SHAHEED BENAZIR BHUTTO WOMEN UNIVERSITY PESHAWAR
TAMPLATE FOR COURSE SPECIFICATIONS

University: Shaheed Benazir Bhutto Women University **Faculty**: Sciences

Course specifications

Programme(s) on which the course is given:
BS(Hons)

Major or minor element of programs:
Major

Department offering the programs:
Biotechnology/Bioinformatics/Zoology/Microbiology

Department offering the course:
Principles of Biotechnology

A- Basic Information

Title: Principles of Biotechnology Code: **BIT-301**
Credit hours: **02 + 1** Lectures: **02/Week**
Tutorial: nil Practical: **01/Week**
Total: **3**

B- Professional Information

- **Overall Aims of the course:**

The course *Principles of Biotechnology* aims to introduce BS-level students to the core concepts, historical development, and interdisciplinary foundations of biotechnology, highlighting its integration of biology, chemistry, genetics, engineering, and computational sciences. It seeks to develop an understanding of the major branches and applications of biotechnology in medicine, agriculture (including food, livestock, fisheries, algae, fungi, resistant varieties, and Bt crops), industry, and the environment. The course also aims to familiarize students with emerging biotechnological techniques, particularly genetic engineering, its tools, enzymes, and stepwise processes, as well as bioprocessing and fermentation technologies involved in the production of primary and secondary metabolites. Furthermore, it emphasizes applications in medical, animal, environmental, industrial, and microbial biotechnology, while fostering awareness of biosafety, protection of biotechnological products, ethical considerations, public perception, and the role of biotechnology in addressing challenges of the developing world. Bioinformatics is the discovery of biological data by using computational techniques. The course is designed to introduce the most important and basic concepts, methods and tools used in Bioinformatics. This course will introduce basic biological database sources, principle and methods for sequence and genome analysis.

Main Aims of the Course (Principles of Biotechnology)

- To develop a clear understanding of the fundamental principles, interdisciplinary foundations, and historical evolution of biotechnology, including its major branches and applications in agriculture, medicine, industry, and environmental management.

- To equip students with basic knowledge of modern biotechnological tools and techniques, particularly genetic engineering, bioprocessing, and fermentation technologies, and their roles in the production of valuable biotechnological products.
- To foster awareness of biosafety, ethical, social, and regulatory aspects of biotechnology, enabling students to critically evaluate its impact on society, public perception, and sustainable development, especially in the context of the developing world.

• Intended Learning Outcomes

a. Knowledge & Understanding:
Students will have the ability to understand:

1. The basic concepts, definitions, historical development, and interdisciplinary foundations of biotechnology.
2. The major branches and applications of biotechnology in agriculture, medicine, industry, animal production, and environmental management.
3. The fundamental principles of genetic engineering, bioprocessing, fermentation technology, and production of primary and secondary metabolites.

b. Intellectual Skills:
At the end of this course, students will have the ability to:

1. Analyze biotechnological techniques and processes in relation to their practical applications.
2. Evaluate the impact of biotechnology on society, environment, and sustainable development, particularly in developing countries.
3. Critically assess ethical, safety, and public perception issues related to biotechnological innovations.

c. Professional & Practical Skills:
At the end of this course, students will have the ability to:

1. Identify and explain the tools, enzymes, and steps involved in genetic engineering and DNA manipulation.
2. Understand the operation and applications of fermenters in industrial and microbial biotechnology.
3. Apply basic biosafety principles and product protection measures in biotechnological practices.

d. **General & Transferable Skills:**

After the end of this course students will be able to:

1. **Search, organize, and interpret biotechnological information** related to genetic engineering, bioprocessing, fermentation technology, and biotechnological applications in agriculture, medicine, and industry.
2. **Continuously update and integrate knowledge** in a rapidly advancing field by understanding emerging trends, innovations, and technologies in modern biotechnology.
3. **Apply core biotechnological concepts** to analyze real-world problems and societal challenges in agriculture, environmental management, and healthcare.

Course Contents

Month	Weeks	Topics to be Covered	
1st	1st	1. Introduction to Biotechnology	1.1 Concepts, Definition, and Historical Development of Biotechnology 1.2 Foundations of Biotechnology and Its Interdisciplinary Nature 1.3 Branches and Applications of Biotechnology in Agriculture, Medicine, and Industry
	2nd & 3rd	2. Genetic Engineering and Modern Biotechnology Techniques	2.1. Development of Resistant Varieties 2.2. Bt Crops and Their Agricultural Applications 2.3 Emerging Techniques in Modern Biotechnology 2.4 Genetic Engineering: Tools, Methods, and Applications
2nd	4 & 5th	3. Bioprocessing and Fermentation Technology	3.1. Introduction to Bioprocessing 3.2. Types and Principles of Fermentation 3.3. Fermenters and Bioreactors 3.4. Applications of Bioprocessing and Fermentation
	6th	4. Primary and Secondary Metabolites	4.1 Introduction to Metabolites 4.2. Primary Metabolites Basic Concept, Production, Examples 4.3. Secondary Metabolites Basic Concept, Production, Examples 4.4. Industrial Importance of Primary and Secondary Metabolites
	7th & 8th	5. Biotechnology in medicine, antibiotics, vaccines	5.1 Introduction to Medical Biotechnology 5.2. Antibiotics: Sources, Production, and Applications 5.3. Vaccines: Types and Development 5.4. Role of Biotechnology in Modern Therapeutics
3rd	9th	**MID TERM EXAMS**	
	10 & 11th	6. Animal biotechnology	6.1. Introduction to Animal Biotechnology 6.2. Biotechnology for Improved Animal Production 6.3. Concept of Transgenic Animals

			6.4. Applications and Ethical Considerations in Animal Biotechnology
	12 & 13th	7. Environmental Biotechnology	7.1. Introduction to Environmental Biotechnology 7.2. Types of Waste and Environmental Pollution 7.3. Biotechnological Waste Management and Treatment Methods 7.4. Applications and Sustainability of Environmental Biotechnology
4th	14th	8. Industrial and Microbial Biotechnology	8.1. Introduction to Industrial and Microbial Biotechnology 8.2. Single-Cell Proteins (SCPs) 8.3. Bio-fertilizers 8.4. Applications and Industrial Importance
	15th	9. Biosafety and Protection of Biotechnological Products	9.1 Introduction to Biosafety in Biotechnology 9.2. Safety Measures in Biotechnology 9.3. Protection of Biotechnological Products 9.4. Regulatory Frameworks and Guidelines
	16th	10. Bioethics	10.1 Public Perception of Biotechnology 10.2. Ethical and Moral Considerations in Biotechnological Practices 10.3. Role of Biotechnology in Socio-Economic Development 10.4. Regulation, and Responsible application of Biotechnology
		FINAL TERM EXAMS	

Teaching and Learning Methods

a. Lecture Method
b. Demonstration Method
c. Collaborative learning
e. Practical/Lab Sessions
f. Formative Assessments
g. Assignments and Presentations

Student assessment methods

Assessment Type	Purpose / Skills Assessed
Quiz	To assess basic understanding and recall of concepts and terminology.
Test	To assess logical and reasoning skills.
Presentation	To assess confidence, communication, comprehension, and ability to convey scientific knowledge effectively.
Assignment	To assess analytical thinking, research, writing, and data interpretation skills.
Mid Term Examination	To assess cumulative knowledge of core concepts .
Final Term Examination	To assess comprehensive understanding and integration of all course components.
Practical Examination	To assess ability to perform the theoretical concepts of enzymology.

Assessment Schedule

Assessment	Activity	Week
Assessment 1	Quiz	Week 1
Assessment 2	Test	Week 2
Assessment 3	Presentation	Week 3
Assessment 4	Assignment	Week 4
Mid Term Examination	Written + Practical	Week 8
Final Term Examination	Written + Practical	Week 17

Weightage Assessment

Component	Weightage (%)
Assignments	**5%**
Presentations	**5%**
Quizzes / Tests	**5%**
Mid Term Examination	**30%**
Final Term Examination	**50%**
Practical Examination	**5%**
Grand Total	**100%**

List of references

Recommended Books:

1. William J, Thieman J, Michael A (2003) 2nd edition, 'Introduction to Biotechnology' McGraw Hill Book company Inc
2. David, B., Jewell, T. R. 2000. Biotechnology: demystifying the concept, Oxford University Press.
3. Sedivy, J. M., Joyner, A. L. 2000. Gene targeting, Oxford University Press.
4. Mukhopadhyay, S.N, 2004. Process Biotechnology Fundamentals, 2nd Edition. Viva Books Pvt. Limited, New Delhi.
5. Goodsell, D.S., 2004. Bionanotechnology: Lessons from Nature . John Wiley & Sons Limited.
6. Purohit, S.S., 2002, Biotechnology: Fundamentals and Applications, Agrobios publishers.
7. Prave, P., Faust, U., Sittig, W., and Sukatsch, D.A., 2002. Fundamentals of Biotechnology, John Wiley & Son.

Website

1. https://www.biotechacademy.dk/en/
2. https://scholar.google.com/
3. https://pubmed.ncbi.nlm.nih.gov/
4. https://uj.ac.za.libguides.com/biotechnology

Facilities required for teaching and learning:
Computer
Broad Band Internet connection
Multimedia.

Course Name: Principles of Biotechnology	**Course Code: BIT-301**
Course Structure: Lectures: 2, Labs: 1	**Credit Hours: 3**
Prerequisites: None	
Course Objective: 1. To acquaint students with the basic concepts and significance of biotechnology as it stands today. 2. To understand application of basic biology in the field of biotechnology to solve problems 3. To equip students with various techniques and concepts used in biotechnology	
Course Outline: Biotechnology, Introduction to biotechnology, definition, brief history; foundations of biotechnology and interdisciplinary pursuit; branches and/or applications of biotechnology in medicine, agriculture (food, livestock, fisheries, algae, fungi, etc.),resistant varieties, bt crops ;emerging Techniques in biotechnology, genetic engineering, tools and steps, enzymes for ligation and cutting DNA, applications, Bioprocessing and fermentation technology, fermenters, primary and secondary metabolites, Biotechnology in medicine, antibiotics, vaccines, Animal biotechnology, better animal production, transgenic animals, Environmental biotechnology, waste management and treatment methods, Industrial and microbial biotechnology, single-cell proteins, bio-fertilizers, protection of biotechnological products; safety in biotechnology; public perception of biotechnology; biotechnology and ethics; biotechnology and the developing world. **Practical:** Laboratory safety: Containment and decontamination. An introduction to microscopy. Principles of Staining Procedures: Simple staining, Gram's staining, Acid-fast staining, cell-wall staining, flagellar staining, capsule staining, spore staining and spirochaete staining. Study of cell motility by hanging drop preparation. Preparation and sterilization of bacteriological media and glassware. Inoculation techniques. Study of colony characteristics of microorganisms. Enumeration of bacteria from milk, water, food, and soil by standard plate count technique (SPC) and/or most probable number technique (MPN). Microbiological analysis of air. Microscopic study of fungi isolated from air.	
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