalinization, Desertification, Losing soil/ground. Pests and pest controls: Need and approach to pest control. Alternate pest control methods. Socio-economic pressure and pest management, Environmental policy in pest management. Water: Water cycle and water management, Human impact on water resources. Pollution. Bi-products of production systems: Sediments, Nutrients and eutrophication, the process and symptoms of eutrophication, combating eutrophication, long term strategies. Sewage pollution: Sewage hazards and potential, sewage management, recycling and impediment to recycling. Hazardous chemical pollution: Nature and chemical risks, pollution sources and control. Major atmospheric changes: Acid deposition, Global warming/cooling, Greenhouse effect, Ozone depletion. Solid wastes (trash): Landfills, combustion, solutions and management. Energy resources (Fuel of production and development): energy sources and uses, fossil fuel, alternate fossil fuel; Nuclear Power, promises and problems, sustainable energy option, solar and other renewable energy sources. Environmental issues of Pakistan: Ecological issues (Soil erosion, deforestation, issues related to irrigated system, natural hazards), issues related to conservation of habitat and biodiversity (major threats to biodiversity in Pakistan, conservation strategy), pollution and industrial resources (water issues, air issues, soil issues, mineral resources issues, energy issues, food, population issues and socio-economic issues.

Practical:

Review, reports, field trips, discussions on current local, national, regional and global issues. Approaches and strategies, mitigation measures.

Recommended Books

1. Botkin, D.B. and Keller, E.A. 2008. Environmental science (Earth as a living planet). 3rd Ed. John Wiley and Sons Inc. N.Y, USA.
2. Ahmad, R.Z. 2000. Pakistan-A-descriptive Atlas (A comprehensive geopolitics Course). 1st Ed. Ferozsons Pvt. Ltd. Lahore Pakistan.
3. Nebel, B.J. and Wright, R.t. 1998. Environmental Sciences (the way the world works). 1st Ed. Prentice Hall International Inc. London, UK.
4. Gaston, K.J. and Spicer, J.I. 1998. 'Biodiversity (An Introduction), 1st Ed. Blackwell Science Ltd. UK.
5. Brandbury, I.K. 1998. The Biosphere. 2nd Ed. John Wiley and Sons Inc. UK.
6. McKinny, M.L. and Schoch, R.M 1998. Environmental Science (systems and solutions). Jones and Artlett Publications Inc. USA.

7. Emiliani, C. 1997. Planet Earth (Cosmology, geology and the evolution of life and environment). 3rd Ed. Cambridge. University Press, UK.
8. Khan, F.K. Geography of Pakistan Environment (Environment, People and economy). 1993. Oxford University Press, NY, USA.
9. Hussain, S.S. 1992. Pakistan Manual of Plant Ecology (A text book of plant ecology for degree students). National Book Foundation, Islamabad, Pakistan.
10. Daily newspapers for current issues.

BOT-6807

Medical Microbiology

3(2-1)

Aims and Objectives

Aims of this course are to let the students know about the science of microbiology, to work with microorganisms, their pathogenicity, and various diseases and problems caused by microorganisms. The course may also initiate their interest in agricultural, industrial and/or environmental microbiology. The course will enable the students to identify specific areas in practical life where the science of microbiology is being applied. Thus they can seek different job in various organizations such as clinical, industrial and environmental microbiology sections.

Course Contents

Morphology and fine structure of bacteria: Size, shape and arrangement of bacterial cells, Flagella and motility, Pili, Capsules, sheaths and stalks, structure and chemical composition of cell wall, cytoplasmic membrane, the cytoplasm, nuclear material. Microbiology and Medicine, antimicrobial agents, mode of action. Bacterial pathogenicity, sources and spread of the infections in the community. Immunological principles, antigen, antibodies and antigen-antibody reactions. Bacterial pathogens and associated diseases. *Staphylococcus*, skin and wound infections. *Streptococcus*, sore throat, scarlet fever, glomeruonephritis. *Pneumococcus*, respiratory infections. *Corynebacterium*. *Diphtheriae* *Mycobacterium tuberculosis*: Pulmonary and other tuberculosis infections. *Actinomyces*. *Neisseria meningitis*, Gonorrhoea, *Salmonella*, *Shigella*, *Escherichia coli*, *Klebsiella proteus*, *Providencia*, *Bacillus anthracis*. *Clostridium tetnai*. Pox viruses, Herpes viruses. Herpes simplex. Cytomegalovirus infections. Adenoviruses. Influenza viruses. Hepatitis viruses. Arbovirus, Rickettsia, Pathogenic. Fungi and Protozoa.

Practicals

Basic techniques.(Staining of microorganisms: Simple stains, positive staining; negative staining. Demonstration of special structures by stains: Spore stain, Flagella stain. Differential stains: Gram stain, Metachromatic Granule stain, Acid fast stain. Culturing of microorganisms: Preparation and sterilization of culture media, agar slope, agar slab, streak plates, pour plates methods. Isolation of a bacterial culture. Quantitative plating methods) Widal test. Laboratory diagnosis and control of infections: Streptococcus. *Corynebacterium*, *Listeria*, *Mycobacterium*. The Enterobacteriaceae: *Salmonella*. *Escherichia*, *Klebsiella* and *Clostridium*. Blood tests: TLC, DLC, RBC.

Recommended Books

1. Kenneth Ryan, C. George Ray, Nafees Ahmad, W. Lawrence Drew, James Plorde. (2010). Sherris Medical Microbiology, Fifth Edition. McGraw Hill Publishers, Washington DC
2. Patrick R. Murry, Ken S. Rosenthal, Michael A. Pfaller: Medical Microbiology, 5th edition, Philadelphia: Elsevier/Mosby, 2005.
3. P.K. Murray, Ph.D., K.S. Rosenthal, Ph.D., G.S. Kobayashi, Ph.D., and M.A. Pfaller, MD, 4th Edition, Mosby, Inc. 2002. ISBN #0323012132
4. Sherris medical microbiology: an introduction to infectious diseases C. George Ray, Editor; McGraw-Hill/Appleton and Lange 5th edition, McGraw-Hill/Appleton & Lange, 2003. ISBN#0838585299
5. Microbial Applications (Complete Version) Laboratory Manual In General Microbiology, 1994. Benson,

H.J. WMC Brown Publishers, England.

6. Microbiology, 1986. Pelczar Jr., Chan, E.C.S. and Krieg, M.R. McGraw Hill, London.
7. Brock Biology Of Microorganisms, 1997. Madigan, M.T., Martinko, J.M. and Parker, J. Prentice-Hall, London.
8. Cruickshank, R, Duguid, J.P., Hermion, B.P. and Swain, R.H.A., (2003). Medical Microbiology. Churchill Livingstone, N.Y.
9. The Microbial World, 1986. Stainier, R.Y., Ingraham, J.L., Wheelis, M.L. and Painter, R.R. Prentice Hall, London.
10. Foundations in Microbiology. (1998). Talaro & Talaro. WCB Publishers, New York.
11. Microbiology: A Human Perspective, 2001. Eugene W. Nester, Denise, G., Anderson, Martha, T., Nester, C., Evans Roberts, Nancy, N. McGraw Hill Higher Education

BOT-6808

Advances in Molecular Biology

3(2-1)

Aims and objectives

Objectives of the course are to impart knowledge about the macromolecules in animal cell and their complex organization of architecture and the unified role it plays for the ultimate sustainability of the organisms.

Course Contents

Molecular Biology of DNA, RNA, Protein, DNA replication and DNA repair. Transcription. Translation, Gene expression in prokaryotes and eukaryotes. Molecular biology of DNA and RNA viruses and yeast. Molecular immunology, Oncogenes and cancer.

Practical

Quantitative estimation of various macromolecules. Demonstration of properties of macromolecules. Methods of bacterial culture.

Recommended Books

1. Kornberg, A. (1980). DNA Replication, W.H. Freeman, San Francisco.
2. Kornberg, A. (1982). Supplement to DNA Replication, W.H. Freeman, San Francisco.
3. Old, R.W. and Primrose, S.B. (1981). Principles of Gene Manipulation, Blackwell, Oxford.
4. Watson, J.D., Hopkins, N.H., Roberts, J.W., Steitz, J.A. and Weiner, A.M. (1990). Molecular Biology of the Gene, Benjamin, California.
5. DuPraw, Advances in Cell and Molecular Biology, Academic Press.
6. Bukhari, A.I., Shapiro, J.A., and Adhya, S.L. (1977). DNA Insertion Elements, Plasmids and Episomes, Cold Spring Harbour Laboratories.
7. Stent, G.S., (1971). Molecular Genetics, Freeman, San Francisco.
8. Glass R.E., (1982). Gene Function: E. coli and its Heritable Elements, Croom Helm, London.
9. Adams, R.L.P., Knowler, J.T. and Leaer, D.P. (1986). The Biochemistry of the Nucleic Acids, Chapman and Hall.
10. Davis, R.W., Botstein, D. and Roth, J.R. (1980). Advanced Bacterial Genetics, Cold Spring Harbor Lab., N.Y.
11. Freifelder, D. (1983). Molecular Biology, A Comprehensive Introduction to Prokaryotes and Eukaryotes. Science Books International, Boston.

BOT-6809

Cell and Tissue Culture

3(2-1)

Aims and Objectives:

The aim of this course is to provide students with a thorough understanding of the importance of cell, tissue and organ culture and its application in life sciences.

Course Contents:

Plant cell and tissue culture: requirements for in vitro cultures; culture facilities; sterile techniques; media preparation and handling; callus cultures; cell suspension cultures; protoplast culture; haploid cultures, organ culture; meristem culture for virus elimination; embryo culture and embryo rescue; regeneration of plants and micro-propagation; somaclonal variation; industrial uses of plant cell culture; tissue culture in genetic engineering and biotechnology. Mammalian cell culture: origin and principles of cell culture; qualitative characteristics of cell cultures; cell counting and analysis; cryopreservation; cell banking and subculture (variety of different systems); primary cell culture techniques; development of immortalized cell line; detection of microbial contaminants; animal cells for bioassays and bioproducts; design and operation of animal cell culture bioreactors for therapeutic protein production; growth environment; Stem cell culture

Recommended Books:

1. Setlow JK, 200. Genetic Engineering: Principles and Methods. Kluwer Academic Publishers.
2. Nichol DST, 202. An Introduction to Genetic Engineering. 2nd Edition; Cambridge University Press.
3. Gale YL, 202. Genetic Engineering.
4. Razdan MK, 203. Introduction to Plant Tissue Culture. 2nd Edition; Intercept, New York, USA.
5. Lanza et al., 200. Principles of Tissue Engineering. 2nd Edition; Academic Press, California.
6. Ignacimuthu S, 197. Plant Biotechnology. Oxford IBH Publisher.
7. Punia MS, 199. Plant Biotechnology and Molecular Biology: A Laboratory Manual. Scientific Publishers.

BOT-6810 Virology**3(3-0)****Aims and Objectives**

Aim of this course is to provide a generalized overview of virology as it stands today.

Course Contents

Historical perspective; general properties of viruses; classification and nomenclature; virus structure and assembly; replication cycle and genetics of viruses; animal and plant viruses; propagation, detection and quantification of viruses; pathogenesis and immune response of viral infections; laboratory diagnosis of viral diseases; vaccines and antiviral drugs; epidemiology; tumor viruses; viral vectors and gene therapy; emerging viruses; specific aspects of selected viral diseases

Recommended Books:

1. Flint et al., 209. Principles of Virology. ASM Press, USA.
2. Lal S, 207. The Biology of Emerging Viruses. Wiley-Blackwell, USA.
3. Carter J Saunders V. Virology: Principles and Applications. First Edition; Wiley.
4. Wagner et al., 207. Basic Virology. Third Edition; Wiley-Blackwell
5. Flint SJ, 209. Principles of Virology, Vol. 2: Pathogenesis and Control. 3rd Edition; ASM Press

BOT-6811 Methods in Molecular Biology**3(2-1)****Aims and Objectives**

To acquaint students with the experimental aspects of molecular biology

Course Contents

Introduction to recombinant DNA technology; restriction and modifying enzymes; cloning and expression vectors and their types; expression of recombinant proteins and their purification by affinity chromatography; polymerase chain reaction (PCR) - types; (inverse, touch-down, nested, hemi-nested, pit stop, multiplex, reverse transcriptase, RACE, real-time) and its applications; detection of mutations and/or SNPs; DNA fingerprinting; analysis of nucleic acids by gel electrophoresis – horizontal, vertical, pulse field, denaturing gradient gel electrophoresis; analysis of proteins by native and SDS-PAGE; 2-D gels; generation of antibodies and their uses; enzyme linked immunosorbent assay; Southern, Western, Northern blotting.

Practical:

Preparation of stock and working solutions; isolation of nucleic acids and their quantification; restriction digestion of DNA and preparation of restriction maps; gel electrophoresis; polymerase chain reaction (PCR); detection of mutations by restriction fragment length polymorphism; preparation of chemically competent cells; transformation of bacteria with plasmid DNA; analysis of proteins by SDS-PAGE

Recommended Books

1. Ausubel FM, 205. Short Protocols in Molecular Biology (2 volume set). 5th Edition; John Wiley and Son.
2. Gren MR and Sambrook J, 201. Molecular Cloning: A Laboratory Manual. 3rd Edition; Cold Spring Harbor Laboratory Pres.
3. Primrose SB and Twyman R, 206. Principles of Gene Manipulation and Genomics. 7th Edition; Wiley-Blackwel.
4. Wilson K and Walker J, 2010. Principles and Techniques of Biochemistry and Molecular Biology. 7th Editon; Cambridge University Pres.
5. Walker JM and Rapley, 208. Molecular Bio methods Handbook (Methods in Molecular Biology). 2nd Edition; Humana Pres.

BOT-6812

Genomics

3(3-0)

Aims and Objectives

The overarching goal of this course is to provide students with a thorough overview of both the theoretical and experimental aspects of structural and functional genomics.

Course Contents

Organization and structure of genomes; genetic mapping (RFLP, microsatellite, SNP); high-resolution physical mapping (STS, EST); flow cytometry; somatic cell and radiation hybrids; artificial chromosomes in bacteria and yeast; hierarchical and whole genome shotgun sequencing; DNA sequencing strategies - manual and automated sequencing, pyrosequencing, Solexa, Helicos, Roche 454, real-time and nanopore sequencing; sequence assembly, obstacles and solutions; estimating gene number – over-prediction and under-prediction, homology searches, exon prediction programs, integrated gene-finding software packages; structural variation in the genome and its applications; microarray and RNA interference.

Recommended books:

1. Strachan T and Read AP, 2010. Human Molecular Genetics. 4th Editon; Garland Science.
2. Sacone C and Pesole G, 203. Handbook of Comparative Genomics: Principles and Methodology. 1st Editon; Wiley-Lis.
3. Town C, 202. Functional Genomics. 1st Editon; Springer.
4. Krebs et al., 2010. Lewin Genes X. 10th Editon; Jones and Bartlet Publishers.
5. Al-Rubeai M and Fuseneger M, 2010. Systems Biology (Cel Engineering). 1st Editon; Springer

BOT-6813

Biodiversity of Plants and Fungi

3(2-1)

Aims and Objectives

To learn about the evolutionary history and phylogenetic relation between plants and fungi.

Course Contents

Introduction: Diversity of life. Arranging the diversity of life into Kingdoms. Prokaryotes and origin of metabolic diversity. The origin of eukaryotic diversity: Eukaryotic origin by symbiosis among prokaryotes. Eukaryotic algae as key producers in aquatic ecosystem. Major characteristics of phyla of kingdom Plant and colonization of land. Plant diversity and evolutionary history of plant kingdom, structural and reproductive adaptation for colonization of land. Plant structure and Growth. Reproduction & Development: Life cycle of plant. Evolutionary adaptation in germination of seeds, methods of reproduction and their role in agriculture, overview of developmental mechanism in plants. Control systems of Plants to cope with environmental stress. Body plan and nutritional modes in Fungi Classification of Fungi.

Practical

1. Study of morphology and reproductive structures of eukaryotes and prokaryotes specimens mentioned in course outline.
2. Identification of various types mentioned from prepared slides and fresh collection.
3. Collection of specimens of plants and their identification.

Recommended Books

1. Schafer, 2006. Photo morphogenesis in plant and Bacteria.
2. Barbara J. E.s., Christine J. C. B. and Thomas N. S. 2010. Microbial Rots Endophytes. Springer.
3. Shely, 2010. Stern's Introductory Plant Biology. McGraw-Hil Sciences.37
4. Ana M. P. and A. Carolina F. 201. Endophytes of forest Tres. Springer.
5. Alexopoulos, 2012. Introductory Mycology.
6. Teij S., Hideki K. et al. 2013. Species Diversity and Community Structure. Springer.

BOT-6814

General Microbiology

3(2-1)

Aims and Objectives

The course is designed to enable the students to work with microorganisms. The basic techniques of sterilization, culturing, isolation and determining different characteristics of the microorganisms are included.

Course Contents

The beginnings of Microbiology: Discovery of the microbial world; Discovery of the role of microorganisms in transformation of organic matter, in the causation of diseases, development of pure culture methods. The scope of microbiology. Microbial evolution, systematics and taxonomy; Characterization and identification of microorganisms. Nomenclature and Bergey's manual. **Viruses:** Bacteriophages and phages of other protests. Replication of bacteriophages. Viruses of animals and plants; History, structure and composition; classification and cultivation of animal viruses. Effects of virus infection on cells. Cancer and viruses. **Morphology and fine structure of bacteria:** Size, shape and arrangement of bacterial cells, Flagella and motility, Pili, Capsules, sheaths, Prosthecae and stalks, structure and chemical composition of cell wall, cytoplasmic membrane, protoplasts, spheroplasts, the cytoplasm, nuclear material. **The Cultivation of Bacteria:** Nutritional requirements, nutritional types of bacteria, bacteriological media, physical conditions required for growth, choice of media, conditions of incubation. **Reproduction and growth of bacteria:** Modes of cell division, New cell formation, Normal growth cycle of bacteria, synchronous growth, continuous culture, quantitative measurement of bacterial growth; Direct microscopic count, Electronic enumeration of cell numbers, the plate count method, Membrane-filter count, Turbidimetric method, Determination of nitrogen content, Determination of the dry weight of cells, The selection of a procedure to measure growth, Importance of measurement of growth. **Pure cultures and cultural characteristics:** Natural microbial populations, selective methods; Chemical methods, Physical methods, Biological methods, Selection in nature, Pure cultures; Methods of isolating pure cultures, Maintenance and preservation of pure cultures, Culture collections, Cultural characteristics; Colony characteristics, Characteristics of broth cultures. **Eukaryotic Microorganisms:** Algae: Biological and economic importance of algae; Characteristics of algae; Lichens. Fungi: Importance of fungi; Morphology; Physiology and reproduction, Cultivation of fungi. Protozoa: Ecology and importance of protozoa. Classification of protozoa. **Prokaryotic diversity Bacteria:** Purple and green bacteria; cyanobacteria, prochlorophytes, chemolithotrophs, methanotrophs and methylotrophs, sulfate and sulfur-reducing bacteria, homoacetogenic bacteria, Budding and appendaged bacteria, spirilla, spirochetes, Gliding bacteria, Sheathed bacteria, Pseudomonads, Free living aerobic nitrogen fixing bacteria, Acetic acid bacteria, Zymomonous and chromobacterium, Vibrio, Facultatively aerobic Gram-negative rods, Neisseria and other Gram-negative cocci, Rickettsias, Chlamydias, Gram-positive cocci, Lactic acid bacteria, Endospore forming Gram-positive rods and cocci, Mycoplasmas, High GC Gram-positive bacteria;

Actinomycetes, Coryneform bacteria, propionic acid bacteria, Mycobacterium, Filamentous Actinomycetes. **Prokaryotic Diversity:** Archaea: Extremely Halophilic archaea, Methane producing archaea: Methanogens, Hyperthermophilic archaea, Thermoplasma. **Microbial Ecology:** Microorganisms in nature, Microbial activity measurements, Aquatic habitats, Deep-sea microbiology, Terrestrial environments, Hydrothermal vents, Rumen microbial ecosystem, Microbial leaching, Biogeochemical cycles; Trace metals and mercury, Biodegradation of Xenobiotics.

Practical:

The culture of microorganisms: preparation and sterilization of culture media, broth culture, agar slope, agar slab, streak plates, pour plates. Isolation of a bacterial culture, Quantitative plating methods. The turbidimetric estimation of microbial growth.

Recommended Books

1. Pelczar, Jr., Chan, E.C.S. and kreig, M.R. (1986). Microbiology, McGraw Hill, London.
2. Peltler, G.L.A Laboratory Manual of Microbiology.
3. Benson, H.J. Microbial Applications: Laboratory Manual in General Microbiology, 1994. WMC Brown Publishers, England.
4. Madigan, M.T., Martinko, J.M. and Parker, J. Brock Biology of Microorganisms, 1997. Prentice-Hall, London.

BOT-6415

Recombinant DNA Technology

3(2-1)

Aims and Objectives

To elucidate the students the techniques of recombinant DNA technology.

Basic Techniques: Extraction of nucleic acids, measurement of nucleic acids, gel electrophoresis, nucleic acid probes, hybridization of nucleic acids, nucleic acid blotting: southern blotting, northern blotting, dot or slot blots, **Cutting and Joining DNA molecules;** Restriction enzymes, host controlled restriction and modification, types of restriction enzymes, nomenclature, isoschizomers, physical methods of breaking DNA, DNA ligases, linkers, adapters, homopolymer tailing, **Vectors:** Desirable properties of vectors, plasmids vectors, bacteriophage λ vectors, cosmids, m13 vector, phasmids, supervectors: BACs, YACs, HACs.

Polymerase Chain Reaction (PCR); PCR reaction, primers, reverse transcriptase PCR, real time PCR, PCR application: PCR cloning strategies, analysis of recombinant clones, diagnostic application, **Gene transfer to Plants;** *Agrobacterium tumefaciens* mediated transformation, direct nuclear transformation, viral vectors, chloroplast transformation, **Application of Transgenic Plants;** Insecticidal resistance, herbicidal resistance, virus resistance, fungal resistance, delayed ripening, salt tolerance, enhancing production and quality of food

PRACTICAL

1. Plasmid DNA isolation from bacterial cells
2. Chromosomal DNA isolation from bacterial cells
3. Agarose gel electrophoresis of isolated DNA
4. Restriction enzyme digestion of plasmid DNA
5. DNA amplification through PCR

Recommended Books

1. Brown, T.A. 2010. Gene Cloning and DNA Analysis. 6th Edition. Wiley-Blackwell, London.
2. Dale, J.W., and Schantz, M.V. 2007. From Genes to Genomes. 2nd Edition. John Wiley & Sons, Inc., London.
3. Hughes, M.A. 1996. Plant Molecular Genetics. Addison-Wesley Longman, London.
4. Nicholl, D.S.T. 2008. An Introduction to Genetic Engineering. 3rd Edition. Cambridge University Press, London.
5. Primrose, S.B., and Twyman, R.M. 2002. Principles of Genome Analysis. 3rd Edition. Blackwell Science, Oxford.