Proposed Curriculum for BS-Biotechnology Department of Biotechnology

WOMEN UNIVERSITY MARDAN

Department of Biotechnology

WOMEN UNIVERSITY MARDAN

CONTENTS

Title of Courses

WOMEN UNIVERSITY MARDAN

Undergraduate Scheme of Studies (New Policy-2023)
Department of Biotechnology

Semester-I				
Course Code	**Course Name**	**Credit Hours**	**General Education Course /Major/Interdisciplinary**	**Marks**
CHEM-322	Organic Chemistry	3(2+1)	General Education Course	
PSY-302	Introduction to Psychology	02	General Education Course	
ENG-301	Functional English	03	General Education Course	
ISL-301	Islamic Studies	02	General Education Course	
PSC-301	Civic and Community Engagement	02	General Education Course	
BIOT-311	Ecology, Biodiversity and Evolution	03	Major Disciplinary Specific	
BIOT-312	Cell-Biology	3(2+1)	Interdisciplinary	
Semester Credit Hours		**18**		
Semester-II				
ISL-302	History of Islamic Civilization	02	General Education Course	
ENG-302	Expository Writing	03	General Education Course	
BBA-322	Entrepreneurship	02	General Education Course	
PSC-302	Ideology and Constitution of Pakistan	02	General Education Course	
MTH-433	QR-1—Exploring Quantitative Skills	03	General Education Course	
BIOT-321	Introduction to Biotechnology	03	Major Disciplinary Specific	
Semester Credit Hours		**15**		
Semester-III				
MTH-444	QR-2—Tools for Quantitative Reasoning	03	General Education Course	
CS-301	Introduction to Computer	03	General Education Course	
BCHM-311	Introductory Biochemistry	03	Interdisciplinary	
BIOT-411	Molecular Biology	03	Major Disciplinary Specific	
BIOT-412	General Genetics	03	Interdisciplinary	
Semester Credit Hours		**15**		
Semester-IV				
MIC-423	Bacteriology	3(2+1)	Interdisciplinary	
MIC-513	Virology	3(2+1)	Interdisciplinary	
BIOT-421	Oncology	03	Major Disciplinary Specific	
BIOT-422	Techniques in Biotechnology	3(2+1)	Major Disciplinary Specific	
BIOT-423	Genetic Engineering	03	Major Disciplinary Specific	
Semester Credit Hours		**15**		
Semester-V				
MIC-422	Bio-risk Management and Bioethics	03	Interdisciplinary	

BIOT-511	Introductory Immunology	3(2+1)	Major Disciplinary Specific	
BIOT-512	Genomics and Proteomics	03	Major Disciplinary Specific	
BIOT-513	DNA Damage, Repair and Carcinogenesis	3(2+1)	Major Disciplinary Specific	
BIOT-514	Animal Biotechnology	03	Major Disciplinary Specific	
Semester Credit Hours		**15**		
Semester-VI				
BIOT-521	Environmental Biotechnology	3(2+1)	Major Disciplinary Specific	
BIOT-522	Microbial Biotechnology	3(2+1)	Major Disciplinary Specific	
BIOT-523	Immunogenetics	3(2+1)	Major Disciplinary Specific	
BIOT-524	Food Biotechnology	3(2+1)	Major Disciplinary Specific	
BIOT-525	Fungal Biotechnology	3(2+1)	Major Disciplinary Specific	
Semester Credit Hours		**15**		
Semester-VII				
BIOT-611	Health Biotechnology	03	Major Disciplinary Specific	
BIOT-612	Cell and Tissue Culture	03	Major Disciplinary Specific	
BIOT-613	Bioinformatics	03	Major Disciplinary Specific	
BIOT-614	Aquatic Biotechnology	03	Major Disciplinary Specific	
BIOT-615	Field Experience	03	Major	
Semester Credit Hours		**15**		
Semester-VIII				
BIOT-621	Industrial Biotechnology	3(2+1)	Major Disciplinary Specific	
BIOT-622	Agriculture Biotechnology	3(2+1)	Major Disciplinary Specific	
BIOT-623	Pharmaceutical Biotechnology	03	Major Disciplinary Specific	
BIOT-624	Nano Biotechnology	03	Major Disciplinary Specific	
BIOT-625	Capstone Project	03	Major	
Semester Credit Hours		**15**		
Total Credit Hours		**123**		

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Semester Wise Breakdown

1ST SEMESTER

Semester-I				
Course Code	**Course Name**	**Credit Hours**	**General Education Course /Major/Interdisciplinary**	**Marks**
CHEM-322	Organic Chemistry	3(2+1)	General Education Course	
PSY-302	Introduction to Psychology	02	General Education Course	
ENG-301	Functional English	03	General Education Course	
ISL-301	Islamic Studies	02	General Education Course	
PSC-301	Civic and Community Engagement	02	General Education Course	
BIOT-311	Ecology, Biodiversity and Evolution	03	Major Disciplinary Specific	
BIOT-312	Cell-Biology	3(2+1)	Interdisciplinary	
Semester Credit Hours		**18**		

WOMEN UNIVERSITY MARDAN

Details of BS Biotechnology Courses

1ST YEAR

1ST SEMESTER

CHEM-322 ORGANIC CHEMISTRY 3(2+1)

Objectives:

The course is aimed to give students knowledge about basic concepts of organic chemistry, chemistry of hydrocarbons and functional groups and the mechanism of organic reactions. Information will be useful for qualitative analysis and synthesis of organic compounds.

Course Outline:

Bonding and hybridization, localized and delocalized bonding, structure- aromaticity, inductive effect, dipole moment, resonance and its rules, hyperconjugation, classification and nomenclature of organic compounds including IUPAC system, types of organic reactions (an overview). Saturated, unsaturated and aromatic hydrocarbons with emphasis on synthesis and free radical, electrophilic addition and electrophilic substitution reactions. Chemistry of Functional Groups: Hydroxyl, ether and amino groups, preparation and properties of alcohols, phenols, ethers, and amines with focus on reaction mechanism and applications, carbonyl compounds, preparations and reaction mechanism of aldehydes and ketones and their applications, carboxylic acids and their derivatives, acidity of carboxylic acids and effect of substituents on their acidity, preparation and reactions of carboxylic acids and their derivatives including esters, amides, acid halides and acid anhydrides.

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.

Recommended Book List

1. John, E. M. Organic Chemistry, 8th ed., Brooks/Cole Publishing Co, USA, (2012).
2. Younus, M., A Textbook of Organic Chemistry, Ilmi Kitab Khana, Urdu Bazar, Lahore, Pakistan, (2006).

3. 6. Solomons, T. W. G. and Fryhle, C. B., Organic Chemistry, 10th ed., John- Wiley & Sons, Inc., (2011).
4. Pavia, D. L., Kriz, G. S., Lampman, G. M. and Engel, R. G., A Microscale Approach to Organic Laboratory Techniques, 5th ed., Brooks/ Cole Cengage Learning, (2013).
5. 9. Mayo, D. W., Pike, R. M. and Forbes, D. C., Microscale Organic to Laboratory with Multistep and Multisacle Syntheses, 5th ed., John-Wiley & Sons, Inc., (2011).
6. 10. Gilbert, J. C. and Martin, S. F., Experimental Organic Chemistry: A Miniscale and Microscale Approach, 5th ed., Brooks/ Cole Cengage Learning, (2010).
7. 11. Brown, W. H., Fotte, C. S., Iverson, B. L. and Anslyn, E. V., Organic Chemistry, 6th ed., Brooks/ Cole Cengage Learning, (2012).

PSY-302 INTRODUCTION TO PSYCHOLOGY (2+0)

Objectives:

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

Course Outline:

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

Methods of Psychology:

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

Biological Basis of Behavior:

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

Motivation:

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

Emotions:

- Definition and Nature
- Physiological changes during Emotions (Neural, Cardial,Visceral, Glandular), Galvanic Skin Response; Pupilliometrics
- Theories of Emotion

- James Lange Theory; Cannon-Bard Theory
- Schachter –Singer Theory

Learning:

- Definition of Learning
- Types of Learning
  - Classical Conditioning
  - Operant Conditioning
- Methods of Learning
  - Trial and Error
  - Learning by Insight
  - Observational Learning

Recommended Book List

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

ENG-301 FUNCTIONAL ENGLISH (3+0)

Objectives:

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

Outcomes:

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

Course Outline:

- Vocabulary (Frequently confused / misused words,
- Phrases,

- synonyms,
- antonyms,
- idioms & General vocabulary),
- Practical Use of Grammar (Nouns, Pronouns, Verbs, Adjectives, Adverbs, Prepositions, Conjunctions, Articles, Interjections & Tenses),
- Sentences (Types of sentences, Parts of sentences),
- Direct and Indirect Speech,
- Active & Passive Voice & Conditional Sentences)

Recommended Book List

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

ISL-301 ISLAMIC STUDIES (2+0)

Objectives:

This course is aimed at to provide Basic information about Islamic Studies and enhance understanding of the students regarding Islamic Civilization. It will also improve Students skill to perform prayers and other worships and enhance the skill of the students for understanding of issues related to faith and religious life.

Course Outline:

Introduction to Quran 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

Recommended Book List

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).

PSC-301 CIVIC AND COMMUNITY ENGAGMENT 2(2+0)

Objectives:

- Understand, critically think about, and reflect upon the history of democracy and civic engagement in the Pakistan.
- Identify and utilize - civic/community engagement skills such as: (advocacy, organizing, communications) and knowledge- (working in groups and teams, leadership, diversity, how systems work)
- Create civic sense and establish importance of civic and community engagement.
- Identify and explain the values and ethics for community engagement.
- Carry out a civic engagement activity incorporating some of their new knowledge and skills of civic engagement and reflect on their learning about the community, the issue addressed, and about themselves.

Course Outline:

Divided into categories for in-depth comprehension-

Category A: General

1. The historical background of civic and community engagement
2. Conceptual understanding of Human Rights and Minority Rights
3. Dimensions of Citizens engagement in Community: Political, Social, Economic
4. Rights and duties of Citizens in Community
5. Organizations (National & International) and Groups
    - Role of non-governmental organizations and their contributions

- NGOs: Nature and Scope
- International Commission for Red Cross (ICRC)
- Amnesty International
- Asia Watch

Category B: Pakistan's context

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

Recommended Book List

1. Hoefer, R. (2012). Advocacy for Practice. 3rd Edition. Chicago, IL: Lyceum Books, Inc. (ISBN-13: 978-1935871828).
2. Putnam, R. and Feldstein, L (2003). Better Together. New York, NY: Simon and Schuster. (ISBN-13: 978-0743235471)
3. Civic Engagement—What Is It and Why Is It Important? Kerry J. Kennedy
4. Universal Human Rights in Theory and Practice by Jack Donnelly
5. Adamantia Pollis and Peter Schwab, Human Rights Cultural and Ideological Perspectives. Preager Publishers, Preager Publishers, London, 1980.
6. Promoting and Protecting Minority Rights- A Guide for Advocates by United Nations.
7. Human Rights in International Law, Council of Europe press, 1992.
8. United Nations, Human Rights Status of International Instruments, United Nations, Baltimore, New York, 1987.

BIOT-311 ECOLOGY, BIODIVERSTY AND EVOLUTION (3+0)

Objectives:

This course aims to introduce students to the fundamentals of ecology, biological diversity and evolution – key areas that are pertinent to modern day biology.

Course Outline:

Introduction; ecosystem and ecological pyramids; role of environment on phenotype of organisms; food chain, webs and trophic levels; factors influencing environment; impact of urbanization and industry on environment; population: air, water, land, thermal, radiation and noise; community ecology; atmosphere – composition and cycles; pollution; climate change (greenhouse effect and global warming); ozone layer – composition and state across the globe; waste and sewerage processing and disposal; microbes, plants and animal species; comparative study of life forms; features and characteristics of bacteria, archaea and eukaryotes; phylogenetic relationships between the three kingdoms; evolution of different members belonging to each of

the three domains of life (with specific examples); models of speciation; causes and consequences of extinction.

Recommended Book List

Davet P, 2004. Microbial ecology of soil and plant growth. Science Publishers.
2. Nico et al., 2006. An Introduction to Ecological Genomics. 1st Edition; Oxford University Press.
3. Aston et al., 2004. Ecological Genetics: Planning and Application. Blackwell Science (UK).
4. Costa LG, and Eaton DL, 2006. Gene-Environment Interactions: Fundamentals of Ecogenetics. 1st Edition; John Wiley and Sons.
5. Freeland JR, 2005. Molecular Ecology. 1st Edition; John Wiley and Sons.
6. Wenz PS, 2001. Environmental Ethics Today. Oxford University Press.
7. Louis P and Pojman LP, 2007. Environmental Ethics: Readings in Theory and Application. 5th Edition; Wadsworth Publishing.

BIOT-322 CELL BIOLOGY 3(2+1)

Objectives:

This course is intended 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 Outline:

Introduction to cell theory including historical perspective; overview of membrane structure and chemical constituents of the cell; function, isolation and molecular organization of cellular organelles specifically the endoplasmic reticulum, lysosome, micro-bodies, mitochondrial ultrastructure and function, chloroplast ultra-structure and the mechanism of photosynthesis; composition and structure of membranes; membrane receptors and transport mechanisms; cell movement- structure and function of cytoskeleton, centriole, cilia and flagella; nucleus; structure and function of chromosomes; cell cycle, mitosis and meiosis.

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 Book List

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)

WOMEN UNIVERSITY MARDAN

2nd SEMESTER

Semester-II				
ISL-302	History of Islamic Civilization	02	General Education Course	
ENG-302	Expository Writing	03	General Education Course	
BBA-322	Entrepreneurship	02	General Education Course	
PSC-302	Ideology and Constitution of Pakistan	02	General Education Course	
MTH-433	QR-1—Exploring Quantitative Skills	03	General Education Course	
BIOT-321	Introduction to Biotechnology	03	Major Disciplinary Specific	
Semester Credit Hours		**15**		

WOMEN UNIVERSITY MARDAN

2nd SEMESTER

ISL-302 HISTORY OF ISLAMIC CIVILIZATION 2(2+0)

Objectives:

This course intends to explain the definition of Islamic Culture & Civilization and Analysis of the Rise and Fall of Islamic Culture in various parts of the World. It also emphasizes on critical study of the effect and benefits of Islamic Civilization on other Cultures

Course Outline:

- Introduction to civilization-1: Introduction of Civilization, Foundation of Civilization, Elements of Civilization.
- Important Civilization in the Pre-Islamic Era: Greek Civilization, Roman Civilization, Egypt Civilization, Hindu Civilization
- Principles of Islamic Civilization Pillars of Culture & Civilization
- Foundations of Islamic Civilization in the Era of the Prophet (SAW) and the Caliphates: Reasons for the evolution of Islamic Civilization in the Era of the Prophet (SAW), Islamic Civilization in the Era of the Caliphates, Elements of Islamic Civilization in the era of Caliphates, Islamic Civilization in the era of Banu Ummayads- 1, Introduction of Banu Ummayads, Intellectual development among the Banu Ummayads, Educational Centers for the Banu Ummayads.
- Islamic Civilization in the era of Banu Ummayads- 2: Social developments of the Banu Ummayads, Causes of the civilization development of the Banu Ummayads, Results of the civilization development of the Banu Ummayads.
- Islamic Civilization in the era of Banu Ummayads- 3: Battles of Crusades, Battlers of Tartarians, The Causes of the fall of the Abbasids and its Effects on Islamic Civilization
- Islamic Civilization in Spain: Causes of the spread of Islamic civilization in Spain, Manifestations of Islamic civilization in Spain, Influence of Islamic civilization in Spain on European civilization
- Islamic Culture and Civilization in the Sub-Continent: Islamic civilization achievements in the Sub-Continent, Reasons for the spread of Islamic cultural in Sub-Content, The effects of the publication of Islamic civilization in the Sub-content on other civilization.

Recommended Book List

1. Muslim History and Civilization by Ehsan ul Karim
2. Islamic Religion History and Civilization, Seyyed Hossein Nasr
3. Tareekh-e-Islam Shah Nadvu Moin-ud-din
4. Islamic History by Dr. Kabeer Ali

5. An Atlas of Islamic History, H.W.Hazard
6. A Short History of Islam, S.F.Mehmood

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

ENG-302 EXPOSITORY ENGLISH (3+0)

Objectives:

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

Outcomes:

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

Course Outline:

- Topic sentence
- Paragraph writing:
- Essay writing:
  - Introduction and Practice: Essay types: descriptive, narrative, discursive, argumentative.
- CV and job application
- Letter and memo writing
- Minutes of meetings
- Summary and précis writing
- Comprehension

Recommended Book List

1. Boutin, M.,& Brinand,S.,& Grellet, F. (1993). Oxford Supplementary Skills. Fourth Impression. Pages 45-53.
2. Nolasco, R. (1992). Oxford Supplementary Skills (3rd ed.). Fourth Impression.
3. Langan, J. (2004). *College Writing Skills*. Mc-Graw-Hill Higher Education.

BBA-322 ENTERPRENEURSHIP 2(2+0)

Objectives

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

Course Outline

Entrepreneurship: an evolving concept, Entrepreneurship – a perspective, The Role of Entrepreneurship, Kinds of Entrepreneurs, Role and Functions of Entrepreneurs, Understanding strategic issues in business plan development, Pitfalls in selecting new ventures, Innovation: the creative pursuit of ideas, Opportunity identification: the search for new ideas, Reason for failures of new ventures, Legal challenges for entrepreneurial ventures, Sources of capital for entrepreneurial ventures, Assessment of entrepreneurial plan, Marketing challenges for entrepreneurial ventures, Developing an effective business plan, Strategic entrepreneurial growth, Problems Faced by Newly Established Company, Post and Field Problems Faced by a New Enterprise, Franchising and the Entrepreneur.

Recommended Book List

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

PSC-302 IDEOLOGY AND CONSTITUTION OF PAKISTAN 3(3+0)

Objectives

- To develop critical thinking for understanding Constitutional development in Pakistan;

- To develop understanding of the legal and constitutional structure of the state;
- To develop comprehension of the interconnectivity between the Constitutional provisions and political practice;
- To develop the understanding of students regarding ideological basis of Pakistan as well as role of ideology in building national character.

Course Outline

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

Section A: Ideological understanding and development of Pakistan

1. Basis of Ideology of Pakistan and Two Nations Theory
2. Ideology of Pakistan: Vision of Quaide e Azam and Allama Iqbal
3. Role of ideology in building national character
4. Democratic system of Pakistan (Issues)
5. Major causes of the Imposition of martial Law (1958, 1969, 1977&1999).

Section B: Constitutional Development of Pakistan

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

Recommended Book List

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

MTH-433 QR-I---EXPLORING QUANTITATIVE SKILLS 3(3+0)

Objectives

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

Course Outline

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

Recommended Book List

1. Bennett, J. & Briggs, W. (2015). Using and understanding mathematics (6th Edition). PearsonEducation, Limited. http://xn--webducation-dbb.com/wp-content/uploads/2019/09/Jeffrey-Bennett-William-Briggs-Using- Understanding-Mathematics_-A-Quantitative-Reasoning-Approach-Pearson-2015.pdf
2. Blitzer, R. (2014). Precalculus. (5th Edition). Pearson Education, Limited. https://www.ilearnacademy.net/uploads/3/9/2/2/3922443/precalculus edition_5f.pdf

BIOT-321 INTRODUCTION TO BIOTECHNOLOGY (3+0)

Objectives

The course is planned to acquaint the students with the basic concepts and significance of biotechnology as it stands today.

Course Outline

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

Recommended Book List

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.

2nd YEAR

3rd SEMESTER

Semester-III				
MTH-444	QR-2—Tools for Quantitative Reasoning	03	General Education Course	
CS-301	Introduction to Computer	03	General Education Course	
BCHM-311	Introductory Biochemistry	03	Interdisciplinary	
BIOT-411	Molecular Biology	03	Major Disciplinary Specific	
BIOT-412	General Genetics	03	Interdisciplinary	
Semester Credit Hours		**15**		

3rd SEMESTER

MTH-444 QR-II----TOOLS FOR QUANTITATIVE REASONING (3+0)

Objectives

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

Course Outline

- Investigating relationships between variables
- Exploring tools to find relationship between variables
- Population and samples,
- Exploring and summarizing data
- Finding a representative value in a data
- Measure and spread of a data,measuring degree of relationship among variables
- Measure of central tendency, dispersion, data interpretation
- Basic probability theory
- Basics of estimation and confidence interval
- Testing hypothesis
- Statistical inferences in decision making
- Survey sampling

Recommended Book List

1. Heumann, Christian, and Schomaker, Michael. Introduction to Statistics and Data Analysis: With Exercises, Solutions and Applications in R. Switzerland, Springer International Publishing, 2023.
2. James, Gareth, et al. An Introduction to Statistical Learning: With Applications in R. Germany, Springer New York, 2013.
3. Reid, Howard M. Introduction to Statistics: Fundamental Concepts and Procedures of Data Analysis. United States, SAGE Publications, 2013.

CS-301 INTRODUCTION TO COMPUTER 3(3+0)

Objectives

- Understand different terms associated with ICT
- Identify various components of a computer system
- Identify the various categories of software and their usage
- Understand different terms associated with the Internet and World Wide Web.

- Use various web tools including Web Browsers, E-mail clients and search utilities.

Course Outline

- Introduction to Computer and Window 98/2000.
- Word processing (Microsoft Word).
- Spread Sheets (Microsoft Excel) and other related software packages (at least two).
- Internet access and different data bases available on the internet.

Recommended Book List

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, Mathews Leon, Leon Press.

BCHM-311 INTRODUCTORY BIOCHEMISTRY 3(2+1)

Objectives

This course aims to give students an idea of the fundamental knowledge of the molecules of life, as well as their function in the context of a living cell.

Course Outline

Introduction to biochemistry; water, pH, buffers, and biochemical composition of cells; carbohydrates - structure and classification; proteins - overview with emphasis on their composition and structure, classification and function; lipids - structure, classification and biological significance; enzymes - properties, nomenclature, classification, and factors affecting enzyme activity including inhibitors and potentiators, basic kinetics, derivation of Km and Vmax; coenzymes and vitamins; nucleic acids - structure and function.

Practical

Preparation of laboratory solutions and pH determination; qualitative and quantitative tests for carbohydrates, proteins and lipids; enzyme assays and the effect of pH, temperature and substrate concentration on enzyme activity.

Recommended Book List

1. Nelson DL and Cox MM, 2012. Lehninger Principles of Biochemistry. 6th Edition; WH Freeman, New York. (Available at www.ncbi.nlm.nih.gov)
2. Stryer et al., 2006. Biochemistry. 6th Edition; WH Freeman, New York. (Available at www.ncbi.nlm.nih.gov)
3. Voet D and Voet TG, 2008. Biochemistry. 4th Edition; John Wiley and Sons, New York.
4. Murray et al., 2012. Harper's Illustrated Biochemistry. 29th Edition; McGraw-Hill Medical

Publishing.
5. Ferrier DR, 2013. Lippincott's Biochemistry. 6th Edition; Lippincott Williams &Wilkin Publishing Company.

BIOT-411 MOLECULAR BIOLOGY (3+0)

Objectives

The general objective of this course is to give students with the chemistry and biology of macromolecules.

Course Outline

Introduction to molecular biology and history; structure and function of DNA; chromatin and structure of chromosomes; protein structure and function; DNA replication in prokaryotes and eukaryotes; transcription in prokaryotes and eukaryotes; post transcriptional processing (e.g., RNA splicing, alternative splicing, editing); genetic code; translation, post-translational processing in prokaryotes and eukaryotes; protein folding, targeting and turnover; DNA damage and repair, recombination and transposable elements. Signaling and control of gene regulation in prokaryotes and eukaryotes.

Recommended Book List

1) Ajit Varma. 2022. Biology and Biotechnology of Quinoa: Super Grain for Food Security
2) Perry Johnson-Green. 2018. Introduction to Food Biotechnology
3) Alexandru Mihai Grumezescu, Alina Maria Holban. 2018. Advances in Biotechnology for Food Industry.
4) Mohammed Kuddus. 2018. Enzymes in Food Biotechnology: Production, Applications, and future Prospects.
5) Chetan Sharma, Anil K. Sharma, K. R. Aneja. 2016. Frontiers in Food Biotechnology.

BIOT-412 CLASSICAL GENETICS 3(2+1)

Objectives

To acquaint students with classical aspects of genetics.

Course outline

Classical Mendelian genetics; monohybrid crosses, dominance, re-cessiveness, co-dominance, and semi-dominance; principle of independent assortment; dihybrid and trihybrid ratios; gene interactions; epistasis and multiple alleles; ABO blood type alleles and Rh factor alleles in humans; probability in Mendelian inheritance; structure of chromosomes; organization of genes and genomes; nucleic acid function; DNA as warehouse of genetic information; experimental evidence that DNA is genetic material; sex determination; linkage and crossing over.

Practical:

1. Karyotyping

2. Extraction of DNA from plants/fruits
3. Extraction of DNA from bacteria
4. Extraction of DNA from fungi

Recommended Book List

1) Isil Aksan Kurnaz. 2021. Techniques in Genetic Engineering
2) T. A. Brown, 2020. Gene Cloning and DNA Analysis: An Introduction 8th Edition, Kindle Edition
3) Farrukh Jamal. 2020. Genetic Engineering: A Glimpse of Techniques and Applications
4) Rakesh S. Sengar, Amit Kumar, Reshu Chaudhary, Ashu Singh. 2018. Advances in Molecular Techniques
5) Ho Nam Chang. 2018. Emerging Areas in Bioengineering.

4th SEMESTER

Semester-IV				
MIC-423	Bacteriology	3(2+1)	Interdisciplinary	
MIC-513	Virology	3(2+1)	Interdisciplinary	
BIOT-421	Oncology	03	Major Disciplinary Specific	
BIOT-422	Techniques in Biotechnology	3(2+1)	Major Disciplinary Specific	
BIOT-423	Genetic Engineering	03	Major Disciplinary Specific	
Semester Credit Hours		**15**		

4th SEMESTER

MIC-423 BACTERIOLOGY 3(2+1)

Objectives

The aim of the course is to enable students to understand the morphology, structure and economic importance of Bacteria

Course Outline

Course Outline:

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

Practical:

- Isolation and identification of bacteria from:
  - Environment
  - Rhizosphere
  - Clinical samples.
- Effect of temperature on growth of bacteria.

Recommended Book List

1. Black, J. G. 2005 Microbiology - Principles and Exploration, John Wiley and Sons, Inc.
2. Prescott, L. M., Harley, J. P. and Klein, D. A. 2005. Microbiology McGraw-Hill Companies, Inc.
3. Arora, D. R. 2004. Textbook of Microbiology, CBS Publishers and Distributors, New Delhi.
4. Ross F. C. 1995. Fundamentals of Microbiology. John Willey & Sons, New York.

MIC-513 VIROLOGY 3(2+1)

Objectives

The main aim of this course it to study and identify major components of viruses, system of traits used for classification of viruses, describe how viruses interact with cells and examine the ways that viruses persist in host cells.

Course Outline

- Principles of electron microscopy.
- Origin and evolution of viruses.
- Nature of animal and plant viruses.
- Classification: structural and functional groups.
- Cell culture: various types of cell lines (plants and animals).
- Replication of viruses (RNA & DNA).
- Principles of viral diagnostic procedures.
- Introduction to bacterial viruses.
- Receptors for bacteriophages, somatic, non-somatic viruses and sex specific viruses. Adsorption sites and mode of replication.
- Transducing viruses of eukaryotes and cross-phylogenetic transfer.
- Prion and viriod.
- Origin of life and Evolution.
- Classification and structure of medically important viruses.
- Introduction to the replication of viral genome.
- Maturation and release of viruses.
- Special features of molecular biology, biochemistry and genetics of the following viruses: Picornaviruses, Poxviruses, Myxoviruses, Paramyxoviruses, Rubella viruses, Rhabdoviruses, Reoviruses, Herpes viruses, Hepatitis viruses, Retroviruses and Tumor viruses (DNA & RNA), Adenoviruses, Coronaviruses.Emerging viral infection

Practical

- Molecular detection and quantification of viruses.
- Heme-agglutination Inhibition assays.
- Chick embryo for propagation of virus and titration.
- Plaque assay.
- Transmission electron microscopy (virtual presentation, field trip).
- Sample preparation for electron microscopy.
- Isolation and identification of phages from various sources.

Recommended Book List

1. Shi, P.Y.,2012. Molecular Virology and Control of Flaviviruses .Caister Academic Press 4. Stent,G.S., and Dohm, J.L., 2012.Molecular Biology Of Bacterial Viruses .Literary Licensing, LLC. 5. Maramorosch,K., and Frederick A. Murphy, F.A., 2013.Advances in Virus Research Elsevier Science.
2. Mahy, B.W.J.,& Van Regenmortel, M.H.V., 2008. Encyclopedia of Virology 3rd. Edition. Elservier
3. Cann, A. J., 2011. Principles of Molecular Virology.5th Edition. Academic Press.

4. Robert, W. Molecular Biology. 2011. McGraw-Hill Sciences
5. Ralf G. Dietzgen, R.F., and Ivan V. Kuzmin, I.V.,2012. Rhabdoviruses: Molecular Taxonomy, Evolution, Genomics,
6. Caister. 2012. Ecology, Host-Vector Interactions, Cytopathology and Control Academic Press. USA.

BIOT-421 ONCOLOGY 3(3+0)

Objectives

The aim of the course is to enable students to acquire specialized theoretical and practical knowledge of cancer biology, from basic research to clinical applications of research findings. The course will enable the students to:

- Understand the cellular, genetic and molecular basis of cancer.
- Learn the research methodologies used in cancer research.
- Attain knowledge to pursue a research career in the field of Oncology

Course Outline

- Introduction to oncology,
- Carcinogens, genes involved in cancer; proto-oncogenes, tumor suppressor genes and cell regulatory genes.
- Prevalence of genes in different age group
- Types of Cancer
- Signs of cancer
- Symptoms of Cancer
- Staging of Cancer
- Cancer Diagnosis
- Treatment of Cancer (Surgery, Radiotherapy, Chemotherapy).
- Other treatments of Cancer

Recommended Book List

1) Antonio Russo, Marc Peeters, Lorena Incorvaia, Christian Rolfo. 2021. Practical Medical Oncology Textbook
2) The American Cancer Society. 2018. The American Cancer Society's Oncology in Practice: Clinical Management
3) Kerr DJ, Haller DJ, van de Velde CJH, Baumann M. 2016. Oxford Textbook of Oncology. 3rd Edition. Oxford University Press, UK.
4) Weinberg RA. 2014. The Biology of Cancer. 2nd Edition. New York: W. W. Norton & Company, USA.
5) Gary S. Stein, Kimberly P. Luebbers. 2019. Cancer Prevention, Early Detection, Treatment and Recovery.

BIOT-422 TECHNIQUES IN BIOTECHNOLOGY 3(2+1)

Objectives

This course provides the information of principles & mechanism of different equipment and analysis of Biochemical and Biological samples.

Course Outline

Homogenization, centrifugation, ultra-centrifugation, paper, TLC, and column chromatography,

Gel filtration, ion exchange chromatography, affinity chromatography, HPLC, lyophilization,

Electrophoresis, flame photometry, atomic absorption spectrophotometry, spectrofluorimetry,

UV / visible spectrophotometry and use of radioisotopes.

Practical:

1. Centrifugation
2. Microbes' isolation, streaking, inoculation and incubation.
3. Identification of sugars, proteins, electrolytes etc by UV/VIS spectrophotometer.

Recommended Book List

Physical Biochemistry: Applications to Biochemistry and Moleculart Biology (1982) by David Freifelder,W. H. Freeeman

2. Introduction to Modern liquid chromatography (1979) by L.L.Snyder & J.J Kirkland. John Wiley & Sons

3. Tools of Biochemistry (1977) T. G. Cooper & T. C. Cooper John Wiley & Sons

4. Centrifugation. A practical approach. (1987) Ed. D. Rickwood, Oxford: IRL press

England.

5. Varley's Pratical Clinical Biochemistry (1991) 5th Edition byA.H. Gowenlock and M.

BIOT-423 GENETIC ENGINEERING 3(3+0)

Objectives

The aim of this course is to learn basic techniques used in recombinant DNA technology and understand the potential problems related to genetic engineering

Course Outline

- Introduction and scope.
- Restriction and modification system.
- Properties of restriction endonucleases, their occurrence and recognition sequences.
- Assay procedures for restriction endonucleases and slab gel electrophoresis. Practical uses of endonucleases. Role in genetic engineering.

- Construction of cloning vector by λ-phage.
- *In vitro* genetic engineering; cloning vehicles: plasmids, cosmids and phagemids, YAC and BAC etc.
- Principles of nucleic acid isolation (DNA & RNA).
- Cloning strategies: construction of chimeric plasmids.
- Methods of introducing exogenous DNA.
- Methods for screening the clones.
- DNA sequencing.
- PCR: its application and primer designing.
- Prokaryotes and Eukaryotes Expression systems.
- Labeling methods of probes.
- Construction of genomic libraries.

Recommended Book List

1. Meyers, R.A., 2006. Genomics and Genetics . John-Wiley and Son Limited.
2. Primrose, S.B., and Twyman, R.M. 2006. Gene Manipulation and Genomics 6th edition. Blackwell Publishing.
3. Snustad, D.P., and Simmons . M.J., 2012. Genetics, 6th Edition. John Wiley and Sons.
4. Snustad, D.P., and Simmons . M.J., 2011. Principles of Genetics, 6th edition. John Wiley and Sons.
5. James, D. W. 2013 Molecular Biology of Gene. Benjamin Cumming.

WOMEN UNIVERSITY MARDAN

3rd YEAR

5th SEMESTER

Semester-V				
MIC-422	Bio-risk Management and Bioethics	03	Interdisciplinary	
BIOT-511	Introductory Immunology	3(2+1)	Major Disciplinary Specific	
BIOT-512	Genomics and Proteomics	03	Major Disciplinary Specific	
BIOT-513	DNA Damage, Repair and Carcinogenesis	3(2+1)	Major Disciplinary Specific	
BIOT-514	Animal Biotechnology	03	Major Disciplinary Specific	
Semester Credit Hours		**15**		

5th SEMESTER

MIC-422 BIO-RISK MANAGEMENT AND BIOETHICS 3 (3+0)

Objectives

- To learn safe practices for handling of microbes.
- To learn about risky and hazardous environment.
- To learn about the development of safe and healthy environment.

Course Outline

- Detailed concept of Risk and Hazardous Environment, Chemicals, Biological factors and Radiations.
- Risk assessment & Management: Preventions, Surveillance and Monitoring.
- Judicial rights / Penalties.
- Concepts of Biosafety Environment: Terrestrial, Marine, Atmosphere.
- Designing of labs based on Biosafety and Biological Containment parameters.
- Details of Biological Containment: Plants, Animals, Microbes.
- Bioethical issues related to Biosafety.
- Biosafety levels.
- Bioethics

Recommended Book List

6. Meyers, R.A., 2006. Genomics and Genetics . John-Wiley and Son Limited.
7. Primrose, S.B., and Twyman, R.M. 2006. Gene Manipulation and Genomics 6th edition. Blackwell Publishing.
8. Snustad, D.P., and Simmons . M.J., 2012. Genetics, 6th Edition. John Wiley and Sons.
9. Snustad, D.P., and Simmons . M.J., 2011. Principles of Genetics, 6th edition. John Wiley and Sons.
10. James, D. W. 2013 Molecular Biology of Gene. Benjamin Cumming.

BIOT-511 INTRODUCTORY IMMUNOLOGY 3(2+1)

Objectives

- The objective of this course is to learn about the structural features of the components of the immune system as well as their functions.
- The primary emphasis of this course will be on the mechanisms involved in immune system development and responsiveness.
- The major experiments that allowed the elucidation of these mechanistic features will be featured to help understand how immunologists think and work.

Course Outline

- Basic immunological concepts
- Principles and techniques of serology
- Immunological response to foreign agents
- Nature of antigens and antibodies
- Antigen-antibody reaction
- Immune competent cells
- Allergic reactions
- Tumor transplantation and immunology
- Immunogenetics

Practical

- Techniques used in serological studies of RBC & WBC count
- Different leukocyte count
- Blood grouping
- Body testing

Recommended Book List:

1. Abbas, A. K., Lichtman, A. H. and Pillai, S. 2007. Cellular and Molecular Immunology, Elsevier Health Sciences, N.Y.
2. Johnson, A. G. G., Ziegler, R. J., Lukasewycz, O. A. and Lukasewycz, O. A. 2007. Microbiology and Immunology: Board Review Series, Lippincot Williams and Wilkins, M.D.
3. Lichtman, A. H. 2007. Basic Immunology. Elsevier Health Sciences, N.Y.
4. Murphy, K., 2011. Janeway'sImmunobiology (Immunobiology: The Immune System, 8th Edition. Garland Science Publishers.

BIOT-512 GENOMICS AND PROTEOMICS 3(3+0)

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 Outline:

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, realtime 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 coimmunoprecipitation.

Recommended Book List:

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.

BIOT-513 DNA DAMAGE, REPAIR AND CARCINOGENESIS 3(2+1)

Objectives:

- To learn about physical and chemical DNA damaging agents.
- To learn about exo and endogenous mutagenic agents.
- To learn about the mechanism of carcinogenesis and mutations.

Course Outline:

- Radiation (ionizing and non-ionizing) as damage inducing agents. DNA, the critical site for damage and interaction. Biological consequences of damage.
- Inactivation of biological systems: bacterial cells and bacteriophages by UV radiations. Post-irradiation macromolecular system.
- Chemical as damage inflicting agents. Exogenously and endogenously induced base modifications and their biological consequences.
- Restoration of DNA damages: photo-enzymatic restoration and dealkylation. Environmental and physiological factors influencing recovery phenomenon viz. Liquid holding recovery, thermal and UV reactivation.
- Repair of DNA damages: excision repair processes, mismatch repair, tolerance mechanism, conditioned repair phenomenon (phenomenology and genetic control of SOS functions, adaptive responses to DNA alkylation and oxidative stress.
- Relevance of inducible repair to carcinogenesis.
- Somatic theory of cancer. Chemistry of carcinogenesis, cellular transformation.

- Anticarcinogenesis: role of repair processes in tumor progression. Molecular genetics of human cancer: diagnostic and therapeutic indices.
- Repair and spontaneous mutagenesis, plasmid gene mediated repair, genetic control of repair phenomenon.
- Enzymology of DNA repair.
- Cancer and gene therapy.

Practical:

- Screening of mutagenic agents by AMES test.
- To determine the effect of UV radiation on prokaryote and eukaryotes.
- Screening of carcinogenic agents by the use of indicator cell lines.

Recommended Book List:

1. Friedberg, E.C., 2006.DNA Repair and Mutagenesis: 2nd Edition Publisher: ASM Press.
2. Howe, H., 2007. Gene Cloning and Manipulation Cambridge University Press
3. Snyder, L. and W. Champness, W., 2007. Molecular Genetics of Bacteria, 3rd edn American Society for Microbiology.
4. Caldecott , K.W.,2011. Eukaryotic DNA Damage Surveillance and Repair: 1st Edition. Springer-Verlag New York, LLC.
5. Stone, M., 2011. Structural Biology of DNA Damage and Repair. American Chemical Society.
6. James D. W. 2013. Molecular Biology of Gene. McGraw-Hill Science.

BIOT-514 ANIMAL BIOTECHNOLOGY 3(2+1)

Objectives:

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

Course Outline:

Introduction and history of transgenic animals; role of synthetic peptides/proteins in animal health; use of monoclonal antibodies as a diagnostic/therapeutic agents; 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.

Practical:

Aquaculture methods and various DNA recombinant techniques for animal biotechnology

Recommended Book List:

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.

6th SEMESTER

Semester-VI				
BIOT-521	Environmental Biotechnology	3(2+1)	Major Disciplinary Specific	
BIOT-522	Microbial Biotechnology	3(2+1)	Major Disciplinary Specific	
BIOT-523	Immunogenetics	3(2+1)	Major Disciplinary Specific	
BIOT-524	Food Biotechnology	3(2+1)	Major Disciplinary Specific	
BIOT-525	Fungal Biotechnology	3(2+1)	Major Disciplinary Specific	
Semester Credit Hours		**15**		

6th SEMESTER

BIOT-521 ENVIRONMENTAL BIOTECHNOLOGY 3(2+1)

Objectives:

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

Course Outline:

Introduction to environmental biotechnology; fundamentals of biological interventions; genetic manipulation strategies in environmental biotechnology; pollution indicators and pollution control strategies; bioreactors; domestic waste water treatment; industrial effluent treatment; sludge treatment; contaminated land and bioremediation; phytoremediation; landfills and composts; concept of integrated environmental biotechnology; biodegradation and biotransformation of hazardous chemicals; products of environmental biotechnology.

Practical:

Biodegradation of environmental pollutants by microorganisms; bacteriology of drinking water; microscopic studies of water specimens collected from various locations; field survey of polluted areas and field study for pollution indicators (e.g., plants, microorganisms and air).

Recommended Book List:

1. Fluker MH, 2010. Environmental Biotechnology. CRC Press.

2. Faster CF and Wase J, 2004. Environmental Biotechnolog. John Willey & Sons.

3. Evans GM and Furlong JC, 2010. Environmental Biotechnology Theory and Application. 2nd Edition; Wiley-Blackwell Publishers.

4. Srinivas T, 2008. Environmental Biotechnology. 1st Edition; New Age International Publishers.

5. Spencer JFT and Spencer ALR, 2004. Environmental Microbiology: Methods and Protocols (Methods in Biotechnology). 1st Edition; Humana Press.

6. Hurst et al., 2007. Manual of Environmental Microbiology. 3rd Edition; ASM Publishers.

BIOT-522 MICROBIAL BIOTECHNOLOGY 3(2+1)

Objectives:

To acquaint students with how modern methods may be employed to enhance the characteristics of microbes that are commonly used in various industries including food, agriculture and pharmaceutical.

Course Outline:

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, fermentation, pharmaceutical and other industries; vaccine development and production; microbiological mining, biofuels and use of microbes in petroleum industry; plant-microbe interactions; bio-fertilizers, biopesticides, composting; antimicrobials; significance of microbial biotechnology in the economic development of Pakistan.

Practical:

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

Recommended Book List:

1. Glick BR et al., 2009. Molecular Biotechnology: Principles and Applications of Recombinant

DNA. 4th Edition; ASM Press. 2. Mukhopadhyay SN, 2004. Process Biotechnology Fundamentals. 2nd Edition. Anshan

Publisher.

3. Goodsell DS, 2004. Bionanotechnology: Lessons from Nature. John Wiley and Sons.

4. Ray RC, 2005. Microbial Biotechnology in Agriculture and Aquaculture. NBN International.

5. Kreuzer H and Massey A, 2005. Biology and Biotechnology Science, Applications, and

Issues. 1st Edition; ASM Press.

BIOT-523 IMMUNOGENETICS 3(2+1)

Objectives:

This course will enable students to comprehend:

- The advances in the field of immuno-genetics
- Genetics of disease resistance
- Immune response through experimentation in different disease models

Course Outline:

- Concept of immune and immune system
- anti-body response
- nature of anti-bodies
- structure and heterogeneity of immunoglobulin
- allelic exclusion
- Monoclonal antibodies.
- Inheritance of immune response
- Immune tolerance
- specific immune variations
- human IR genes
- anti-genic variation: genetic pathways for synthesis of A, B & O antigens
- secretor loci
- Rh factor and other blood groups.
- Histocompatibility: Histocompatibility of blood antigens, transplantation.
- HLA complex: HLA haplotypes, MHC/HLA and diseases.
- Immunological diseases: immune deficiency diseases, AIDS, auto immune diseases, inherited abnormalities of complement system.

Practical:

- Coomb's test
- Agglutination test (WIDAL, RF, CRP)
- Precipitin test (Radio-immunodiffusion technique)
- ELISA
- Immunochromatographic technique

Recommended Book List:

1. Methods and Applications in Clinical Practice, Ch Immunogenetics, Editors: Frank T. Christiansen, Brian D. Tait 2012.
2. Cellular and molecular immunology. 4th Ed. Abbas, A. K., A. H. Lichtman, J, S. Pober. W. B. Saunders Co. 2000.
3. Advances in Immunology. Dixon, F. J., F. Alt, and K. F. Austen. Vol. 75. Academic Press. 2000.
4. Immunogenetic: Webster's Timeline History, Icon Group International, 1950 – 2007. 2010
5. Fundamentals of immunology. 2nd Edition. Myrvik, W. LEA & Febiger. 1984.
6. Immunogenetics of Autoimmune Disease. Oksenberg, J. R.; B. David (Eds.) 2006

BIOT-524 FOOD BIOTECHNOLOGY 3(2+1)

Objectives:

To acquaint students with the role of microorganisms in food and the food industry in addition to principles of enzymology, and food engineering

Course Outline:

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.

Practical:

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 Book List:

1. Joshi VK, 2012. Food Biotechnology. 1st Edition; I K International Publishing House.

2. Campbell-Platt G, 2009. Food Science and Technology. 1st Edition; Wiley- Blackwell.

3. Singh RP, 2008. Introduction to Food Engineering. 4th Edition; Academic Press

4. Belitz HD, 2009. Food Chemistry. 4th Edition; Springer.

5. Nielsen SS, 2010. Food Analysis. 4th Edition; Springer

BIOT-525 FUNGAL BIOTECHNOLOGY 3(2+1)

Objectives:

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

Course Outline:

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; biodeterioration and biodegradation; biotechnology and the control of pathogenic fungi; current applications of fungal biotechnology and screening of fungal metabolites; mycotoxins.

Practical:

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 Book List:

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.

8. Frisvad et al., 1998. Chemical Fungal Taxonomy. 1st Edition; CRC Press.

4th YEAR

7th SEMESTER

Semester-VII				
BIOT-611	Health Biotechnology	03	Major Disciplinary Specific	
BIOT-612	Cell and Tissue Culture	03	Major Disciplinary Specific	
BIOT-613	Bioinformatics	03	Major Disciplinary Specific	
BIOT-614	Aquatic Biotechnology	03	Major Disciplinary Specific	
BIOT-615	Field Experience	03	Major	
Semester Credit Hours		**15**		

7th SEMESTER

BIOT-611 HEALTH BIOTECHNOLOGY 3(3+0)

Objectives:

To acquaint students with biotechnology in healthcare including diagnostic tools, immunization and therapeutics.

Course Outline:

Introduction to health biotechnology; social acceptance of medical biotechnology; molecular basis of disease; molecular and genetic markers; detection of mutations and infectious agents; active and passive immunization; vaccines (live, killed, recombinant DNA vaccines, subunit vaccines, DNA vaccines, edible vaccines); organ transplantation; applications of transgenic animals (animal models of diseases, farming and enhancement of farm animals); drug delivery systems; blood transfusion and grafting techniques; pharmacogenetics; gene therapy; biopharmaceuticals from plants; stem cell technology.

Recommended Book List:

1. Pongracz J. and Keen M. 2009. Medical Biotechnology. 1st Edition; Elsevier Health Sciences.
2. Schacter B. Z. 2005. Biotechnology and Your Health: Pharmaceutical Applications. Chelsea
House Publishers,
3. Chetan DM and Dinesh KP, 2006. Health and Pharmaceutical Biotechnology. Firewall Media.
4. Bustillo LGT and Pena IG, 2012. Biotechnology: Health, Food, Energy and Environment
Applications (Biotechnology in Agriculture, Industry and Medicine). Nova Science Publication.
5. Dogramatzis, 2010. Health care Biotechnology. 1st Edition; CRC Press

BIOT-612 CELL AND TISSUE CULTURE 3(3+0)

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 Outline:

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 Book List:

1. Setlow JK, 2000. Genetic Engineering: Principles and Methods. Kluwer Academic Publishers.

2. Nicholl DST, 2002. An Introduction to Genetic Engineering. 2nd Edition; Cambridge

University Press.

3. Gale YL, 2002. Genetic Engineering.

4. Razdan MK, 2003. Introduction to Plant Tissue Culture. 2nd Edition; Intercept, New York,

USA.

5. Lanza et al., 2000. Principles of Tissue Engineering. 2nd Edition; Academic Press, California.

6. Ignacimutu S, 1997. Plant Biotechnology. Oxford IBH Publisher.

7. Punia MS, 1999. Plant Biotechnology and Molecular Biology: A Laboratory Manual.

BIOT-613 BIOINFORMATICS 3(2+1)

Objectives:

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

Course Outline:

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

Practical:

Practically perform all Bioinformatics tools (NCBI, Homology, Protein Data bases) etc

Recommended Databases and Tools:

1. NCBI, PDB, EcoCyc, DDBJ, SWISS-PROT, TIGR, KEGG etc.

2. Bioedit, Repeatmasker, PHRED, PHRAP, BLAST, Prosite/BLOCKS/PFAM, CLUSTALW, Emotif, RasMol, Oligo, Primer3, Molscript, Treeview, Alscript, Genetic Analysis Software, Phylip, MEGA4.0 etc.

Recommended Book List:

1. Claverie JM and Notredame C, 2006. Bioinformatics for Dummies. 2nd Edition; Wiley Publishing.

2. Xiong J, 2006. Essential Bioinformatics. 1st Edition; Cambridge University Press.

3. Xia X, 2007. Bioinformatics and the Cell: Modern Computational Approaches in Genomics, Proteomics and Transcriptomics. 1st Edition. Springer

4. Mathura V and Kangueane P, 2009. Bioinformatics: A Concept-Based Introduction. Springer
5. Mount DW, 2004. Bioinformatics Sequence and Genome Analysis. 2nd Edition; Cold Spring Harbor Laboratory Press.

6. Sperschneider V, 2008. Bioinformatics: Problem Solving Paradigms. Springer.

BIOT-614 AQUATIC BIOTECHNOLOGY 3(3+0)

Objectives:

At the end of the course, students will be able to: At the end of this course, the students will be able to: identify the basic forms of life that live in aquatic environment, apply aquatic biotechnology and in agricultural, environmental protection, medicine and apply aquaculture technology in food production.

Course Outline:

The course deals with Introduction to Aquatic biotechnology; Molecular Genetics of Aquatic organisms: Discovery & cloning of novel genes, Genetic manipulations of finfish & shellfish; Medical Applications of aquatic biotechnology: Drugs & medicines from the sea, health & human disease; Environmental applications of Aquatic biotechnology: Antifouling Agents, Biosensors, Environmental remediation; Marine biotechnology: Fish & marine invertebrate, transgenic fish technology & its application in fish production; The uses of macro & micro algae.

Recommended Book List:

1. Marine Board (2010). Marine Biotechnology: A New Vision and Strategy for Europe. Marine Board-ESF Position Paper 15
2. ESF Marine Board (2001). Marine Biotechnology: A European Strategy for Marine Biotechnology.
3. Cole, G.A. (1983). Textbook of Limnology. (3rd ed.) The C.V.Mosby Company,St. Louis
4. FAO (2018). The State of World Fisheries and Aquaculture 2018 - Meeting the sustainable development goals. Rome. Licence: CC BY-NC-SA 3.0 IGO. Page 2 of 8
5. Robert Arthur (MRAG), Chris Béné (IDS), William Leschen and David Little (2013). Fisheries and aquaculture and their potential roles in development: an assessment of the current evidence.

8th SEMESTER

Semester-VIII				
BIOT-621	Industrial Biotechnology	3(2+1)	Major Disciplinary Specific	
BIOT-622	Agriculture Biotechnology	3(2+1)	Major Disciplinary Specific	
BIOT-623	Pharmaceutical Biotechnology	03	Major Disciplinary Specific	
BIOT-624	Nano Biotechnology	03	Major Disciplinary Specific	
BIOT-625	Capstone Project	03	Major	
Semester Credit Hours		**15**		

8th SEMESTER

BIOT-621 INDUSTRIAL BIOTECHNOLOGY 3(2+1)

Objectives:
To provide students with a broad-based introduction to the field of industrial biotechnology.

Course Outline:

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

Practical:

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 Book List:

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

6. Singh R and Ghosh S, 2004. Industrial Biotechnology. Global Vision Publishing House

BIOT-622 AGRICULTURAL BIOTECHNOLOGY 3(2+1)

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

Course Outline:

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 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 trans formant's; regeneration of plantlets and acclimatization; plant DNA extraction and PCR for detecting introduction of foreign DNA into plants.

Recommended Book List:

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.

BIOT-623 PHARMACEUTICAL BIOTECHNOLOGY 3(3+0)

Objectives:

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

Course Outline:

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 Book List

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.

BIOT-624 NANO BIOTECHNOLOGY 3(3+0)

Objectives:

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

Course Outline:

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 nanobiotechnology; future prospects of nano-biotechnology; use of nanotechnology for diagnosing and curing disease.

Recommended Book List:

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.