

CURRICULUM
OF
BIOTECHNOLOGY
BS (Hons)



DEPARTMENT OF BIOTECHNOLOGY
FACULTY OF BIOLOGICAL SCIENCES
UNIVERSITY OF SCIENCE & TECHNOLOGY BANNU
KHYBER PAKHTUNKHWA, PAKISTAN

BACHELOR OF BIOTECHNOLOGY (4 YEAR) (130-136 Cr Hr)

DEGREE PROGRAM STRUCTURE

Sr.	Categories	No. of courses	Credit Hours
1.	Compulsory Requirement (No Choice)	9	24
2.	General Courses to be chosen from other departments	6	18
3.	Discipline Specific Foundation Courses	13	39
4.	Major Courses including research project / Optional Courses	11	33
5.	Electives within the major	7	21
	Total	46	135

- Total numbers of Credit hours 135
- Duration 4 years
- Term duration 16-18 weeks
- Terms 8
- Course Load per Term 15-18 Cr hr
- Number of courses per term 4-6

SCHEME OF STUDIES FOR BACHELOR OF BIOTECHNOLOGY (4 YEAR)

YEAR ONE /TERM FIRST

Course Code	Name of Subject	Credits
Biotech -111	Introduction to Biotechnology	3+0
Biotech -112	Cell Biology	2+1
Biotech -113	Organic Chemistry	2+1
Biotech -114	English-I	3+0
Biotech -115	Pakistan Studies	2+0
Biotech -116	Mathematics-I	3+0
	Total	17

YEAR ONE /TERM SECOND

Course Code	Name of Subject	Credits
Biotech-121	Fundamentals of Genetics	2+1
Biotech-122	Microbiology	2+1
Biotech-123	Inorganic Chemistry	2+1
Biotech-124	English-II	3+0
Biotech-125	Islamic Studies/Ethics	2+0
Biotech-126	Mathematics-II	3+0
	Total	17

YEAR TWO /TERM ONE

Course Code	Name of Subject	Credits
Biotech-211	Biochemistry-I	2+1
Biotech-212	Molecular Biology-I	2+1
Biotech-213	Physical Chemistry	3+0
Biotech-214	Introduction to Computer Science	2+1
Biotech-215	Entrepreneurship in Biotechnology	3+0
Biotech-216	English-III	3+0
	Total	18

YEAR TWO /TERM TWO

Course Code	Name of Subject	Credits
Biotech-221	Biochemistry-II	2+1
Biotech-222	Molecular Biology-II	2+1
Biotech-223	Genetic Resources & Conservation	2+1
Biotech-224	Biophysics	3+0
Biotech-225	Biostatistics	3+0
Biotech-226	Psychology	3+0
	Total	18

YEAR THREE /TERM ONE

Course Code	Name of Subject	Credits
Biotech-311	Immunology	2+1
Biotech-312	Plant Physiology	2+1
Biotech-313	Enzymology	2+1
Biotech-314	Recombinant DNA Technology	2+1
Biotech-315	Bioinformatics	2+1
	Total	15

YEAR THREE /TERM TWO

Course Code	Name of Subject	Credits
Biotech-321	Analytical Chemistry & Instrumentation	2+1
Biotech-322	Microbial Biotechnology	2+1
Biotech-323	Plant Cell and Tissue Culture	2+1
Biotech-324	Food Biotechnology	2+1
Biotech-325	Animal Biotechnology	2+1
Biotech-326	Research Methodology & Skill Enhancement	3+0
	Total	18

YEAR FOUR /TERM ONE

Course Code	Name of Subject	Credits
Biotech-411	Health Biotechnology	3+0
Biotech-412	Industrial Biotechnology	2+1
Biotech-413	Genomics and Proteomics	3+0
Biotech-414	Plant Biotechnology	2+1
Biotech-415	Principles of Biochemical Engineering	2+1
Biotech-416	Biosafety & Bioethics	2+0
	Total	17

YEAR FOUR /TERM TWO

Course Code	Name of Subject	Credits
Biotech-421	Pharmaceutical Biotechnology	3+0
Biotech-422	Environmental Biotechnology	2+1
Biotech-423	Nanobiotechnology	3+0
Biotech-424	Research Project/ Special Paper	6+0
	Total	15

BACHELOR OF BIOTECHNOLOGY YEAR-1 TERM-1

Biotech-111 INTRODUCTION TO BIOTECHNOLOGY (3+0)

Course Objectives:

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

Course Contents:

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

Recommended Books:

1. Daugherty E, 2012. Biotechnology: Science for the New Millennium.1st Edition, Revised; Paradigm Publication.
2. Smith JE, 2009.Biotechnology. 5th Edition; Cambridge University Press.
3. Nicholl TSD, 2004. An Introduction to Genetic Engineering. 2nd Edition; Cambridge University Press, UK.
4. Purohit SS, 2005. Biotechnology Fundamentals & application. 4th Edition; Agro Bios, India.
5. Ratlegde C and Kristiansen B, 2006. Basic Biotechnology. 2nd Edition; Cambridge University Press, UK.
6. Thomas JA and Fuchs RL, 2002. Biotechnology and Safety Assessment.3rd Edition; Academic Press, UK.

Biotech-112 CELL BIOLOGY (2+1)

Course Objectives:

To acquaint students with features of eukaryotic cells, functions of different compartments and the overall structure/ultrastructure of cells as visualized by electron microscopy.

Course Contents:

Introduction to cell theory including historical perspective; chemical constituents of the cell and their function, cell organelles including ribosomes, endoplasmic reticulum, lysosome, golgi apparatus, mitochondria, peroxisome, vacuole, chloroplast, structure and their functions, composition and structure of cell membranes; membrane receptors and transport mechanisms; nucleus; structure and function of chromosomes; cell cycle, mitosis and meiosis; cell movement, structure and function of cytoskeleton, centriole, cilia and flagella.

Practical:

Microscopy and staining techniques; study of prokaryotic, eukaryotic, plant and animal cells; cell structure in the staminal hair of Tradescantia; study of different types of plastids; cellular reproduction; Mitosis: smear/squash preparation of onion roots.

Recommended Books:

1. Alberts B and Johnson A, 2006. Molecular Biology of the Cell. 4th Edition; Garland Publishers, New York. (available at www.ncbi.nlm.nih.gov)
2. Karp, 2002. Cell and Molecular Biology. 3rd Edition; John Wiley and Sons, New York.
3. Alberts et al., 2009. Essential Cell Biology. 3rd Edition; Garland Publishers, New York.
4. Lodish et al., 2007. Molecular Cell Biology. 6th Edition; Freeman and Company, New York. (available at www.ncbi.nlm.nih.gov)
5. Cooper GM and Hausman RE, 2009. The Cell, a molecular approach. 5th Edition; Sinauer Associates, Inc.

Course Objectives:

To acquaint the students with Chemical Bonding and Properties of Organic Molecules, Classes and Nomenclature of Organic Compounds and to introduce them with the chemistry of hydrocarbons.

Introduction to Organic Chemistry

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

Chemical Bonding and Properties of Organic Molecules

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

Classes and Nomenclature of Organic Compounds

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

Functional Group Chemistry

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

Recommended Literature:

(Latest available editions of the following books)

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

Course objectives:

Enhance language skills and develop critical thinking.

Course Contents:

Basics of Grammar

Parts of speech and use of articles

Sentence structure, active and passive voice

Practice in unified sentence

Analysis of phrase, clause and sentence structure

Transitive and intransitive 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

Recommended books:**1. Functional English****A. Grammar**

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

B. Writing

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.

B. Reading/Comprehension

1. Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.

C. Speaking

Course 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 Outline:**1. Historical Perspective**

- a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah.
- b. Factors leading to Muslim separatism
- c. People and Land
 - i. Indus Civilization
 - ii. Muslim advent
 - iii. Location and geo-physical features.

2. Government and Politics in Pakistan

Political and constitutional phases:

- d. 1947-58
- e. 1958-71
- f. 1971-77
- g. 1977-88
- h. 1988-99
- i. 1999 onward

3. Contemporary Pakistan

- j. Economic institutions and issues
- k. Society and social structure
- l. Ethnicity
- m. Foreign policy of Pakistan and challenges
- n. 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 Banglades.*, 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.

Course Objectives:

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, function, 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.

Binomial Theorem: Introduction to mathematical induction, binomial theorem with rational and irrational indices.

Trigonometry: Fundamentals of trigonometry, trigonometric identities.

Recommended Books:

1. Dolciani MP, Wooton W, Beckenback EF, Sharron S, *Algebra 2 and Trigonometry*, 1978, Houghton & Mifflin, Boston
2. Kaufmann JE, *College Algebra and Trigonometry*, 1987, PWS-Kent Company, Boston
3. Swokowski EW, *Fundamentals of Algebra and Trigonometry* (6th edition), 1986, PWS-Kent Company, Boston

BACHELOR OF BIOTECHNOLOGY YEAR-1 TERM-2

Biotech-121

FUNDAMENTALS OF GENETICS

(2+1)

Course Objectives:

To acquaint the student with the Mendelian inheritance, gene interaction and gene mapping.

Course Contents:

Mendelian Genetics, principle of segregation, monohybrid crosses, dominance, recessiveness, codominance, semidominance, principle of independent assortment, dihybrid and trihybrid ratios, gene interaction, epistasis, multiple alleles, ABO blood type alleles in humans, Rh factor alleles in humans, probability in Mendelian inheritance, structure of chromosomes and Genes, function of DNA and RNA, classes of RNA, DNA as storage of Genetic information, experimental evidence that DNA is genetic material; physical and chemical structure of DNA, Difference between Prokaryotic and Eukaryotic Genetic material, sex determination and differentiation, sex-linked traits, sex anomalies, linkage and crossing over.

Practicals:

Introduction to Fast plants and Drosophila. Set up a Drosophila opened-ended cross, Pollinate Fast Plants, ABO blood group, Isolation of DNA from Drosophila.

Recommended Text Books:

1. Snustad DP and Simmons MJ, 2008. Principals of Genetics. 5th Edition; John Willy & Sons, New York.
2. Klug WS and Cumming MR, 2008. Concepts of Genetics. 9th Edition; Prentice Hall, USA.
3. Pierce B, 2004. Genetics: A Conceptual Approach. 2nd Edition; WH Freeman, New York.
4. Brooker R, 2011. Genetics: Analysis and Principles. 4th Edition; McGraw-Hill.
5. Pierce BA, 2011. Genetics: A conceptual approach. 4th Edition. WH Freeman Publisher.

Course Objectives:

To acquaint student with the knowledge of Microbiology and its applications.

Course Contents:

Overview and history of microbiology including microbial diversity (Archaea, bacteria, fungi, algae, protozoa), nutrition, growth, metabolism; cultivation; viruses; control of microorganisms: sterilization and disinfection, antimicrobial agents, antibiotics, antibiotic resistance and susceptibility, antifungal and antiviral agents; cell death; symbiosis, carbon, nitrogen, sulfur and phosphorus cycles; microbiology of soil, freshwater and seawater.

Practicals:

Sterilization techniques, culturing, staining (Gram, simple, negative, capsule and spore), colony and cell morphology, bacterial cell count and growth curve, biochemical tests (Oxidation Fermentation (OF), urease, oxidase and catalase) of bacteria.

Recommended Text Books:

1. Talaro, K. P., 2006. Foundations in Microbiology: Basic Principles. McGraw Hill. Publisher.
2. Black, J. G., 2005. Microbiology: principles and explorations, *by* 6th Edition, J. Wiley & Sons, USA.
3. Cappuccino, J. G. and Sherman, N. 2004, Microbiology: a laboratory manual. Pearson Education, USA.
4. Pollack, R. A. Findlay, L., Mondschein, W. Modesto R. R., 2004. Laboratory Exercises in Microbiology *by* 2nd Edition, J. Wiley and Sons, USA.
5. Tortora, G. J., Funke, B. R. and Case, C. L. 2008. Microbiology: an introduction 9th Edition, Pearson Education, USA.
6. Kathleen P. T., and Arthur, T. 2001. Foundations in Microbiology: Basic Principles McGraw-Hill Companies/
7. Tortora, G. J., Funke, B. R., Case, C. L. 2000. Microbiology: An Introduction, Study Guide. Benjamin-Cummings Publishing Company.
8. Tortora, G. J., Funke, B. R. and Case, C. L. 2004. Microbiology: an introduction 8th Edition, Pearson Education, USA.
9. Tortora, G. J., Christine, L. Case, C. L., Funke, B. R., Funke, B., Case, C., 2006. Microbiology: An Introduction, Publisher: Pearson Education.
10. Alcamo, I. E., 2001. Fundamentals of Microbiology *published by* Jones and Bartlett Publishers, USA.

Course objectives:

The program is aimed that the student should learn:

1. The Development of periodic law and properties of elements in a systematic way.
2. The principal of chemical bonding
3. Chemistry of acid and bases
4. Chemistry of p-block Elements

1. The Periodic Law and Periodicity

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

2. Principles of Chemical Bonding

Types of chemical bonding; ionic bonding; the localized bond approach: VB theory, hybridization and resonance; the delocalized approach to bonding: molecular orbital theory as applied to diatomic and polyatomic molecules, three center bonds, bonding theory of metals and intermetallic compounds; conductors, insulators and semiconductors; bonding in electron deficient compounds; hydrogen bonding.

3. Acids and Bases

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

4. Chemistry of p-block Elements

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

Practical:**1. Laboratory Ethics and safety measures**

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

2. Qualitative analysis

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

3. Quantitative analysis**Recommended Books:**

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

2. Cotton, F. A., Wilkinson, G. and Gaus, P. L., "Basic Inorganic Chemistry", 3rd Ed., Wiley, New York, 1995.
3. Clyde Day, M. & Selbin, J., "Theoretical Inorganic Chemistry", 2nd Ed., Van Nustrand Reinhold, 1969.
4. Lee, J.D., "Concise Inorganic Chemistry", Chapman and Hall, 5th Edition, 1996.
5. Shriver, D. F., Atkins, P. W. and Langford, C. H., "Inorganic Chemistry", Oxford University Press, 2nd Edition, 1994.
6. Bassette, J., Denney, G. H. and Mendham, J., "Vogel's Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis" English Language Book Society, 4th Edition, 1981.
7. Vogel, A. I., "A Textbook of Micro and Semi-micro Qualitative Inorganic Analysis" Longman Green & Co. 1995.

Course 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)

Recommended books:**Communication Skills****a) Grammar**

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third 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 453403 0.
2. Reading and Study Skills by John Langan
3. Study Skills by Richard Yorky.

Course objectives:

This course is aimed at:

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

Course Contents:**Introduction to Quranic Studies**

1. Basic Concepts of Quran
2. History of Quran
3. Uloom-ul -Quran

Study of Selected Text of Holly Quran

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

Study of Selected Text of Holly Quran

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

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

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

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

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

Introduction To Sunnah

1. Basic Concepts of Hadith
2. History of Hadith
3. Kinds of Hadith
4. Uloom –ul-Hadith
5. Sunnah & Hadith
6. Legal Position of Sunnah

Selected Study from Text of Hadith

Introduction To Islamic Law & Jurisprudence

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

Islamic Culture & Civilization

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

Islam & Science

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

Islamic Economic System

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

Political System of Islam

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

Islamic History

1. Period of Khlaft-E-Rashida
2. Period of Ummayyads
3. Period of Abbasids

Social System of Islam

1. Basic Concepts Of Social System Of Islam
2. Elements Of Family
3. Ethical Values Of Islam

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 Jrisprudence and the Quranic Law of Crimes" Islamic Book Service (1982)

8. H.S. Bhatia, "Studies in Islamic Law, Religion and Society" Deep & Deep Publications New Delhi (1989)
9. Dr. Muhammad Zia-ul-Haq, "Introduction to Al Sharia Al Islamia" Allama Iqbal Open University, Islamabad (2001)

Biotech-126 MATHEMATICS-II (CALCULUS) (3+0)

Prerequisite(s): Mathematics I (Algebra)

Course objectives:

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

Course Outline:

Preliminaries: Real-number line, functions and their graphs, solution of equations involving absolute values, inequalities. *Limits and Continuity:* Limit of a function, left-hand and right-hand limits, continuity, continuous functions.

Derivatives and their Applications: Differentiable functions, differentiation of polynomial, rational and transcendental functions, derivatives.

Integration and Definite Integrals: Techniques of evaluating indefinite integrals, integration by substitution, integration by parts, change of variables in indefinite integrals.

Recommended Books:

1. Anton H, Bevens I, Davis S, *Calculus: A New Horizon* (8th edition), 2005, John Wiley, New York
2. Stewart J, *Calculus* (3rd edition), 1995, Brooks/Cole (suggested text)
3. Swokowski EW, *Calculus and Analytic Geometry*, 1983, PWS-Kent Company, Boston
4. Thomas GB, Finney AR, *Calculus* (11th edition), 2005, Addison-Wesley, Reading, Ma, USA
5. "Mathematics for biological sciences" by Raymond

BACHELOR OF BIOTECHNOLOGY YEAR-2 TERM-3

Biotech-211

BIOCHEMISTRY-I

(2+1)

Course Objectives:

To acquaint the student with the chemistry and biology of biomolecules.

Course Contents:

Introduction to biochemistry, amino acids and proteins, general functions, classification, primary, secondary, tertiary and quaternary structure, Fibrous and globular proteins, Protein stability, Protein folding. Classification of carbohydrates, structure and functions of mono, oligo and polysaccharides, sugar derivatives, Structural polysaccharides, storage polysaccharides, Structure and function of bacterial cell-walls. Classification, structure, properties and functions of different types of lipids, fatty acids, triglycerides, glycerophospholipids, sphingolipids, cholesterol, Micelles, bilayers and liposomes. Properties and functions of lipoproteins, Fat and water soluble vitamins.

Practicals:

Qualitative tests for amino acids, Amino acid titration, Hydrolysis of proteins and chromatographic separation of amino acids, Isolation and solubilization of proteins from plant and animal tissues, Estimation of proteins using different methods, Estimation of glucose in a mixture of monosaccharides, estimation of sucrose by polarimeter, chromatographic separation of sugars. Estimation of acid, saponification and iodine values of fat, Enzymes assay, effect of pH, temperature and substrate concentration on the properties of enzymes, Kinetic analysis of enzymes. Isolation of nucleic acids.

Recommended Text Books:

1. Principles of Biochemistry, A. L. Lehninger, D.L. Nelson, 3rd edition (2000), Worth Publishers.
2. Biochemistry, L. Stryer, 6th Edition (2006), W.H. Freeman and Co.
3. Biochemistry, D. Voet, T. G. Voet, 3rd edition (2004), John Wiley and Sons, New York.
4. Harper's Illustrated Biochemistry, 27th edition (2006), McGraw-Hill Medical.
5. Lippincott's Biochemistry, P.C. Champe, R.A. Harvey, D.R. Ferrier, 4th edition (2008), J.B. Lippincott Company.
6. An Introduction to Practical Biochemistry, D. T. Plummer, 3rd edition (1987), McGraw-Hill.
7. Handbook of Molecular and Cellular Methods in Biology and Medicines, P.B. Kaufmann, W.Wu, L.J. Creke (1995), CRC Press.

Latest books

Course Objectives:

To acquaint the student with the chemistry and biology of macromolecules.

Course Contents:

Overview of Molecular Biology, Macromolecules, chemical structures of the major classes of Macromolecules: Proteins, Nucleic Acids, Polysaccharides, Nucleic Acids, DNA Helix, Form of DNA Helix, Factor that determine structure of DNA, properties of Genetic Material (storage and Transmission of Genetic information by DNA). Transmission of information from parent to progeny, chemical stability of DNA, Ability of DNA to change, DNA Replication, Enzymology of DNA Replication. Events in the Replication Fork, Initiation of synthesis of Leading and lagging strands, Okazaki fragments, importance of 3 → 5 and 5 → 3 Exonuclease activities of DNA polymerase, Rolling circular Replication, Loop Rolling circular Replication, Difference between Prokaryotic and Eukaryotic Replication.

Practicals:

Isolation & Purification of DNA, Determination of Concentration of DNA using spectrophotometer. Hypochromicity determination of DNA,

Recommended Text Books:

1. Molecular Biology by Daved Freifelder, Jones & Barlet Publisher, Boston
2. Molecular Biology of the cell by B. Alberts. D. Brag, J. Lewis. M. Raff, K. Roberts and J. D. Watson, Garland Publishers. Jones & Barlet Publisher, Boston

Latest books

Course Objectives:

To acquaint the students with the Thermodynamics, Chemical Kinetics, Chemical Equilibrium, Acids and Bases and structure of matter (atoms, elements, molecules, compounds etc.)

Course Contents:**Solutions and Solubility:**

Various concentration terms like Normality, Molarity, Mole fraction, Percent solution, W/w, W/v, V/v, solubility, solubility product, factors effecting solubility, pH, Buffer solution, Physiological buffer, Buffer activity, titration curves, acid base indicators.

Chemical Kinetics:

Introduction, Type of chemical reaction, exothermic and endothermic reaction, rate and rate expression, order and molecularity of reaction, Zero order, 1st and 2nd order reaction, Various factors effecting rate of chemical reaction. The kinetics of enzyme catalyzed reaction and enzyme inhibitions.

Colloids:

Introduction, Classification, Preparation, Purification, Properties and application of colloid, colloid and dialysis.

Nuclear Chemistry:

Introduction, Natural and Artificial radioactivity, Properties of Alpha, beta and gamma particles. Radioactive decay and half-life, detection and measurement techniques, fission and fusion reaction, radio tracers. Biological and diagnostic application of radioactive isotopes, Metal ions in carcinogenesis and in anticancer battle.

Miscellaneous Process:

Osmosis and osmotic pressure, adsorption and theory of adsorption, sterilization and disinfection i.e. dry heat, Moist heat, radiation, Gaseous sterilization, Aseptic techniques.

Recommended Books:

1. J. Fisher and J.R. Arnold (2001) 1st edition, 'Chemistry for Biologist', Bios scientific publisher Ltd. Oxford UK
2. M. Satake, Y. Hayashi and M.S Sethi (2003) 2nd Edition, 'Bio physical chemistry', Discovery Publishing House. New Delhi.
3. A.K. Das (2002) 4th edition 'Bio organic Chemistry' CBS publisher and distributors.
4. C. Raymond (1998), 2nd Edition. 'Chemistry with application to biological system', Oxford Publisher Co.
5. Alberty R. "Physical Chemistry" 17th ed., John Wiley and Sons (1987).
6. Atkins, P.W. "Physical Chemistry" 6th ed., W.H. Freeman and Co. New York (1998).

Course Objectives:

To give students basic computing knowledge and to enable them to use computer in advancing their knowledge

Course Contents:

1. Introduction to computer hardware and software, computer applications for biotechnologists, Spreadsheet work, Word processing; Graphical and Statistical analysis packages.
2. Basic Definitions & Concepts
3. Hardware: Computer Systems & Components
4. Storage Devices
5. Software: Operating Systems
6. The Internet, Browsers and Search Engines
7. The Internet: Email and Social Networking

We need to put practicals here

Text Books/Reference Books:

1. Introduction to Computers by Peter Norton, 6th International Edition (McGraw HILL)
2. Using Information Technology: A Practical Introduction to Computer & Communications by Williams Sawyer, 6th Edition (McGraw HILL)
3. Computers, Communications & information: A user's introduction by Sarah E. Hutchinson, Stacey C. Swayer
4. Fundamentals of Information Technology by Alexis Leon, Mathewsleon Leon press

Biotech-215 ENTREPRENEURSHIP IN BIOTECHNOLOGY (3+0)

Course Objectives:

Course Contents:

Text Books/Reference Books:

Biotech-216 ENGLISH-III (Technical Writing and Presentation Skills) (3+0)

Course Objectives:

Enhance language skills and develop critical thinking

Course Contents:

Presentation skills

Essay writing

Academic writing

Technical Report writing

Progress report writing

Recommended books:

Technical Writing and Presentation Skills

A) Essay Writing and Academic Writing

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).

College Writing Skills by John Langan. Mc=Graw-Hill Higher Education. 2004.

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

B) Presentation Skills

C) Reading

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

BACHELOR OF BIOTECHNOLOGY YEAR-2 TERM-2

Biotech-221

BIOCHEMISTRY-II

(2+1)

Course Objectives:

To acquaint the student with the key concepts of intermediary metabolism of proteins, nucleic acids, carbohydrates and lipids.

Course Contents:

Introduction to metabolism and basic aspects of bioenergetics and biochemical thermodynamics (endergonic and exergonic reactions); phosphoryl group transfer and ATP production; metabolism, oxidation-reduction; carbohydrate metabolism and regulation (glycolysis, glycogenolysis; gluconeogenesis; pentose phosphate pathway); citric acid cycle (reactions, energetics and control), electron transport chain, oxidative phosphorylation, shuttle mechanisms (glycerol-phosphate shunt), lipid metabolism (energy yield from fatty acid oxidation, ketone bodies, acyl glycerol, compound lipids, cholesterol); Calvin Cycle; metabolism of nitrogenous compounds (amino acid synthesis, catabolism, purine and pyrimidine synthesis); nucleic acid metabolism and control; urea cycle.

Practicals:

Basic biochemical methods such as iodine test for polysaccharides, fermentation of sugars by Baker's yeast; isolation of amylose and amylopectin from starch; extraction of glycogen from liver; acid and enzymatic hydrolysis of glycogen; extraction and estimation of lipids from plant tissue/seed and lipid separation from different tissues; fractionation by thin layer chromatography (TLC).

Recommended Text Books:

1. Biochemistry, D. Voet, J.G. Voet, 3rd (2004), John Wiley and Sons Inc.
2. Principles of Biochemistry, A.L. Lehninger, D.L. Nelson, 3rd edition (2000), Worth Publishers.
3. Lippincott's Biochemistry, P.C. Champe, R.A. Harvey, D.R. Ferrier, 4th edition (2008), J.B. Lippincott Company.
4. An Introduction to Practical Biochemistry, D. T. Plummer, 3rd edition (1987), McGraw-Hill.
5. Modern Experimental Biochemistry, R.F. Boyer, 3rd edition (2000), Pearson Education Inc.

Course Objectives:

To acquaint students with the experimental aspects of molecular biology

Course Contents:

Mutations, Types of Mutations, Biochemical basis of Mutagenesis, Base-Analogue Mutagens, chemical Mutagens, Intercalating Agents, Reversion, Transcription, Basic Features of RNA synthesis, Enzymology of RNA synthesis, RNA chain synthesis Initiation, elongation and Termination, Transcription in Eukaryotes, Post-transcriptional Modifications, Translation, Genetic code, codons, Decoding system, Role of mRNA, Role of tRNA, chemical composition of Ribosomes, initiation of protein synthesis, Elongation of polypeptide chain, Termination of polypeptide chain, Difference between protein synthesis in prokaryotes and Eukaryotes, Post-translational Modifications, Regulation of gene expression in prokaryotes and Eukaryotes, Protein sorting and transport. DNA repair mechanisms.

Practicals:

Restriction digestion of DNA and preparation of restriction maps, Gel Electrophoresis, PCR, Blotting Techniques, RNA isolation and RT-PCR.

Recommended Text Books:

1. Molecular Biology by Daved Freifelder. Jones & Barlet Publisher, Boston
2. Molecular Biology of the cell by B. Alberts. D. Brag, J. Lewis. M. Raff, K. Roberts and J. D. Watson, Garland Publishers. Jones & Barlet Publisher, Boston

Biotech-223 GENETIC RESOURCES & CONSERVATION (2+1)

Course Objectives:

To accustom Students with bio resources of the country and conservation.

Course Contents:

Introduction to Genetic resources and its importance, Evolution of Terrestrial and Marine biodiversity, An overview of Wild and Domesticated Genetic Resources of Pakistan, Extent of genetic diversity, Low genetic diversity in threatened species, Genotype and environment interaction, Mutation selection balance, Genetic drift, Population bottle necks, Inbreeding, Migration and gene flow, Introduction to extinctions and its causes, Threatened Animal and Plant Species, Conservation of Genetic Resources through Mapping of Existing Biological Diversity, Assessing Conservation Status, Management Strategies. Laws and Treatises of conservation, Introduction to wildlife and forest Acts, Biodiversity action plan of Pakistan, Quarantine regulations, Future Prospects of Conservation.

Practicals:

Experiments on Diversity Studies,
Standard methods of sample collection and preservation.
Analysis Techniques of wild organisms and fossil Samples.
Visits to National Parks
Visits to Plant and Animal Genetic Resources Conservation Centers.

Recommended Text Books:

1. Bush, M.B. 1997. Ecology of a changing planet. Prentice Hall.
2. Cunningham, A.B. 2001. Applied Ethnobotany: People, wild plant use and conservation. Earthspan Publications.
3. Cotton, C.M. 1996. Ethnobotany Principals and Application. John Willy and Sons hichester, UK.
4. De Klemm, C. 1990. Wild Plant Conservation, IUCN, Gland.
5. Dyke, F.V. 2003 Conservation Biology. Mc Graw Hill, New York.
6. Krupnick, G.A. 2005. Plant Conservation. The University of Chicago Press.
7. Mc Neely, J.A., Mc Carthy, T.M., Smith, A., Whittaker, L.O, and Wikramanayake. 2006. conservation biology in Asia. Resources Himalaya Foundation.
8. Given, D.R. 1994. Principals and practices of plant conservation Timber Press.

Biotech-224**BIOPHYSICS****(3+0)****Course Objectives:**

This course is intended for students studying life sciences and aims to impart fundamental concepts of physics in the context of biological systems.

Course Contents:

Essentials of thermodynamics; concept of entropy, enthalpy and Gibb's free energy; order and disorder in biological systems; molecules, diffusion, random walks and friction; methods of studying macromolecules; interactions of molecules in 3-D space – determining binding and dissociation constants; molecular motors; sedimentation; Reynold's number; chemical forces and self-assembly; physics of ion channels.

Modification of the course material is needed**Recommended Books:**

1. Nelson P, 2004. Biological Physics, Energy, Information and Life. First Edition; WH Freeman & Company.
2. Kirsten et al., 2010. Introduction to Biological Physics for the Health and Life Sciences. Second Edition; John Wiley & Sons.
3. Davidovits P, 2013. Physics for Biology & Medicine. Fourth Edition; Academic Press.
4. Newman, 2008. Physics of the Life Sciences. Springer.
5. Duncan, 1975. Physics for Biologist. Blackwell Science.

Biotech-225**BIOSTATISTICS****(3+0)****Course Objectives:**

To acquaint students with statistical techniques frequently used in biology to process real data.

Course Contents:

Definition of statistics, characteristics, importance and limitations, population and samples, Frequency distribution and probabilities, formation of frequency table from raw data, histograms, Applications of probabilities to simple events, Measures of central tendencies and dispersion, Arithmetic mean, median, mode, range, variance and standard deviation, standard error of the mean, mean deviation, semi interquartiles range. Standard distribution (Binomial, poisson and normal distributions, properties and application, Normality), Test of significance (t-test, X²-test, F-test, L.S.D. test, multiple range test), Design of experiment: Brief account of

correlation and regression, Computer based statistical software (**Name of softwares**) applications.

Recommended Text Books:

1. Sullivan, L.S., 2008. Essentials of biostatistics. Jones and Bartlett press.
2. Daniel, W.W., 2008. Biostatistics:A Foundation for Analysis in the Health Sciences John Wiley & Sons
3. Gertmsn, B. B, 2007. Basic biostatistics: statistics for public health practice. Jones and Bartlett press.
4. Essex-Sorlie, D. 1995. Medical Biostatics & Epidemiology, International Edition, Appleton & Lange 2nd.Edition,
5. Marzillier, L.F., 1990. Elementary statistics , Wm.C.Brown Publisher
6. Stanton, A.G., 2001. Primer of Biostatistics. McGraw Hill
7. Beth, D.D., Robert, G.T 2000. Basic and clinical biostatistics. Appleton & Lange
8. Streiner, N., Norman, G.R., 2000. Biostatistics: The bare essentials B.C. Decker, Inc.
9. Rosner, B., 2000. Fundamentals of biostatistics. Cole Pub. Co.
10. Quinn, G., 2002. Experimental Design and Data Analysis for Biologists. Cambridge University Press.

Biotech-226 PSYCHOLOGY (3+0)

Course Contents:

Recommended Text Books:

BACHELOR OF BIOTECHNOLOGY YEAR-3 TERM-5

Biotech-311

IMMUNOLOGY

(2+1)

Course Objectives:

To acquaint the student with the basic principles of defense mechanism and immune system.

Course Contents:

Overview of the body defense mechanisms, the immune system, elements of innate and acquired immunity, antibody structure and function, antigen-antibody interactions, cells of the immune system, monoclonal antibodies, Genetics of antibody structure and diversity, Activation and function of T and B cells and their receptors, Major histocompatibility complex, Complement system, Hypersensitivity, cytokines, Autoimmunity, resistance and immunity to infectious diseases, cell-mediated effector response, leukocyte migration and inflammation, vaccines, diseases of the immune system - autoimmunity, transplantation immunology.

Practicals:

Radioimmunoassay of hormones (thyroid, growth, adrenal and others), Enzyme-linked immunosorbent assay (ELISA), Antibody profiling, Western blot. HCV, HBV.

Recommended Text Books:

1. Immunology, J. Kuby, 6th edition (2007), W.H. Freeman and Co.
2. Immunobiology - The immune system in health and disease, C.A. Janeway, P.Travers, 3rd edition (1997), Garland Publication Inc. New York.
3. Roitt's Essential Immunology, Ivan Roitt, 11th edn (2007), Blackwell Scientific Publication.
4. Harlow ED, David L., Antibodies - A laboratory Manual, (1988), Cold Spring Harbor laboratory Press.
5. Methods for protein analysis, R.A. Copeland, (1994), Chapman and Hall.
6. The Basic Protein and Peptide Protocols, J.M. Walker (1994), Humana Press.
7. The Protein Protocols Handbook, J.M. Walker (1996), Humana Press.
8. Basic Biochemical Methods, R.R. Alexander, J. M. Griffiths, 2nd edition (1993), Wiley Liss.

Latest Editions

Course Objective:

To create awareness of basic physiological processes going on within plants.

Course Contents:

Introduction to tissues and tissues system in primary plant body, mechanisms of absorption and translocation of water. Mechanism of phloem transport. Stomata structure and factors affecting stomatal movement. Photosynthesis; concepts, an overview of the mechanism, photosystem I and II, mechanism and biochemistry of CO₂ fixation in C₃, C₄ and CAM plants. Respiration; concept, mechanism of aerobic and anaerobic respiration, electron transport, ATP formation and oxidative phosphorylation. Photorespiration, an overview of the mechanism, Nitrogen cycle and fixation, assimilation of sulfur, Phytohormones; kinds, structure and physiological role.

Practicals:

Identification of C₃ and C₄ leaves, microscopic examination of stomata, determination of relative water content, extraction of chlorophyll and proteins from leaves, SDS PAGE electrophoresis, staining and destaining of proteins.

Recommended Books:

1. Plant Physiology (5th edition) Taiz and Zeiger eds, 2014.
2. Hopkins, W.G. 2004. Introduction to Plant Physiology, 3rd ed. John Wiley and Sons, New York, USA.
3. Hans, M. and P. Schopfer. 1995. Plant Physiology. Springer Verlag, Heidelberg, Germany.
4. Fageria, N.K., V.C. Baligar and R.B. Clark. 2005. Physiology of Crop Production. Academic Press, New York
5. Gardener, F.P., R.B. Pearce, and R.L. Mitchell. 1988. Physiology of Crop Plants. Iowa state University Press, Ames, Iowa, USA.
6. Hall, D.O. and K. Rao. 1999. Photosynthesis, 6th ed. Cambridge University Press, UK.

Course Objectives:

This course emphasize on the enzymes and its components.

Course Contents:

Introduction to enzymes; enzyme nomenclature and classification; substrate specificity; co-enzymes; regulation of enzyme activity; chemical kinetics and enzyme

kinetics, Michaelis-Menten equation; activation energy; effect of pH and other factors on rates of reactions; inhibition of enzymatic reactions and kinetics; bisubstrate reactions; catalytic mechanisms; structure and mechanics of lysozyme; serine proteases and glutathione reductase; enzymes immobilization.

Practical:

Preparation and assay of amylase/peroxidase; effect of pH, temperature, enzyme and substrate concentration on activity; effect of cofactors, activators and inhibitors; determination of enzyme kinetics, k_m and V_{max} ; enzyme stability.

Plz put recommended books

Biotech-314 RECOMBINANT DNA TECHNOLOGY (2+1)

Course Objectives:

To acquaint the students with Basic techniques and tools used in gene manipulation and its practical uses.

Course Contents:

Introduction and History of Recombinant DNA technology, An overview of cloning steps; Preparation of insert, restriction endonucleases, restriction mapping, vectors and their types, cloning vectors, cloning strategies, site-directed mutagenesis, sequencing strategies, transformations, regeneration through tissue culture techniques, expression of recombinant proteins and their purification by affinity chromatography; Polymerase Chain reaction, analysis of nucleic acids by gel electrophoresis, analysis of proteins by native and SDS-PAGE; 2-D gels; generation of antibodies and their uses; Southern, Western, Northern blotting. Application of recombinant DNA Technology (agriculture, health, industry, environment and basic research).

Practicals:

DNA and plasmid isolation and agarose gel electrophoresis, conjugation, transformation, role of mutagenic agents in mutation, analysis of proteins by SDS-PAGE, Blotting techniques.

Recommended Text Books:

1. Robert F.W., 2005. Molecular Biology. McGraw-Hill.
2. Dale, J.W. and von Schantz, M. 2002. From Genes to Genomes: Concepts and Applications of DNA Technology. John-Wiley and Son Limited.
3. Meyers, R.A., 2006. Genomics and Genetics. John-Wiley and Son Limited.
4. Primrose, S.B., and Twyman, R.M. 2006. Gene Manipulation and Genomics 6th edition. Blackwell Publishing.

5. Watson, J.M., Caudy, A.A., Meyers, R.A., and Witkowski, J.A., 2007. Recombinant DNA. Gene and genomes. 3rd Edition. W.h. Freeman and Company, New York.

Biotech-315 BIOINFORMATICS (2+1)

Course Objectives:

To acquaint the students with bioinformatics tools, databases, algorithms and applications.

Course Contents:

Introduction to Bioinformatics, its Definition and History, Introduction to Data Mining and its Application, Database Hierarchies, Genomic and Proteomic Sequence Database and their Interpretation (UCSC Genome Database, NCBI, PDB, EcoCyc, DDBJ, SWISS-PROT, TIGR, KEGG etc)

Biocomputing (Introduction to String Matching Algorithms, Database Search Techniques, Sequence Comparison and Alignment Techniques, Use of Biochemical Scoring Matrices, Introduction to Graph Matching Algorithms, Genome Comparison, Prediction and its Implication).

Practicals:

Bioinformatics Tools: Repeatmasker, PHRED, PHRAP, BLAST, Prosite/BLOCKS/PFAM, CLUSTALW, Emotif, RasMol, Oligo, Primer3, Molscript, Treeview, Alscript, Genetic Analysis Software, Phylip

Recommended Text Books:

1. Claverie, J.M. and Notredame C. 2003 Bioinformatics for Dummies. Wiley Editor.
2. Letovsky, S.I. 1999 Bioinformatics. Kluwer Academic Publishers.
3. Baldi, P. and Brunak, S. 1998 Bioinformatics. The MIT Press.
4. Setubal, J. and Meidanis, J. 1996 Introduction to Computational Molecular Biology. PWS Publishing Co., Boston.
5. Lesk, A.M. 2002 Introduction to Bioinformatics. Oxford University Press.
6. Rastogi, S.C., Mendiratta, N. and Rastogi, P. 2004 Bioinformatics: Concepts, Skills & Applications. CBS Publishers & Distributors, New Delhi.
7. Fogel, G.B. and Corne, D.W., Evolutionary Computation in Bioinformatics.
8. Mont, D.W., Bioinformatics: Sequence and Genome Analysis.
9. Evens, W.J. and Grant, G.R., Statistical Methods in Bioinformatics: An Introduction.
10. Pierre Baldi and Soren Brunak, Bioinformatics: The Machine Learning Approach.

BACHELOR OF BIOTECHNOLOGY YEAR-3 TERM-6

Biotech-321 ANALYTICAL CHEMISTRY & INSTRUMENTATION (2+1)

Course Objectives:

To acquaint the student with key analytical concepts of identification and analysis at molecular levels by introducing a variety of analytical chemistry techniques and their applications at the molecular level; designing analytical chemistry methods to obtain analysis data with the high precision and accuracy from experiments; demonstrating biochemical laboratory techniques and explaining the theory and background behind these techniques.

Course Contents:

Introduction to various analytical techniques; principles and applications of various types of chromatography including paper, thin layer, gel filtration, ion-exchange, affinity, high performance liquid chromatography (HPLC), gas chromatography, GC-MS and LC-MS; spectroscopy types including nuclear magnetic resonance (NMR), visible, ultraviolet, luminescence, flame, atomic absorption, fluorescence, emission and inductively coupled plasma emission spectroscopy (ICPMS); introduction to X-ray diffraction; general analytical instrumentations and methods of fractionation and characterization of proteins and nucleic acids, dialysis, ultra-filtration, lyophilisation, centrifugation and amino acid analyzer.

Practicals:

Separation of biomolecules by paper, column and thin layer chromatography; determination of molecular weight of proteins by gel filtration; identification of sugars, proteins, electrolytes etc. by UV/Visible spectrophotometer; determination of sodium and potassium content in blood serum by flame photometer and mineral analysis of plant tissues using atomic absorption spectrophotometer.

Recommended Text Books:

1. Methods for protein analysis, R.A. Copeland, (1994), Chapman and Hall.
2. Campbell L, Durek, Braun B (1987) 1st edition, "Introduction to instrumental Analysis" Mc Graw Hill International editions, chemistry series Liss.
3. A Biological Guide to Principles and Techniques of Practical Biochemistry, K.Wilson, K.H. Goulding, 3rd edition (1991), ELBS.
4. Protein Methods, D.M. Bollag, M.D. Rozycki, S.J. Edelstein, 2nd Edition (1996), Wiley- Liss.
5. A Biological Guide to Principles and Techniques of Practical Biochemistry, K.Wilson, K.H. Goulding, 3rd edition (1991), ELBS.
6. Methods for Protein Analysis, R.A. Copeland, (1994), Chapman and Hall.
7. Protein Methods, D.M. Bollag, M. D. Rozycki, S.J. Edelstein, 2nd Edition (1996), Wiley- Liss.

8. Analytical Chemistry, A. Skoog, M. Donald (2000), Saunderson Publishers Kenkel J (1994) 2nd edition, "Analytical Chemistry for Technicians" Lewis Publishers, BocaRaton.
9. Wilson K, Walker J (1994) 3rd edition, "Principles and Techniques of Practical Biochemistry" Cambridge University Press. Cambridge.
10. Basic Biochemical Methods, R.R. Alexander, J. M. Griffiths, 2nd edition (1993), Wiley

Biotech-322 MICROBIAL BIOTECHNOLOGY (2+1)

Course Objectives:

To acquaint the students with biotechnological potentials of microbes in food, pharmaceuticals, industries, mining, disease control and as a biofertilizer.

Course Contents:

Issues and scope of microbial biotechnology, genetically modified microorganisms, microbes as tools for microbiological research, Biotechnological potential of microbes, significance of microorganisms in food production and fermentation, pharmaceutical and other industrial products, Vaccine development and production, biofertilizers, composting, microbiological mining, biofuels, use of microbes in petroleum industry, Microbial role in regulatory mechanism of plant, Significance of microbial biotechnology in economic development of Pakistan.

Practicals:

Isolation and screening of potential microbes from different environmental sources, Lab scale production of bacterial enzymes, lab scale production of alcohol by yeast, use of microbes in bioleaching, use of microbes in microbial enhanced oil recovery.

Recommended Text Books:

1. Olguin, E., Sanchez, G., and Elizabeth Hernandez, E., 1999. Environmental Biotechnology and Cleaner Bioprocesses. CRC Press.
2. Agathos, S.N.N. and Reineke, W., 2002. Biotechnology for the Environment: Soil Remediation. Springer-Verlag New York, LLC.
3. Stevens, C., Verhe, R., Verhé, R., 2004. Renewable Bioresources: Scope and Modification for Non-Food Applications. Wiley, John and Sons, Incorporation
4. Groves, M. J., 2005. Pharmaceutical Biotechnology. CRC Press.
5. Glick, B. R., and Pasternak, J., 2002. Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press.
6. Klefenz, H., 2002. Industrial Pharmaceutical Biotechnology, Wiley-VCH Verlag GmbH.
7. Mukhopadhyay, S. N, 2004. Process Biotechnology Fundamentals, 2nd Edition: Viva Books Pvt. Limited, New Delhi.

8. Goodsell, D. S., 2004. Bionanotechnology: Lessons from Nature . John Wiley and Sons Limited.
9. Purohit, S. S., 2002, Biotechnology: Fundamentals and Applications, Agrobios publishers.
10. Prave, P., Faust, U., Sittig, W., and Sukatsch, D. A., 2002. Fundamentals of Biotechnology, John Wiley and Sons.

Biotech-323 PLANT CELL AND TISSUE CULTURE (2+1)

Course Objectives:

To acquaint the student with the techniques to produce disease free plant material.

Course Contents:

Cell and Plant Tissue culture, Introduction, history and importance, requirements for in vitro culture, culture facilities, sterile techniques, media preparation and handling, methods of cell and tissue culture, callus culture, cell and suspension culture, organogenesis, somaclonal variation, protoplast isolation and fusion, anther and pollen culture, micropropagation, embryo rescue, cryopreservation, improvement of Plants via Plant cell culture, production of variant plants from selected cells, tissue culture in genetic engineering and biotechnology.

Practicals:

Preparation of stock and working solutions, preparation of culture media (liquid) semi-liquid and semi-solid) Explants preparation, callus culture and organogenesis. Preparation and fusion of protoplasts.

Recommended Text Books:

1. Plant Tissue culture manual. K. Lindeseg Kluwer. Academic Publisher, The Netherlands
2. Principles of Tissue Engineering, R.P. Lanza, R. Langer and J. Vacantuy. Academic Press, California, USA.

Course Objectives:

To acquaint the student with the role of microorganisms in food and food industry.

Course Contents:

Food composition, probiotics, fermented foods, food enzymes, colors and additives; overview of metabolic engineering of bacteria for food ingredients; techniques used for production of food ingredients by microbes; genetic modification of plant starches for food applications; biotechnological approaches to improve nutritional quality and shelf life of fruits and vegetables; microbial food spoilage and food borne diseases; detection and control of food borne bacterial pathogens; food safety and quality control; international aspects of quality and safety assessment of food derived by modern biotechnology.

Practicals:

Pure culture study of fermented products such as yogurt, bread, pickles, acetic acid etc.; isolation and handling of microbial flora of fermented products as *Lactobacilli*, *Saccharomyces*, *Aspergillus*, *Acetobacter* etc.; preparation of fermented products using pure cultures; effect of pH on the microbial flora of different fermented products.

Recommended Text Books:

1. Food Biotechnology by Ulf Stahl, Ute E.B. Donalies and Elke Nevogit, 2008.
2. Food colors, flavors and additives technology by NIIR, National Institute of industrial research, Dehli, India 2007.
3. Biotechnology and food processing by Meenakshi Paul, 2007
4. Food Biotechnology, edited by K. Shetty et al , 2nd edition, 2006.
5. Fundamentals of food Biotechnology, Dyong H.Lee, 1996 Food Chemistry, lab. Manual by Dennis D. Miller, Willey Inter science. , 1998
6. Food analysis Manual by Javid Aziz Awan.2000.
7. Biotechnology and our Food by Joan Nordquist, Mass Market paper back, 2000

Latest books

Biotech-325 ANIMAL BIOTECHNOLOGY (2+1)

Course Objectives:

To acquaint students with techniques for engineering transgenic animals and embryonic micromanipulations

Course Contents:

Introduction and history of transgenic animals; role of synthetic peptides/proteins in animal health; Production and uses of monoclonal antibodies from animals; cytokines and their potential therapeutic value as applicable to the diagnosis of microbial infections; micromanipulations of farm animal embryos; use of biotechnological techniques in animal breeding strategies; gene transfer through embryo microinjection; ethical and social issues in animal biotechnology, Applications of transgenic animals (animal models of diseases, pharming, farm animals improvement),.

Practicals:

Aquaculture methods and various DNA recombinant techniques for animal biotechnology

Recommended Text Books:

1. Freshney IR, 2010. Culture of animal cells: A manual of basic techniques and specialized application. 6th Edition; Wiley-Blackwell
2. Masters JR, 2000. Animal cell culture. 3rd Edition; Oxford University Press.
3. Lanza et al., 2001. Methods of tissue engineering Academic Press Inc.
4. Doyle et al., 1998. Cells and tissue culture: Laboratory procedures in biotechnology. Wiley, John and Sons.
5. Barnum S, 2004. Biotechnology: An Introduction (with Infotrac) Brooks /Cole.
6. Tourte Y and Catherine TC, 2005. Genetic Engineering and Biotechnology: Concepts, Methods, and Agronomic Applications. Science Publishers.
7. Houdebine LM, 2003. Animal Transgenesis and Cloning. 1st Edition; John Wiley and Sons.

Biotech-326 RESEARCH METHODOLOGY & SKILL ENHANCEMENT (3+0)

Course Objectives:

To familiarize students with various methods used for conducting research and latest trends in the field of biotechnology through reading and understanding scientific literature, preparing scientific manuscripts, designing research projects and presenting them.

Course Contents:

Introduction; need of research and research types; extraction and review of literature; identifying a research problem and formulating a hypothesis; designing a study; data collection, interpretation and analysis; writing a research report, project, thesis and/or research article or review; preparing posters; making scientific presentations; intellectual property, conflict of interest, Bibliography, unethical academic practices (plagiarism).

Recommended Books:

1. Bryman A, 2001. Social research methods. 2nd Edition; Oxford University Press.
2. Awan JA, 2003. Scientific Presentation. Unitech Communication, Faisalabad, Pakistan.
3. Kumar R, Kindersley D, 2010. Research Methodology: A step by step guide for beginners. Third Edition; SAGE Publications.
4. Kothari CR, 2004. Research Methodology: Methods and Techniques. Second Revised Edition; New Age International Publishers, New Delhi.
5. Durrani SA, 2004. Technical Writing. Higher Education Commission, Islamabad.

BACHELOR OF BIOTECHNOLOGY YEAR-4 TERM-7

Biotech-411 HEALTH BIOTECHNOLOGY (3+0)

Course Objectives:

To acquaint the student with diagnostic tools, immunization and therapeutics.

Course Contents:

Introduction to Health biotechnology, Social acceptance of medical biotechnology, The molecular basis of disease, Molecular and genetic markers, Detection of mutations, Detection of infectious agents, Active and passive immunization, vaccines (live, killed, recombinant DNA vaccines, subunit vaccines, DNA vaccines, edible vaccines), Drug delivery systems, Blood transfusion, Grafting techniques, Pharmacogenetics, Strategies of gene therapy, gene delivery vehicles, genetic disorders and gene therapy, Biopharmaceuticals from plants, Uses of stem cell technology, Interferon; cloning interferon, types of interferon, engineering interferon, therapeutic use and mechanism of action of interferon. Engineering human growth hormone. Enzymes therapy; DNase 1, alignate lyase.

Recommended Text Books:

1. "Medical Biotechnology" by Judit Pongracz, Mary Keen "(2009). Published by Elsevier Health Sciences.
2. "Biotechnology and Your Health: Pharmaceutical Applications" by Bernice Zeldin Schacter, Bernice Schacter (2005). Published by Chelsea House Publishers,
3. "Health and Pharmaceutical Biotechnology" by D.M. Chetan, K.P. Dinesh, D.M. Chetan (2006). Published by Firewall Media.

Latest books

Course Objectives:

This course aims to help the students to understand the concept of biotechnology and its uses in the industrial sector.

Course Contents:

Industrial biotechnology – introduction and scope; microorganisms commonly used in industry; media and nutritional requirements of industrial organisms; screening for productive strains and strain improvement; culture collections; fermentation and fermenters; extraction of fermented products; production of beer, wines, spirits and vinegar; use of single cell proteins as food products; biocatalysts; microbial insecticides; production of metabolites: organic acids and amino acids; vaccines and antibiotic production.

Practicals:

Isolation of *Lactobacillus* from dairy products, fruit juices, etc.; fermentation of different sugars by bacteria (or other microorganisms); identification of proteases/ amylases producing bacteria; extraction of hydrolytic crude enzymes from microbes; effect of environmental factors (e.g., pH, temperature, salt, etc.) on activity of crude enzymes.

Recommended Books:

1. Okafor N, 2007. Modern Industrial Microbiology and Biotechnology. 1st Edition; Science Publishers, USA.
2. Waites et al., 2001. Industrial Microbiology: An Introduction. Blackwell Science Ltd.
3. Shara et al., 2009. Industrial Biotechnology. 1st Edition; Nova Science Publishers
4. Abhilasha MS, 2009. Industrial Biotechnology. ANE Books
5. Singh R and Ghosh S, 2004. Industrial Biotechnology. Global Vision Publishing House

Course 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 as well as proteomics.

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, pyro-sequencing, Solexa, Helicos, Roche 454, real-time and nano-pore 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; proteomics; cellular communication/signalling pathways; protein-protein interactions and validation - yeast two hybrid system, affinity purification-mass spectrometry (AP-MS), tandem affinity purification (TAP) tagging, fluorescence resonance energy transfer (FRET) and co-immunoprecipitation.

Recommended Books:

1. Strachan T and Read AP, 2010. Human Molecular Genetics. 4th Edition; Garland Science.
2. Saccone C and Pesole G, 2003. Handbook of Comparative Genomics: Principles and Methodology. 1st Edition; Wiley-Liss.
3. Town C, 2002. Functional Genomics. First Edition; Springer.
4. Krebs et al., 2010. Lewin Genes X. 10th Edition; Jones and Bartlett Publishers.
5. Al-Rubeai M and Fussenegger M, 2010. Systems Biology (Cell Engineering). 1st Edition; Springer.

Course 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, biosafety guidelines, DNA finger printing.

Practicals:

Preparation of Murashige and Skoog 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 transformant's; regeneration of plantlets and acclimatization; plant DNA extraction and PCR for detecting introduction of foreign DNA into plants.

Recommended Text Books:

1. Qaim M, 2010. Agricultural Biotechnology in Developing Countries: Towards Optimizing Benefits for Poor. Springer
2. Kemp Ken F, 2010. Genetic Modification of Plants: Agriculture, Horticulture and Forestry (Biotechnology in Agriculture and Forestry). Springer.
3. Herren RV, 2012. Introduction to Agricultural Biotechnology. 2nd Edition; Delmar Cengage Learning.
4. Slater A, 2008. Plant Biotechnology: The Genetic Manipulation of Plants. 2nd Edition; Oxford University Press, USA
5. Altman A, 2011. Plant Biotechnology and Agriculture: Prospects for the 21st Century. 1st Edition; Academic Press.

Biotech-415 PRINCIPLES OF BIOCHEMICAL ENGINEERING (2+1)

Course Objectives:

To acquaint the student with biological and engineering sciences.

Course Contents:

Introduction to microorganisms and biological molecules, Internal mass transfer effect on immobilized growth. Stoichiometry models of microbial growth, structured model, of microbial growth. Continuous Stirred tank bioreactor, Plug-flow and packed bed bioreactors imperfect mixing, Fed batch bioreactors, Gas liquid mass transfer in bioreactors, Power requirement for bioreactor, Sterilization, Heat transfer in bioreactors, Introduction to bioproduct recovery. Manufacture of biological products, Economic analysis of bioprocesses, Case study Penicillin, Upstream and downstream processing, Mass/energy balance.

Practicals:

Unstructured Microbial growth with application of Monod Model, Inhibition kinetics and nutrient uptake rate, Methods of immobilization by binding and physical retention, Yield coefficient and Stoichiometry, Production of enzymes by structured model, segregated model. Bioreactor design and analysis (Batch, Fed-batch and Continuous). Enzyme catalysis in the CSTR. Packed bed and plug flow bioreactor, Rheology of fermentation broth, mixing and gas-liquid mass transfer, Heat transfer, media and bioreactor sterilization techniques, Techno-economic analysis of a typical bioprocess.

Recommended Text Books:

1. Biochemical Engineering by Harvey W. Blanch, S. Douglas and Clark.
2. Biochemical Engineering Fundamentals. J. E. Bailey and D. F. Olilis.
3. Biochemical Engineering. S. Aiba, A. G. Humphrey and N. F. Millis 2nd Edition (1973) Academic Press Inc. N.Y.

Course Objectives:

To acquaint students with principles of biosafety and ethical perspectives of Biotechnological systems.

Course Contents:

Introduction to Biosafety (Definition, Concept, Uses and abuses of genetic information, Biohazards), Good Laboratory Practices, Risks Related to GMOs, International Rules & regulations for Biosafety & GMOs. Introduction to Bioethics, Ethical issues regarding GMOs, Euthanasia, Issues related to Reproductive & Cloning technologies, Issues to transplants and Eugenics, Patenting, Commercialization and Benefits Sharing, role of National Bioethic committees.

Recommended Text Books:

1. WHO. 2006. Laboratory Biosafety manual third edition. AITBS publishers and distributors, India. (Available online free of cost).
2. Lewis RJ. Sax dangerous properties of Industrial materials, 10th edition. Toronto, John Wiley and sons, 1999.
3. Lenga RE. 1988. The Sigma-Aldrich Library of chemical safety data, 2nd ed. Milwaukee, WI, Aldrich chemical company.
4. Furr AK. 2000. CRC handbook of laboratory safety 5th edition. Boca Raton, FL, CRC press.
5. United states Department Health and Human services. 1999. Biosafety in Microbiological and biomedical laboratories. 4th edition. Centers for disease control and prevention/National institutes of Health, Washington DC.
6. Biosafety in the Laboratory: Prudent Practices for Handling and Disposal of Infectious Materials Committee on Hazardous Biological Substances in the Laboratory, National Research Council ISBN: 0-309-55920-0, (1989) available from the National Academies Press at: <http://www.nap.edu/catalog/1197.html>
7. Genes Technology and Policy. Jose Maria A. Ochave 2003 <http://www.apdip.net/publications/iespprimers/eprimer-genes.pdf>
8. Bioethics & Biosafety in Biotechnology by V Sree Krishna.

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Biotech-421 PHARMACEUTICAL BIOTECHNOLOGY (3+0)

Course Objectives:

To familiarize students with the general process of drug development, basic concepts of biopharmaceuticals and how they are better than conventional drugs.

Course Contents:

Introduction and basic concepts of pharmaceutical biotechnology; properties of an effective drug; drug development process; selection of a lead molecule from available pool, lab scale studies, pilot scale studies and clinical trials (Phase I, II and III); drug toxicity; impact of genomics and other related technologies on drug discovery; use of DNA and protein microarrays in identification of disease targets and for monitoring effectiveness of drugs; pharmacogenomics; plants and microorganisms as sources of drugs; polymers: classification, polymerization and characterization; controlled drug release system and its advantages and disadvantages over conventional release methods; legal and regulatory issues.

Recommended Text Books:

1. Kayser O, 2012. Pharmaceutical Biotechnology: Drug Discovery and Clinical Application. 2nd Edition; Wiley-Blackwell.
2. Kokate C, 2012. Textbook of Pharmaceutical Biotechnology. ELSEVIER
3. Crommelin et al.,2007. Pharmaceutical Biotechnology: Fundamentals and Applications. 3rd Edition. Informa Healthcare.
4. am Ende DJ, 2010. Chemical Engineering in the Pharmaceutical Industry: R&D to Manufacturing. 1st Edition; Wiley
5. Subramanian G, 2012. Biopharmaceutical Production Technology. 1st Edition. Wiley-VCH.

Biotech-422 ENVIRONMENTAL BIOTECHNOLOGY (2+1)

Course Objectives:

To acquaint the students with conservation and reclamation of environment through biotechnology.

Course Contents:

Introduction to Environmental biotechnology, Fundamentals of Biological Intervention, Genetic manipulation strategies in environmental biotechnology, Pollution indicators, Pollution control strategies, Biology of Waste water and its treatment, Sludge treatment, Contaminated land and bioremediation, Aerobes and

Effluents, Phytotechnology (Terrestrial Phyto-systems, Metal Phytoremediation, Rhizofiltration etc) Hyper accumulation, Solid Waste treatments, Concept of integrated Environmental biotechnology, Detoxification of hazardous chemicals: biodegradation, Biotransformation, Products of environmental biotechnology.

Practicals:

Biodegradation of environmental pollutants by microorganisms, Bacteriology of Drinking water, Microscopic studies of water specimens collected from various locations, Field survey of polluted areas, Field study for pollution indicators (Plants, Microorganisms).

Recommended Text Books:

1. Christon Hurst, Ronald Crawford, Jay Garland, David Lipson, Aaron Mills and Linda Stetzenbach (2007) Manual of Environmental Microbiology. 3rd Ed. Blackwell Publishers
2. Christopher F. Faster and D. A John Wase, John Wase (2004) Environmental Biotechnology. John Willey & Sons.
3. Derek R. Lovley (2000) Environmental Microb-Metal Interactions. ASM Press.
4. Environmental Biotechnology by Bhattacharyya and Rintu Banerjee (Paperback - Mar 1, 2007) OUP India.
5. Environmental Biotechnology by Bruce E. Rittmann and Perry L. McCarty (Paperback - Jan 1, 2001). McGraw-Hill Publishing Co.
6. Environmental Biotechnology Theory and application, 2003. Gareth M Evans and Judith C. Furlong. Wiley Publishers.
7. Environmental Biotechnology, 2008. T, Srinivas New Age international Publishers.
8. Environmental Microbiology: Methods and Protocols (Methods in Biotechnology) by John F. T. Spencer and Alicia L. Ragout de Spencer (Hardcover - Jul 15, 2004) Humana Press; 1 edition.
9. Laqrence P. Wackett (2001) Biocatalysis and Biodegradations: Microbial Transformation of Organic Compounds. ASM Press

Course Objectives:

To acquaint students with key integrative technologies and use of nanoparticles in biological systems

Course Contents:

Introduction; interface between nanotechnology and bio-nanotechnology; manipulating molecules; carbon fullerenes and nanotubes; non-carbon nanotubes and fullerene-like materials; quantum dots; nanowires, nanorods and other nanomaterial's; magnetic nanoparticles; natural biological assembly at the nanoscale and nanometric biological assemblies (complexes); nanobionics and bio-inspired nanotechnology; applications of biological assemblies in nanotechnology; medical, cosmetics, agriculture, water and other applications of nano-biotechnology; future prospects of nano-biotechnology; use of nanotechnology for diagnosing and curing disease.

Recommended Books:

1. Gazit E, 2007. Plenty of Room for Biology at the Bottom: An Introduction to Bionanotechnology. 1st Edition; Imperial College Press.
2. Renugopalakrishnan V and Lewis RV, 2006. Bio-nanotechnology: Proteins to Nano devias. Springer.
3. Greco et al., 2004. Nano Scale Technology in Biological Systems. CRC Press.
4. Mirkin CA and Niemeyer CM, 2007. Nano-biotechnology II: More Concepts and Applications. John Wiley & Sons.
5. Niemeyer CM and Mirkin CA, 2004. Nano-biotechnology. 1st Edition; Wiley VCH.

Biotech-424 RESEARCH PROJECT/SPECIAL PAPER (6+0)

Students are required to undertake research project on important topics related to the degree program. Alternatively students will be required to undertake two extra courses to complete the degree program.

List of optional Courses

Biotech-425 MARINE BIOTECHNOLOGY (3+0)

Course Objectives:

To acquaint students with recent advancements in the field of marine biotechnology and how molecular techniques may be applied for studying marine organisms.

Course Contents:

Introduction to marine microorganisms and marine biotechnology; marine flora/phytoplankton; aquaculture techniques; marine microbes of biotechnological importance; primary and secondary metabolites (e.g., antibiotics, organic acids, toxins, etc); role of marine microbes in global carbon cycling; genomics of marine organisms; recent progress in discovery of drugs and enzymes from marine sources.

Recommended Books:

1. Gal YL, 2010. Marine Biotechnology I (Advances in Biochemical Engineering Biotechnology). Springer. 35
2. Gal YL, 2010. Marine Biotechnology II (Advances in Biochemical Engineering Biotechnology). Springer.
3. Kim SK, 2011. Handbook of Marine Microalgae: Biotechnology and Applied Physiology. 1st Edition; Wiley.
4. Johansen MN, 2011. Microalgae: Biotechnology, Microbiology and Energy. Nova Science Pub Inc.
5. Buchholz R, 2012. Microalgae Biotechnology. Walter De Gruyter Inc.
6. Gal YL 2010. New Developments in Marine Biotechnology. Springer

Biotech-426 RADIOBIOLOGY (3+0)

Course Objectives:

To acquaint students with use of radiation and radioactive materials in agriculture, health and basic research.

Course Contents:

Introduction to radiobiology, radioisotopes and types and sources of radiation; physics of radioactive substances; effects of radiation on living cells; exposure and radiation dose-effect; molecular basis of cellular effects and cell radiation sensitivity; radiation therapy, radiation protection, safety measures and treatment of radiation

injuries; fundamental aspects and relationship of imaging physics and radiobiology including current regulation and recommendations in radiation biology, radiological technologies and labeling techniques; use of radioisotopes as diagnostic and therapeutic tools.

Practicals:

To enhance awareness of radiation use, visits to different medical centers/hospitals will be arranged for students for studying different types of radiation in use for treating various conditions; visit to different stations/offices where any type of radio waves, electromagnetic waves etc. are in continuous use and collecting data about any harmful effects.

Recommended Books:

1. Wambersie A, 2007. Introduction to Radiobiology. Tylor and Francis.
2. Nias AHW, 2007. Introduction to Radiobiology. Academic Press.
3. Forshier CM, 2008. Essentials of Radiation, Biology and Protection. 2nd Edition. Cengage Learning Press
4. Washington CM, 2009. Principles and Practice of Radiation Therapy. Elsevier Health Sciences
5. Dder Kogel AV and Joiner M, 2009. Basic Clinical Radiobiology. 4th Edition; A Hodder Arnold Publication

Biotech-427 HOSPITAL WASTE MANAGEMENT (2+1)

Course Objectives:

To acquaint students with the principles and applications of clinical waste management.

Course Contents:

An introduction to the management of infectious materials/waste; various types of infectious material and methods of their handling and disposal; laboratory and hospital acquired infections - possible sources and causes; hazardous microorganisms; basic containment rules and laboratory contamination levels, control measures; guidelines for workers in microbiology and pathology labs, and post-mortem rooms; rules for safe conduct during field work and outdoor activities; risk assessment including recognition of hazards; competence and elimination of hazards; collection of data, etc.; risk group personnel and their education, training and monitoring; radiation hazards and disposal of radioactive waste.

Practicals:

Techniques for waste minimization; waste sorting; anaerobic and aerobic composting; industrial and hospital waste treatment processes.

Recommended Books:

1. LaGrega et al., 2001. Hazardous Waste Management. 2nd Edition; McGraw- Hills.
2. McDougall et al., 2001. Integrated Solid Waste Management: A Life Cycle Inventory. 2nd Edition; Blackwell Publishers.
3. WHO Biosafety Manual, World Health Organization, 2001. WHO, Geneva.
4. Garvin ML, 1995. Infectious Waste Management: A Practical Guide. Lewis Publishers, Inc.
5. Wayne LT, 1995. Biohazardous Waste: Risk Assessment, Policy, and Management. Lewis Publishers, Inc.
6. Hickman HL and Anderson WC , Principles of Integrated Solid Waste Management. MSW Management

Biotech-428 WATER AND WASTE WATER TREATMENT (2+1)**Course Objectives:**

To acquaint students with the principles and applications of treatment systems for water, waste water and hazardous wastes.

Course Contents:

Water and wastewater sources and characteristics; drinking water treatment process; industrial effluent treatment process; novel treatment processes and recycling technology; theory and application of commonly used processes; sedimentation, coagulation, filtration, disinfection, gas transfer, activated sludge, trickling filters, oxidation ponds, sorption, and sludge stabilization and disposal; process combinations to produce treatment systems; role of microorganisms in waste treatment; utilization and management of waste; microbial characterization.

Practicals:

Designing individual aerobic and anaerobic unit processes; physicochemical characteristics of drinking water and waste water; analytical analysis of drinking and waste water for detecting heavy metals and minerals.

Recommended Books:

1. Metcalf and Eddy, 2003. Waste water Engineering: Treatment, Disposal, and Reuse. 4th Edition; McGraw-Hill.
2. Clark N and Crull A, 1997. Bioremediation of Hazardous Wastes, Waste Water and Municipal Waste. Business Communication
3. Maier et al., 1999. Environmental Microbiology. Academic Press Inc.
4. Bitton G, 2011. Wastewater Microbiology. 4th Edition; Wiley-Blackwell.
5. Csuros M and Csuros C, 1999. Microbiological Examination of Water and Wastewater. 1st Edition; CRC Press

Biotech-429 FUNGAL BIOTECHNOLOGY (3+0)

Course Objectives:

To acquaint students with the understanding of fungi and their utilization in industry and agriculture

Course Contents:

Introduction to mycology; production techniques used in fungal biotechnology; metabolites produced by fungi; utilization of fungi in medical and agricultural biotechnology; industrial uses of fungi including food manufacturing; bio-deterioration and biodegradation; biotechnology and the control of pathogenic fungi; current applications of fungal biotechnology and screening of fungal metabolites; mycotoxins.

Practicals:

Fungal morphology; identification of fungi; sexual and asexual reproductive structures of fungi; DNA extraction from hyphae and zoospores; molecular techniques for detecting genetic variations among different fungi.

Recommended Books:

1. Tkacz JS and Lange L, 2004. Advances in fungal Biotechnology for Industry, Agriculture and Medicine. 1st Edition; Springer.
2. Arora et al., 2003. Fungal Biotechnology in Agricultural, Food and Environmental Applications. 1st Edition; CRC Press.
3. An Z, 2004. Handbook of Industrial Mycology. 1st Edition; CRC Press
4. Sati SC, 2007. Recent Mycological Research: Fungal Biotechnology. IK International Publishing House.
5. Rai M, 2009. Advances in Fungal Biotechnology. IK International Publishing House
6. Carlile et al, 2001. The Fungi. 2nd Edition; Academic Press
7. Arora et al., 2003. Handbook of Fungal Biotechnology. 2nd Edition; CRC Press.
8. Oliver RP and Schweizer M, 1999. Molecular Fungal Biology. 1st Edition; Cambridge University Press.
9. Frisvad et al., 1998. Chemical Fungal Taxonomy. 1st Edition; CRC Press.

Biotech-430 BIOSENSORS (3+0)

Course Objectives:

To acquaint students with fundamentals of sensors that are capable of specifically detecting minute quantities of various individual biomolecules or those displayed on cellular or viral surfaces.

Course Contents:

Introduction; miniaturization and microsystems including sensing by optical techniques, field-effect transistors, ion-selective and enzyme-sensitive electrodes; biological signals and their types; amperometric biosensors based on redox enzymes, potentiometric biosensors and enzyme field effect transistors (ENFET); thermal biosensors; optical biosensors based on redox enzymes; indirect affinity sensors; optical and electrical antibody-based biosensor; direct affinity detection using surface plasmon resonance and piezoelectric biosensors.

Recommended Books:

1. Nielson et al., 2003. Bioreaction Engineering Principles. 2nd Edition; Kluwer Academic / Plenum Publisher, New York.
2. Monsi et al., 2011. Fermentation Microbiology and Biotechnology. 3rd Edition; CRC Press.
3. Bone S and Zaba B, 1992. Bioelectronics. 1st Edition; Wiley.
4. Hall EAH, 1991. Biosensors. John Wiley & Sons.
5. Koryta J, 1993. Ions, Electrodes and Membranes. 2nd Edition; John Wiley & Sons.

Biotech-431 BIOFUELS AND BIOREFINERIES (3+0)

Course Objectives:

To acquaint students with the sources of biomass and their extraction and processing for common use.

Course Contents:

Biofuels-introduction, types and sources; agro-industrial byproducts and biodegradable materials; genomics of biofuels; metabolic engineering; bio-refineries; biobased industrial products; basics of green bio-refineries; agriculture, forestry and primary refinery raw material; lingo-cellulosic feedstock bio-refinery; whole-crop bio-refinery based on wet/dry milling and products from whole-crop bio-refinery; fundamental sugar platform and syngas platform.

Recommended Textbooks:

1. Kamm et al., 2006. Biorefinery-Industrial Processes and Products Status Quo and Future Directions. Wiley-VCH.
2. Meroehr, 2001. Biotechnology of Ethanol. Wiley-VCH
3. Verts et al., 2010. Biomass to Biofuels: Strategies for Global Industries. 1st Edition; Wiley.
4. Lee S and Shah YT, 2012. Biofuels and Bioenergy: Processes and Technologies (Green Chemistry and Chemical Engineering). First Edition; CRC Press.

Biotech-432 MOLECULAR DIAGNOSTICS (3+0)**Course Objectives:**

To acquaint students with modern techniques used in molecular diagnostics.

Courses Contents:

Introduction and applications of molecular diagnostics techniques in agriculture and forensic sciences; polymerase chain reaction (PCR); detection of mutations and single nucleotide polymorphisms (SNPs) by restriction fragment length polymorphisms (RFLPs); DNA sequencing; blotting techniques (e.g., Southern, Northern and Western); enzyme-linked immunosorbant assays (ELISA); immunofluorescence staining and immunohistochemistry; micro-arrays; *in situ* hybridization; molecular cytogenetics.

Practicals:

ELISA; PCR. Visits to various diagnostic, pathology laboratories and/or research institutes.

Recommended Books:

1. Debnath et al., 2010. Molecular Diagnostics: Promises and Possibilities. Springer
2. Deniese D Wilson, 2008. Manual of Laboratory and diagnostic tests. McGraw-Hills publisher.
3. Brown TA, 2010. Gene Cloning and DNA analysis. 6th Edition. Wiley-Blackwell Publishing.
4. Buckingham et al., 2007. Molecular Diagnostics Fundamentals, Methods, and Clinical Applications. First Edition. FA Davis Publisher.
5. Walker JM and Rapley R, 2005. Medical Biomethods Handbook. Humana Press.

Biotech-433 VIROLOGY (3+0)

Course 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., 2009. Principles of Virology. ASM Press, USA.
2. Lal S, 2007. The Biology of Emerging Viruses. Wiley-Blackwell, USA.
3. Carter J Saunders V. Virology: Principles and Applications. First Edition; Wiley.
4. Wagner et al., 2007. Basic Virology. Third Edition; Wiley-Blackwell
5. Flint SJ, 2009. Principles of Virology, Vol. 2: Pathogenesis and Control. 3rd Edition; AMS Press

Biotech-434 FERMENTATION BIOTECHNOLOGY (2+1)

Course Objectives:

To acquaint students with theoretical and experimental techniques used for fermentation.

Course Contents:

Overview of fermentation technology: definition, economics, applications; strain development and improvement: isolation of microorganisms - plating, criteria for selection and improvement through genetic engineering; growth requirement of various organisms and media preparation; stoichiometry of microbial growth; preparation of inoculum; microbial growth kinetics in batch culture; continuous culture; sterilization: modes & kinetics of sterilization, design of batch and continuous sterilization process, air sterilization & theory of fibrous filters; fluid rheology: classification, Newtonian & non-Newtonian factors effecting KLa in fermentation vessel; design of bioreactors and configuration for free and immobilized cells; waste treatment; tissue engineering for plant and animal cell cultures; aeration and agitation; product recovery; scaling-up of fermentation process

Practicals:

Initiation of a bacterial/plant or animal cell/tissue culture in a simple conical flask or in a fermenter depending on availability and its handling according to the techniques introduced in theory as sterilization, media formulation, growth kinetics, product recovery etc.

Recommended Books:

1. Doran PM, 2012. Bioprocess Engineering Principles.2nd Edition; Academic Press.
2. McNeil B, 2008. Practical Fermentation Technology. John Willey & Sons
3. El-Mansi et al., 2007. Fermentation Microbiology and Biotechnology.CRC Press.
4. Shuler ML and Kargi F, 2002. Bioprocess Engineering: Basic concept. Prentice Hall.