Course Specification

(Postgraduate Programs)

Course Title:	Biological Treatment
Course Code:	BIO-6134
Program:	Master of Science in Applied Biology (Industrial and Environmental Biotechnology)
Department:	Biology
College:	Science
Institution:	Imam Mohammad Ibn Saud Islamic University
Version:	1
Last Revision Date:	*Pick Revision Date.*

Table of Contents

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A. General information about the course:

1. Course Identification:

1. Credit hours: 3 (Lecture 2+ Lab 2)

2. Course type

A.	☐University	☐College	☐Department	☒ Track
B.	☒ Required		☐ Elective	

3. Level/year at which this course is offered: (Level 1 / first year)

4. Course General Description:

This Biological Treatment course delves into the world of harnessing living organisms to clean up our environment. Since microorganisms can be used to treat pollution in water, soil, municipal and industrial effluents, and marine environments, we will begin by defining bioremediation and then delve into the wonderful workings of bioreactors - controlled environments. flocs bioreactors , membrane bioreactors, moving bed biofilm reactors and anaerobic bioreactors

We'll also learn about microbial communities that can disrupt treatment causing bulking , foaming and and deflocculation and how to keep them in check. This knowledge is essential for the design, operation and control of robust and efficient bioprocessing systems.

Beyond the walls of the bioreactor, we will explore how bioremediation addresses pollutants in diverse natural environments such as seas, soil, valleys and dams, and explore the versatility of this green technology.

The cycle doesn't stop there. You'll delve into concepts such as probiotic or bioaugmentation (boosting beneficial microbes), biostimulation (creating a friendly environment for them), and bioremediation (cleaning up the contamination). Learn how these technologies are applied in real-world scenarios, from remediating oil spills to restoring contaminated land.

For Master's students, this course is a passport to a cutting-edge field with huge potential. You will graduate not only with theoretical knowledge, but also with practical skills and insights to contribute to solving the environmental challenges we face. Imagine designing the next generation of bioremediation systems, or advising industries on sustainable waste management.

5. Pre-requirements for this course (if any):

6. Co-requisites for this course (if any):

7. Course Main Objective(s):

1- Understand the fundamentals of biotreatment: This includes its definition, principles, and various applications in different environments.

2- Gain in-depth knowledge of bioreactor systems: Explore the different types of bioreactors (flocs bioreactors , membrane bioreactors, moving bed biofilm reactors and anaerobic bioreactors and anaerobic), their operational principles, and factors influencing their effectiveness.

3- Master the diverse microbial communities within bioreactors: Identify both beneficial and harmful microorganisms, their roles in treatment, and strategies for optimal performance.

4- Learn about advanced biotreatment concepts: Understand the principles of bioaugmentation, biostimulation, and bioremediation and their practical applications in various environmental contexts.

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	-	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning	-	-
4	Distance learning	-	-

3. Contact Hours: (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	30
3.	**Field**	-
4.	**Tutorial**	-
5.	**Others (specify) .....**	
	Total	60

B. Course Learning Outcomes, Teaching Strategies, Assessment Methods

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	**Biological treatment Fundamentals:** Define and explain the concept of Biological treatment. Identify the different types of biological treatment processes and their applications. Understand the advantages and limitations of biological treatment technologies and systems. Explain the role of microorganisms in biological treatment and their metabolic pathways. Analyze the key factors influencing biotreatment performance (environmental factors and microbial community structure).		Two credits weekly lectures	-Quizzes -Presentations -Assignments -written exams
1.2	**Bioreactor Systems:** Design and differentiate between various types of bioreactors (flocs bioreactors , membrane bioreactors, moving bed biofilm reactors and anaerobic bioreactors and anaerobic).		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	Describe the operational principles of different bioreactor systems. Explain the mass transfer biological processes (oxygen, nutrients) within bioreactors.			
1.3	**Microbial Communities:** Identify and characterize different types of microorganisms involved in biotreatment processes. Explain the role of beneficial microbial communities in pollutant degradation. Analyze the potential impact of harmful microbial communities on treatment efficiency. Develop strategies for controlling harmful microbial populations and maintaining stable bioreactors. Evaluate the potential of bioaugmentation and biostimulation for enhancing treatment performance.		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams
1.4	**Advanced Biotreatment Concepts:** Assess the feasibility and limitations of biotreatment in various environmental contexts.		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	Describe emerging trends and future directions in biotreatment research and development.			
2.0	Skills			
2.1	Develop critical thinking and problem-solving skills: Apply your knowledge of biotreatment to analyze real-world scenarios and design appropriate solutions for polluted environments.		-Two credits weekly lectures -Tutorials	-Presentations -Assignments -written exams
2.2	Enhance technical skills: Understand bioreactor operation, data analysis, and interpretation of results related to biotreatment processes.		-Two credits weekly lectures -Tutorials	-Presentations -Assignments -written exams
2.3	Prepare for professional environments: Gain the knowledge and skills to contribute to research, development, and implementation of biotreatment technologies in various sectors, including environmental consulting, and waste management.		-Two credits weekly lectures -Tutorials	-Presentations -Reports
3.0	Values, autonomy, and responsibility			
3.1	**Values:** Environmental Stewardship: Understand the role of biological treatment in addressing environmental challenges and promoting sustainable practices. Ethical Decision-Making:		Group discussions	-Presentations -Reports

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	Apply ethical principles to biological treatment technology development and implementation, considering environmental impact, public safety, and social responsibility. Intergenerational Equity: Analyze the long-term consequences of biological treatment choices and prioritize solutions that benefit future generations.			
3.2	**Autonomy**: Critical Thinking and Problem-Solving: Develop independent thinking skills to assess biological treatment needs, evaluate different technologies, and propose innovative solutions. Research and Data Analysis: Conduct independent research using scientific methods, analyze data effectively, and draw informed conclusions about biotreatment performance. Adaptability and Lifelong Learning: Embrace the rapidly evolving field of biological treatment, adapt to new technologies and challenges, and commit to		Group discussions	-Presentations -Reports

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	continuous learning and professional development.			
3.3	**Responsibility**: Safety and Regulatory Compliance: Understand and adhere to safety regulations governing biological treatment practices, ensuring the well-being of humans and the environment. Resource Management: Optimize biological treatment processes for efficient resource utilization, minimizing energy consumption and waste generation. Public Communication and Advocacy: Effectively communicate the benefits and limitations of biotreatment to diverse audiences, promoting informed decision-making and public trust		Group discussions	-Presentations -Reports

C. Course Content:

No	List of Topics	Contact Hours
1.	**Introduction of Biological waste treatment**	4
2.	**Biological wastewater treatment bioreactors** - Sustention flocs bioreactors - Membrane bioreactors (MBR) - Moving bed biofilm bioreactors (MBBR)	8

	- Unwanted microbial communities in bioreactors, foam forming bacteria, bulk forming bacteria. - Undesirable microbial community behaviors, deflocculation and weakening of biodegradation. - anaerobic bioreactors	
3.	**Bioaugmentation, applications and limitations**	6
4.	**Microbes and Land Remediation and Detoxification**	8
5.	**Biostimulation** - Strategies for Biostimulation. - Synergy with Other Techniques.	6
Total		**30**

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Midterm exam-1**	5th week	20%
2.	**Midterm exam-2**	10th week	20%
3.	**Assignments, presentations, attendance, data search, participation**	Throughout the course duration	20%
4.	**Final exam**	16th week	40%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.)

E. Learning Resources and Facilities:

1. References and Learning Resources:

Essential References	1- Basile, A., & Gallucci, F. (Eds.) (2020). Current trends and future developments on (Bio-) membranes: Recent advances in

	metallic membranes. Elsevier. https://doi.org/10.1016/C2018-0-01769-7. 2- Maulin P. Shah. (2023).Microbial technologies in industrial wastewater treatment. Springer. https://doi.org/10.1007/978-981-99-2435-6. 3- Ravindra Soni., Deep Chandra Suyal., Lourdes Morales-Oyervides., & Mireille Fouillaud. (2023). Current Status of Marine Water Microbiology,Springer. https://doi.org/10.1007/978-981-99-5022-5 4- Davis Jenkins., Michael G. Richard., & Glen T. Daigger. Manual on the Causes and Control of Activated Sludge Bulking, Foaming, and Other Solids Separation Problems. (2004). CRC Press. **5-** Michael H. Gerardi . (2016) An Operator's Guide to Biological Nutrient Removal (BNR) in the Activated Sludge Process. Chemical Publishing Company
Supportive References	
Electronic Materials	
Other Learning Materials	

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	**Classroom**
Technology equipment (Projector, smart board, software)	**Projector, smart board**
Other equipment (Depending on the nature of the specialty)	

F. Assessment of Course Quality:

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Indirect
Effectiveness of students assessment	Faculty	Direct
Quality of learning resources	Faculty	Direct
The extent to which CLOs have been achieved	Faculty	Direct
Other		

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

-	**BIOLOGY DEPARTMENT COUNCIL**
REFERENCE NO.	**23**
DATE	**23/8/1445**