Course Specification

(Postgraduate Programs)

Course Title:	**Bioactive Natural Compounds**
Course Code:	**BIO-6000**
Program:	**Master of Science in Applied Biology (Cell and Molecular Biology)**
Department:	**Biology**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	**1**
Last Revision Date:	*Pick Revision Date.*

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عبد الملك بن عبد العزيز بن عبد الله الرحيلي الناصر

A. General information about the course:

1. Course Identification:

1. Credit hours: (Lecture 2 + Lab 0)				
2. Course type				
A.	☐University	☐College	☐ Department	☒ Track
B.	☐ Required		☒ Elective	
3. Level/year at which this course is offered: (undetermined level)				
4. Course General Description:				

This course describes the use of biologically active natural substances or molecules, including its relevance to bioscience and biotechnology. Classification of bioactive molecules, their necessity and purpose, and interpretation of their pharmacological activity are included. The course encompasses topics such as the origin of naturally occurring products, and the expression of activity of natural pharmaceutical drugs, basic chemical biology, and basic medicinal chemistry. The course topics include general applications of bioactive natural products and phytochemicals used in pharmaceuticals to treat numerous disease conditions. These natural chemicals protect against cancer through antioxidant and pro-oxidant actions and combat cancer via apoptosis and necrosis as well as modulation of the immune system. In addition, the course content describes trending topics including the antibacterial and antifungal effects of plant metabolites from tropical medicinal plants, molecular mechanistic actions, and the role of natural bioactive compounds as anti-diabetic agents, marine sources of pharmacological effects such as anti-cardiovascular, anti-coagulant, anti-obesity, bone growth, and healing. The course topics also provide basic knowledge regarding the natural biomaterials employed in genetic engineering.

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

None

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

None

7. Course Main Objective(s):

This course aims to offer students a thorough comprehension of various classifications of secondary metabolites, commonly known as natural compounds, produced by diverse plants, marine macro-organisms, and microbes. Additionally, the course explores the potential pharmaceutical applications of these natural compounds. Moreover, this

educational module offers students the opportunity to gain expertise in the methods of extraction, purification, and determination of structure, as well as performing bioassays to evaluate the biological characteristics of marine natural substances. The course objectives encompass the role of natural bioactive compounds in treating diabetes, cancer, cardiovascular diseases, and their activity as anticoagulants.

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**	-
3.	**Field**	-
4.	**Tutorial**	-
5.	**Others (specify) ……**	-
	Total	**30**

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods:

Code	Course Learning Outcomes	Code of CLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Outline the common bioactive natural compounds	K1	-Lectures -Tutorials	-Assignments -Class participation -Data search -Written exams

Code	Course Learning Outcomes	Code of CLOs aligned with the program	Teaching Strategies	Assessment Methods
1.2	Describe the general applications of bioactive natural compounds	K2	-Lectures -Tutorials	Assignments -Class participation -Data search -Written exams
1.3	Explain the major molecular mechanistic pathways of natural compounds	K3	-Lectures -Tutorials	Assignments -Class participation -Data search -Written exams
2.0	Skills			
2.1	Relate the chemistry of bioactive natural products to their applications	S1	-Lectures -Class discussions	-Class participation -Presentations -Data search -Written exams
2.2	Design and conduct research work on a bioactive natural compound in the area of cell and molecular biology by employing lab skills and convenient methods	S2	-Guided lab work	Presentations -Reports
2.3	Interpret and analyze the research results using critical	S3	-Group discussions	-Presentations -Reports

Code	Course Learning Outcomes	Code of CLOs aligned with the program	Teaching Strategies	Assessment Methods
	thinking and the appropriate analytical methods			
3.0	Values, autonomy, and responsibility			
3.1	Share in the discussion of scientific issues and submit the research data professionally via oral presentations and written formats	V1	-Group discussion	- Presentations -Reports
3.2	Perform the assigned work independently and collaborate effectively in a teamwork	V2	-Demonstrations of teamwork	Presentations -Reports
3.3	Adhere to the ethical rules and research principles while conducting research work in molecular biology	V3	-Lectures -Tutorials	-Reports

C. Course Content:

No	List of Topics	Contact Hours
1.	**An Introduction to Bioactive Natural Products and General Applications:** -Bioactive Natural Compounds: Distribution and Geographical Sources -Phytochemistry of Bioactive Natural Compounds	4
2.	**Metabolites from Plant Sources:** Comparison of Secondary Metabolites with Primary Metabolites Alkaloids ; Saponins; Phenolic Compounds; Terpenes and Terpenoids; Carbohydrates;Lipids; Glycosides	4
3.	**General Applications of Bioactive Natural Products**: -Traditional Medicine -Plant Polysaccharides in Pharmaceutical Applications	4
4.	**The Role of Phytochemicals in Cancer Prevention and Cure:** -Role of Phytochemicals in Cancer Prevention via Antioxidant Activity -Role of Phytochemicals in Cancer Prevention Via Pro-Oxidant Activity -Role of Phytochemicals in Cancer Cure Via Apoptosis Induction -Role of Phytochemicals in Cancer Cure Via Necrosis Induction	4
5.	**Natural Compounds Extracted from Medicinal Plants and Their Immunomodulatory Activities:** Plant-Derived Bioactive Compounds as Immunomodulators: Curcumin and Colchicine	2
6.	**Antibacterial and Antifungal Plant Metabolites from Tropical Medicinal Plants:** Target for Antimicrobial Agents and Resistance Mechanisms Tropical Plants with Relevant Antibacterial Activities	2
7.	**Antimicrobial Application of Phytoconstituents from Turmeric and Garlic:** -Phytochemistry of Turmeric: Antimicrobial Applications of Phytoconstituents from Turmeric -Phytochemistry of Garlic: Antimicrobial Mechanism of Phytochemicals of Garlic	2
8.	**Therapeutic Properties and Molecular Mechanisms of Carvacrol (Origanum vulgare):** -Extraction and Isolation of Carvacrol: Biosynthesis of Carvacrol -Anticancer Effect of Carvacrol and the Related Mechanism of Actions -Role of Natural Bioactive Compounds as Antidiabetic Agents	2
9.	**Mechanisms of Action of Antidiabetic Bioactive Substances**	2

10.	**Biological Activities of Marine Products and Nutritional Importance:** Marine Sources for Pharmacological Effect Anti-cancer.; Anti-Cardiovascular Effect ;Anti-coagulant Activity ; Anti-obesity ;Bone Growth and Healing	2
12.	**Cardiac Tissue Engineering:** A Role for Natural Biomaterials	
13.	**Extraction of Bioactive Natural Compounds**	2
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, Participation, Reports, data search, Attendance, presentations**	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	-Dilipkumar P, Nayak A K. (2021). Bioactive Natural Products for Pharmaceutical Applications. Advanced Structured Materials, Vol. 140. ISBN: 978-3-030-54027-2 (eBook) https://doi.org/10.1007/978-3-030-54027-2 -Sinha RP, Hader DP.(2020) Natural Bioactive Compounds, Technological Advancements. ISBN: 978-0-12-820655-3 https://www.sciencedirect.com/book/9780128206553/natural-bioactive-compounds
Supportive References	https://2u.pw/mqlCs8f
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 and Smartboard
Other equipment (Depending on the nature of the speciality)	

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	Indirect
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:

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

Course Specification

(Postgraduate Programs)

Course Title:	**Sustainable development and Environmental impact assessment**
Course Code:	**BIO-6001**
Program:	**Master of Science in Applied Biology (Industrial and Environmental Biotechnology & sustainability)**
Department:	**Biology**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	**1**
Last Revision Date:	*Pick Revision Date.*

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C. Course Content: ..... **Error! Bookmark not defined.**

D. Students Assessment Activities: 7

E. Learning Resources and Facilities: 7

F. Assessment of Course Quality: 9

G. Specification Approval Data: 9

A. General information about the course:

1. Course Identification:

1. Credit hours: 2 (Lecture 2+ Lab 0)				
2. Course type				
A.	☐University	☐College	☐Department	☒ Track
B.	☐ Required		☒ Elective	
3. Level/year at which this course is offered: (Undetermined level)				
4. Course general Description:				

This postgraduate course provides the candidates with the concepts of sustainable development and the processes involved in conducting Environmental Impact Assessments (EIAs). It provides students with the knowledge and skills necessary to evaluate the environmental, social, and economic impacts of development projects and to recommend sustainable practices. This interdisciplinary course offers a comprehensive exploration of sustainable development principles and the practices of Environmental Impact Assessment (EIA). It aims to equip students with an understanding of how sustainable development can be achieved in the context of various development projects and how these projects can be planned and executed with minimal environmental impact. The course delves into the concept of sustainable development, examining its historical context, theoretical underpinnings, and its practical application in various sectors. Students will explore the interplay between environmental, economic, and social pillars of sustainability, and understand how these pillars are integrated in the planning and execution of development projects. A significant focus of the course is on Environmental Impact Assessment - a critical tool used worldwide to predict and manage the environmental consequences of proposed projects. Students will learn about the different stages of EIA, including screening, scoping, impact analysis, mitigation, and monitoring. The course will also cover the legal and policy frameworks that govern EIAs in different contexts, both internationally and nationally. Throughout the course, emphasis will be placed on critical thinking, ethical considerations, and the development of practical skills necessary for conducting and evaluating environmental impact assessments. Students will engage with current debates and challenges in the field, preparing them for careers in environmental planning, policy-making, consultancy, and research in both the public and private sectors.

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

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

7. Course Main Objective(s):
The objective of this course is to provide the students with a with a comprehensive understanding of the theoretical foundations, practical skills, and applications of bioinformatics in the field of molecular biology and genomics. Through a combination of lectures, hands-on exercises, and projects, students will acquire various knowledge and skills.

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**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify) ……**	
	Total	30

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	**Understand the principles of sustainable development, methodologies used in environmental impact assessment.**		Two credits weekly lectures	-Quizzes -Presentations -Assignments -written exams
1.2	**Explore global challenges and sustainable development goals (SDGs)**		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams
1.3	**Explore types of EIAs and their scopes.**		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams
2.0	Skills			
2.1	**Analyze and structure the components of EIA report, and critical analysis of EIA reports.**		-Two credits weekly lectures -Tutorials	-Presentations -Assignments -written exams
2.2	**Apply tools for EIA reports**		-Two credits weekly lectures -Tutorials	-Presentations -Assignments -written exams
2.3	**Critically analysis of EIA reports.**		-Two credits weekly lectures -Tutorials	-Presentations -Reports
3.0	Values, autonomy, and responsibility			
3.1	**Show independence and responsibility and cooperate effectively in a team to carry out research work in Sustainability and resilience in project planning**		Group discussions	-Presentations -Reports
3.2	**Discuss the scientific issues and present research results via oral presentations and in written format.**		Group discussions	-Presentations -Reports

C. Course Content:

No	List of Topics	Contact Hours
1.	**Introduction to Sustainability** Concepts and definitions of sustainability Historical development of sustainability The three pillars of sustainability: Environmental, Social, and Economic Global sustainability challenges and responses	2
2.	**Principles of Sustainable Development** The Sustainable Development Goals (SDGs) Principles of sustainable development Case studies of sustainable development practices	2
3.	**Introduction to Environmental Impact Assessment (EIA)** History and evolution of EIA Purpose and importance of EIA Overview of the EIA process Types and scopes of EIAs	3
4.	**The EIA Process - Part 1** Screening and scoping in EIA Baseline environmental studies Identification of significant impacts Impact prediction and assessment Mitigation and management of impacts Environmental Management Plans (EMPs)	2
5.	**Legal and Policy Frameworks** International conventions and agreements National legislation and policies for EIA Compliance and enforcement in EIA	3
6.	**Social Impact Assessment and Community Engagement** Principles of Social Impact Assessment (SIA) Stakeholder identification and analysis Community engagement techniques	2
7.	**Environmental Monitoring and Auditing** Post-EIA monitoring Environmental auditing and compliance monitoring Adaptive management in EIA	2

8	**Sustainable Project Management** Integration of sustainability into project management Tools and techniques for sustainable decision-making Case studies in sustainable project management	2
9	**Advanced Topics in EIA** Strategic Environmental Assessment (SEA) Cumulative impact assessment Climate change and EIA	2
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	• **Robertson, M. (2021). Sustainability Principles and Practice (3rd ed.). Routledge. https://doi.org/10.4324/9780429346668** • **Arjun Kumar A. Rathi (2021). Handbook of Environmental Impact assessment: Concepts and Practice. Cambridge Scholars Publishing** • **Hanna, K. S. (Ed.). (2022). Routledge handbook of environmental impact assessment. Routledge.**
Supportive References	• **IISD's EIA Online Learning Platform: This platform provides a comprehensive overview of Environmental Impact Assessment (EIA), including its history, approaches, key steps, and case studies. It is designed for EIA trainers, policy-makers, developers, and students. The content is adapted from resources published by the**

	United Nations University, UNEP, and RMIT University, making it a valuable resource for both beginners and experienced professionals. You can explore this resource at IISD's EIA Online Learning Platform. • UNEP's Massive Open Online Courses: The United Nations Environment Programme (UNEP) offers a variety of online courses on critical environmental issues. These courses cover topics such as nature-based solutions for disaster and climate resilience, marine litter, and the Source-to-Sea approach. These courses are suitable for a wide range of audiences, including those without an environmental background. More information is available on UNEP's website. • Alison's Principles of Environmental Impact Assessments: This free online course covers the fundamental principles of EIA and their role in sustainable development. It includes topics like legal and regulatory frameworks, EIA methodologies, public participation, and crafting effective environmental management plans. The course also provides practical insights into EIA review, auditing, decision-making practices, and real-world case studies. You can start this course at Alison's website. • FutureLearn's Environmental Impact Assessment (EIA) Course: Hosted by The University of Adelaide, this course on FutureLearn guides learners through the EIA process and its alignment with community engagement. It's a skill-oriented course designed for environmental professionals and those seeking to advance their knowledge and career. The syllabus covers the history and principles of impact assessment, different forms of assessments, and practical case studies. You can enroll in this course at FutureLearn's website.
Electronic Materials	
Other Learning Materials	

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities	Classroom

Items	Resources
(Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	
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:

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

Course Specification

(Postgraduate Programs)

Course Title:	**Vaccine Development**
Course Code:	**BIO-6032**
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.*

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A. General information about the course: 3

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods: ..... **Error! Bookmark not defined.**

C. Course Content: ..... **Error! Bookmark not defined.**

D. Students Assessment Activities: 13

E. Learning Resources and Facilities: 13

F. Assessment of Course Quality: 14

G. Specification Approval Data: 14

A. General information about the course:

1. Course Identification:

1. Credit hours: 2 (Lecture 2 + lab 0)

2. Course type

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

3. Level/year at which this course is offered: (Undetermined level)

4. Course general Description:

In this course, as an introduction, we will explore why vaccination is important for yourself, your family and community.
This course delves into the critical biological tools and techniques used to develop vaccines manufacturing.
Unravel the secrets of how vaccines work and their impact on herd immunity, who cannot have vaccines and side effects of vaccination.
discovering what's in a vaccine (ingredients), how vaccine's safety is thoroughly tested using bioassays (testing on living organisms) before pass for approval.
Master the art of the vaccines manufacturing: Learn about the diverse approaches of vaccine types (Pathogen-Based Vaccines, Viral-Vector-Based Vaccines, Nucleic Acid–Based Vaccines, Protein-Based Vaccines), and explore model test systems like bacteria, algae, and invertebrates. Learn about the advances in genetic engineering in the improvements of vaccine design and strategies e.g. recombinant subunit vaccines as an emerging technology to prevent diseases spreading.
Dive into the realm of antigen display systems such as VLPs or those designed by nanotechnology as well as the innate RNA interference (RNAi) mechanism and their role in improving the efficacy of subunit vaccines. Shedding light on platforms used in production of recombinant vaccines from the first hosts such as *Escherichia coli* and *Saccharomyces cerevisiae*, to insect or mammalian cells.
Learn about the challenges and hurdles that are facing vaccines commercialization and seeking for saving a low-cost platform for vaccines production. Addressing some infectious diseases that still do not have a treatment and may create possible future pandemics such as COVID-19 induced by the SARS-CoV-2.
By the end of this course, you will be equipped to:
Apply biomonitoring tools and techniques used to produce Infectious-disease vaccines.
Interpret and communicate pathogen-derived future pandemics for informed decision-making.
Contribute to the development and implementation of strategies for society health protection and risk mitigation.
This course is ideal for anyone interested in medical science, biology, molecular biology, drug delivery and public health.

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

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

7. Course Main Objective(s):

1-Understand the importance of vaccines and its impacts on human public health, and define the effect of vaccine design, delivery, and dynamics on its therapeutic effect.

2-Master the concepts and applications of techniques used in production of Infectious-disease vaccines at the national and international levels.

3- Recognize types of recombinant vaccines using various hosts such as *Escherichia coli* and *Saccharomyces cerevisiae*, to insect or mammalian cells.

3-Gain in-depth knowledge of new different strategies for vaccines developments such as Pathogen-Based Vaccines, Viral-Vector-Based Vaccines, Nucleic Acid–Based Vaccines, Protein-Based Vaccines).

4- Discover the potential and limitations of nanotechnology and RNAi applications in development of front-line therapies against viruses and pathogen-derived diseases.

5-Analyze the specific challenges and approaches for vaccines commercialization and seeking for saving a low-cost platform for possible future pandemics.

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**	-
3.	**Field**	-
4.	**Tutorial**	-
5.	**Others (specify) .....**	
	Total	30

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	**Vaccines Essentials:** Define and explain the key concepts of vaccines. Identify different types of pathogen-derived diseases and history of vaccines production. Analyze the mode of action of Infectious-disease vaccines in living organisms. Assess the potential health impacts of vaccines on individuals and community. Evaluate the regulatory frameworks and policies		Two credits weekly lectures	-Quizzes -Presentations -Assignments -written exams

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	pertaining to vaccines development and infectious-disease risk management.			
1.2	**Vaccines properties and effectiveness:** Explain the principles and applications of vaccines for the combating infectious pathogens. Define the effect of vaccine design, delivery, and dynamics on its therapeutic effect. Differentiate between different types of pathogen-based vaccines as drug and the routes of administration. Describe the components and implementation of different types of vaccines. Define new different strategies for vaccines developments such as pathogen-based vaccines, viral-vector-based vaccines, nucleic acid–based vaccines, protein-based vaccines). Evaluate the strengths and limitations of nanotechnology and RNAi applications in development of vaccines		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams
1.3	**Key Aspects in Vaccine Design:** Define the key aspects of vaccine design and their effectiveness in the target populations. The use of animal		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	models that accurately mimic human disease. Explain the emerging technologies in nonviral vaccine development. Recognize and comprehend the Virus-Like Particle and Nanoparticle Subunit Vaccines and DNA and RNA Vaccines			
1.4	**New Strategies for Vaccine Development** Identify different technologies used in vaccines manufacturing (Pathogen-Based Vaccines, Viral-Vector-Based Vaccines and Nucleic Acid–Based Vaccines) Evaluate the pros and cons of each		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams
1.5	**Specific Technologies:** Recognize new technologies such Nanotechnology applied to subunit vaccines (VLPs and Small Subviral Particles, Ferritin Cages, Vault Particles, Encapsulins, In Silico Designed Nanoparticles and innate RNA interference (RNAi) mechanisms. Explain the traditional platforms for protein vaccine manufacturing (Bacteria (E. coli, Yeast, Insect cell, Mammalian Cells) and recognizing types of recombinant vaccines using various hosts		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams
2.0	Skills			

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
2.1	**Vaccines Design and Implementation:** Design and implement appropriate vaccine strategy for addressing some infectious diseases. Select and adapt suitable bioassays vaccine's delivery components to key immune cells and lymphoid tissues. Perform basic bioassay procedures and laboratory techniques for vaccines effectiveness. Maintain accurate records and document biomonitoring activities as per scientific standards.		-Two credits weekly lectures -Tutorials	-Presentations -Assignments -written exams
2.2	**Data Analysis and Interpretation:** Analyze bioassay and results using appropriate statistical tools and software. Interpreting bioassay results in the context of established drug delivery and immunization knowledge and relevant published data. Identify and analyze potential confounding factors and limitations in biomonitoring data. Draw conclusions and inferences from biomonitoring studies to inform health risk assessment and management decisions.		-Two credits weekly lectures -Tutorials	-Presentations -Assignments -written exams

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
2.3	**Critical Thinking and Problem-Solving:** Critically evaluate existing knowledge and apply it to address future pandemic challenges. Develop creative solutions for Improving vaccines development strategies and interpretation of data. Recognize ethical considerations and potential biases in drug delivery research and data analysis. Contribute to the advancement of bioassay techniques and technologies for production of effective vaccines and evaluating risk assessment		-Two credits weekly lectures -Tutorials	-Presentations -Reports
2.4	**Continuous Learning and Professional Development:** Stay updated with the latest advancements in vaccines emerging technologies, bioassay techniques, and vaccines design, delivery, and dynamics. Seek out opportunities for professional development and collaboration with other professionals in biotechnology engineering. Adapt and expand student's skillset to address emerging universal challenges and contribute to innovative solutions			

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
3.0	Values, autonomy, and responsibility			
3.1	**Values** Biotechnological Stewardship: Develop an understanding of the intrinsic value of vaccines and a commitment to their development for effective therapeutic effect. Sustainability: Integrate principles of sustainability into bioassay practices, considering long-term consequences and challenges provoked by future pandemics. Precautionary Principle: Apply the precautionary principle when assessing potential contagious pathogens, favoring caution and protective measures even in the face of uncertainty. Social Justice: Recognize the unequal distribution of pathogenicity risks and advocate for equitable access to safe environments for all communities.		Group discussions	-Presentations -Reports
3.2	**Autonomy**: Critical Thinking and Problem-Solving: Foster independent thinking skills for evaluating bioassay data, interpreting results, and proposing innovative solutions to health risk challenges. Scientific Integrity: Uphold the principles of scientific integrity by		Group discussions	-Presentations -Reports

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	conducting research with honesty, transparency, and accountability. Lifelong Learning: Develop a passion for continuous learning and self-directed research to stay current with advances in biotechnological knowledge and techniques. Professional Communication: Hone effective communication skills to share complex infectious disease control and drug delivery data and analyses with diverse audiences, influencing informed decision-making.,			
3.3	**Responsibility**: Data Quality and Ethics: Ensure adherence to ethical research practices and maintain lofty standards of data quality control throughout the bioassay process. Risk Communication: Effectively communicate risks and uncertainties associated with infectious diseases control to stakeholders, empowering them to make informed decisions about their health and environment. Policy Advocacy: Engage in responsible advocacy for effective biotechnological and drug delivery policies and regulations based on sound scientific evidence, promoting informed risk management strategies.		Group discussions	-Presentations -Reports

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	Professional Accountability: Recognize and take responsibility for the potential impacts of biomonitoring activities on the human health and surrounding communities.			

C. Course Content:

No	List of Topics	Contact Hours
1	Introduction on vaccines and its impacts on public health, principles of structure-based vaccine design, mode of action of vaccines and their impact on herd immunity, who cannot have vaccines and side effects of vaccination.	3
2	Key Aspects in vaccine design, delivery, and dynamics and their effects on therapeutic efficiency.	3
3	Novel strategies for vaccine development (Pathogen-Based Vaccines, Viral-Vector-Based Vaccines and Nucleic Acid–Based Vaccines)	3
4	Nanotechnology applied to subunit vaccines (VLPs and Small Subviral Particles, Ferritin Cages, Vault Particles, Encapsulins, In Silico Designed Nanoparticles and innate RNA interference (RNAi) mechanisms	3
5	Traditional platforms for protein vaccine manufacturing (Bacteria (*E. coli*, Yeast, Insect cell, Mammalian Cells) and recognizing types of recombinant vaccines using various hosts	3
6	Alternative platforms for protein vaccine manufacturing (Non–E. coli Bacterial Systems, New Approaches in Yeast Platform, Transgenic Animals, Insects, Plant-Based Systems and Microalgae.	3
7	Recent applications of structure-based vaccine-design principles (e.g. SARS-CoV-2, Influenza virus, Nipah virus, Human metapneumovirus F, Ebola, and Marburg viruses and RNAi based vaccines for covid-19	3
8	Challenges and approaches of vaccines commercialization and assessment of vaccines safety	3

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- Arpagaus, C. (2023). *Spray drying of vaccines: from laboratory research to industrial applications*. Springer Nature. 2- Mao, H. H., & Chao, S. (2020). Advances in vaccines. *Current Applications of Pharmaceutical Biotechnology*, 155-188. 3- Orenstein, W., Offit, P. A., Edwards, K. M., & Plotkin, S. A. (2017). *Vaccines E-Book*. Elsevier Health Sciences. 4- Giese, M. (2013). *Molecular Vaccines*. Springer.
Supportive References	
Electronic Materials	Tizard, I. R. (2019). *Vaccines for Veterinarians E-Book*. Elsevier Health Sciences.
Other Learning Materials	

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	**Classroom**

Items	Resources
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:

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

Course Specification

(Postgraduate Programs)

Course Title:	**Photobiology and photobiostimulation**
Course Code:	**BIO-6034**
Program:	**Master of Science in Applied Biology (Industrial and Environmental Biotechnology & Sustainability)**
Department:	**Biology**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	**1**
Last Revision Date:	*Pick Revision Date.*

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A. General information about the course: 3

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods: ..... **Error! Bookmark not defined.**

C. Course Content: ..... **Error! Bookmark not defined.**

D. Students Assessment Activities: 7

E. Learning Resources and Facilities: 7

F. Assessment of Course Quality: 8

G. Specification Approval Data: 8

A. General information about the course:

1. Course Identification:

1. Credit hours: 2(Lecture 2 + Lab 0)				
2. Course type				
A.	☐ University	☐College	☐Department	☒ Track
B.	☐ Required		☒ Elective	
3. Level/year at which this course is offered: (Undetermined level)				
4. Course general Description:				

This postgraduate course provides the candidates with a comprehensive understanding of the interaction between biological systems and light. Gain a solid foundation in the basic principles of photobiology, including the nature of light, its properties, and its interactions with biological molecules. Understand the molecular mechanisms by which organisms, including plants, perceive and respond to light. This may involve studying photoreceptor proteins and their roles in signal transduction. Photosynthesis and Light Reactions: Explore the role of light in photosynthesis, including the absorption of light by pigments, the light-dependent reactions, and the synthesis of ATP and NADPH. Investigate how organisms, from bacteria to plants and animals, exhibit specific responses to light stimuli. This includes phototropism, circadian rhythms, and photomorphogenesis. Learn about the applications of photobiology in medicine, such as the use of light in photodynamic therapy and the effects of light on human health, including circadian rhythm regulation. Explore how light influences ecological processes, including the adaptation of organisms to different light conditions, the role of light in ecosystems, and the impact of light pollution. Delve into specialized areas of photobiology, such as the study of UV radiation effects, photorepair mechanisms, and the use of light in biotechnology and agriculture. Acquire hands-on experience with laboratory techniques used in photobiological research. This may include spectrophotometry, fluorescence analysis, and other methods for studying light-matter interactions. Recognize the interdisciplinary nature of photobiology and its connections to other scientific disciplines, such as physics, chemistry, and environmental science.

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

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

7. Course Main Objective(s):

The objective of this course is to provide the students with a fundamental theoretical understanding of This postgraduate course provides the candidates with a comprehensive understanding of the interaction between biological systems and light. Gain a solid foundation in the basic principles of photobiology, including the nature of light, its properties, and its interactions with biological molecules.

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**	-
3.	**Field**	-
4.	**Tutorial**	-
5.	**Others (specify) ……**	
	Total	30

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	**Distinguish the photobiology and its significance to plants, light spectrum, and wavelengths.**		Two credits weekly lectures	-Quizzes -Presentations -Assignments -written exams

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.2	**Understanding plant photoreceptors including phytochrome, cryptochromes, and phototropins.**		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams
1.3	**Outline the structure and organization of photosynthetic pigments, light harvesting complexes.**		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams
2.0	Skills			
2.1	**Interpret and analyze the role of light wavelengths on plants growth and development.**		-Two credits weekly lectures -Tutorials	-Presentations -Assignments -written exams
2.2	**Relate between the light stress and photoprotection mechanisms in plants, ROS and antioxidants defense.**		-Two credits weekly lectures -Tutorials	-Presentations -Assignments -written exams
2.3	**Design a research study in photobiology and photobiostimulation using critical thinking and the acquired skills**		-Two credits weekly lectures -Tutorials	-Presentations -Reports
3.0	Values, autonomy, and responsibility			
3.1	**Show independence and responsibility and cooperate effectively in a team to carry out research work on Photobiology**		Group discussions	-Presentations -Reports
3.2	**Discuss the scientific issues and present research results via oral presentations and in written format.**		Group discussions	-Presentations -Reports

C. Course Content:

No	List of Topics	Contact Hours
1.	**Fundamental principles on Photobiology:** • Overview of photobiology and its significance in plants • Historical development and key milestones in plant photobiology • Introduction to light as a crucial environmental factor for plants • Light spectrum, wavelengths, and their effects on plant growth and development	3
2.	**The Photoreceptors in plants** • Understanding plant photoreceptors: phytochromes, cryptochromes, phototropins, and others • Molecular mechanisms of photoreceptor action • Signal transduction pathways in response to light signals • Role of photoreceptors in various plant processes, such as seed germination, flowering, and phototropism	4
3.	**Photosynthesis and light harvesting** • Photosynthetic pigments and their absorption spectra • Light-dependent reactions in photosynthesis • Light harvesting complexes and their role in capturing light energy •Regulation of photosynthesis by light intensity and quality	4
4.	**Light and Plant development** • Photomorphogenesis: light-induced changes in plant development • Photoperiodism and its significance in flowering • Circadian rhythms in plants	4
5.	**Light Stress and Plant Responses:** • Effects of light stress on plant growth and development • Photoprotection mechanisms in plants • Reactive oxygen species (ROS) and antioxidant defenses • Role of light in abiotic stress responses.	3
6.	**Advanced Topics in Plant Photobiology:** • Light signaling networks in plants • Recent research and advancements in plant photobiology • Applications of plant photobiology in agriculture and horticulture • Future directions in plant photobiology research	4
7.	**Review and Synthesis:** • Recap of key concepts and topics covered throughout the course • Discussion of recent research papers in plant photobiology	2

	• Integration of plant photobiology principles into broader aspects of plant biology	
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	*Björn LO (ed) (2015) Photobiology. Springer New York, New York, NY. https://link.springer.com/book/10.1007/978-0-387-72655-7 * McDonald, M. S. (2003). Photobiology of higher plants. J. Wiley. Giese, A. C. (2013). Photophysiology: Current topics in photobiology and photochemistry (Vol. 6). Elsevier. *Whitelam, G. C., & Halliday, K. J. (Eds.). (2010). Plant Photobiology: Theoretical Principles and Experimental Approaches. Berlin: Springer. * Nicholls, D. G., & Ferguson, S. J. (2013). Bioenergetics (4th edition). Academic Press, Elsevier..
Supportive References	https://www.photobiology.eu/photobiology-school
Electronic Materials	**https://www.photobiology.eu/photobiology-school** **http://photobiology.info/Chalker-Scott.html**
Other Learning Materials	

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities	**Classroom, Field**

Items	Resources
(Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	
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:

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

Course Specification

(Postgraduate Programs)

Course Title:	**Plant Environmental Physiology**
Course Code:	**BIO-6036**
Program:	**Master of Science in Applied Biology (Industrial and Environmental Biotechnology & sustainability)**
Department:	**Biology**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	**1**
Last Revision Date:	*Pick Revision Date.*

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C. Course Content: ..... **Error! Bookmark not defined.**

D. Students Assessment Activities: 7

E. Learning Resources and Facilities: 7

F. Assessment of Course Quality: 8

G. Specification Approval Data: 9

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A. General information about the course:

1. Course Identification:

1. Credit hours: 2 (Lecture 2 + Lab 0)

2. Course type

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

3. Level/year at which this course is offered: (Undetermined level)

4. Course general Description:

This postgraduate course provides the candidates with a deep understanding of how plants respond to and interact with their environment. Understand the basic principles of plant environmental physiology. Comprehend the importance of studying plant responses to environmental factors for agriculture, ecology, and conservation. Analyze how plants uptake, transport, and utilize water. Evaluate adaptations of plants to water stress and different soil conditions. Grasp the processes involved in photosynthesis. Understand how light influences plant growth and development. Analyze how plants optimize photosynthesis under different light conditions. Examine the effects of temperature on plant growth and metabolism. Evaluate plant responses to cold and heat stress. Understand photoperiodic responses and vernalization. Explore nutrient uptake and transport mechanisms. Analyze the role of essential nutrients in plant growth and development. Identify nutrient deficiencies and toxicities in plants. Analyze plant interactions with pathogens and pests. Understand plant defense mechanisms and responses to herbivory. Explore symbiotic relationships that benefit plant health. Examine how environmental cues influence plant development. Understand the role of plant hormones in growth and responses to stimuli. Explore the molecular mechanisms underlying plant responses to environmental signals. Recognize the impact of climate change on plants. Understand how pollution affects plant physiology. Explore conservation strategies and sustainable practices in the context of plant environmental physiology. Develop critical thinking skills in analyzing complex physiological processes. Apply knowledge to solve problems related to plant responses to environmental challenges. Conduct independent research on specific aspects of plant environmental physiology. Effectively communicate research findings through presentations and reports. Understand the implications of plant environmental physiology in addressing global challenges such as food security and biodiversity conservation. Gain hands-on experience through laboratory work, field studies, and experiments. Apply theoretical knowledge to practical situations.

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

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

7. Course Main Objective(s):

The objective of this course is to provide the students with a fundamental theoretical understanding of complex Epigenetic Phenomena. The course familiarizes the student with the current technology and drives principles of epigenetics. Among the course aims is to allow the students to identify the state-of-the-art experimental approaches in "Epigenetics and Chromatin Research".

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**	-
3.	**Field**	-
4.	**Tutorial**	-
5.	**Others (specify) .....**	
	Total	30

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	**Distinguish principles of plant environmental physiology, importance of studying plants responses to environmental factors for agriculture, ecology, and conservation**		Two credits weekly lectures	-Quizzes -Presentations -Assignments -written exams
1.2	**List the various water relations in plants, nutrient acquisition, metabolism, environmental signals and plant development**		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams
1.2	**Outline the global environmental issues, climate change, understand how pollution affect plants physiology.**		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams
2.0	Skills			
2.1	**Interpret and analyze how plants uptake, transport, and utilize water.**		-Two credits weekly lectures -Tutorials	-Presentations -Assignments -written exams
2.2	**Relate between various environmental stimuli and plants response and metabolism including biotic and abiotic**		-Two credits weekly lectures -Tutorials	-Presentations -Assignments -written exams
2.3	**Design a research study in plant environmental physiology using critical thinking and the acquired skills**		-Two credits weekly lectures -Tutorials	-Presentations -Reports
3.0	Values, autonomy, and responsibility			
3.1	**Show independence and responsibility and cooperate**		Group discussions	-Presentations -Reports

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	effectively in a team to carry out research work			
3.2	**Discuss the scientific issues and present research results via oral presentations and in written format.**		Group discussions	-Presentations -Reports

C. Course Content:

No	List of Topics	Contact Hours
1.	**Fundamental Concepts:** Understand the basic principles of plant environmental physiology. Comprehend the importance of studying plant responses to environmental factors for agriculture, ecology, and conservation. Water Relations: Analyze how plants uptake, transport, and utilize water. Evaluate adaptations of plants to water stress and different soil conditions.	4
2.	**Photosynthesis and Light Responses:** Grasp the processes involved in photosynthesis. Understand how light influences plant growth and development. Analyze how plants optimize photosynthesis under different light conditions.	4
3.	**Temperature Responses:** Examine the effects of temperature on plant growth and metabolism. Evaluate plant responses to cold and heat stress. Understand photoperiodic responses and vernalization.	3
4.	**Environmental Signals and Plant Development:** Examine how environmental cues influence plant development. Understand the role of plant hormones in growth and responses to stimuli. Explore the molecular mechanisms underlying plant responses to environmental signals.	4
5.	**Global Environmental Issues:** Recognize the impact of climate change on plants. Understand how pollution affects plant physiology.	3

	Explore conservation strategies and sustainable practices in the context of plant environmental physiology.	
6.	**Critical Thinking and Problem-Solving:** Develop critical thinking skills in analyzing complex physiological processes. Apply knowledge to solve problems related to plant responses to environmental challenges.	4
7.	**Research and Presentation skills** Conduct independent research on specific aspects of plant environmental physiology. Effectively communicate research findings through presentations and reports**.**	2
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	Lincoln Taiz, Ian Max Moller, Angus Murphy, Eduardo Zieger (2022). Plant Physiology and Development. Sinauer Associates. Taiz, Lincoln, and Eduardo Zeiger. Plant Physiology. Sinauer Associates, 2010. Fitter, A. H., & Hay, R. K. M. (2002). Environmental Physiology of Plants. Academic Press. Wünschiers, R. (2013). Computational Biology: A Practical Introduction to BioData Processing and Analysis with Linux, MySQL, and R. Wiley-Blackwell.

Supportive References	1. **Plant Physiology Online (American Society of Plant Biologists)** • Offers a variety of educational resources, including animations, teaching tools, and articles. (https://plantae.org/education/) 2. **NCBI Bookshelf - Plant Physiology Section** • Provides access to various online books related to plant physiology. (https://www.ncbi.nlm.nih.gov/books/) 3. **BioMan Biology: Plant Physiology Simulations** • Interactive simulations and virtual experiments for plant physiology concepts. (https://biomanbio.com/HTML5Simulations/plantPhysMain.html) 4. **Virtual Plant Cell (University of North Carolina)** • An interactive resource providing insights into plant cell structure and function. (https://www.bio.unc.edu/faculty/hugheslab/vpc/vpc.htm)
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:

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

Course Specification

(Postgraduate Programs)

Course Title:	**Biomonitoring of Ecotoxicological Risks**
Course Code:	**BIO-6038**
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.***

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A. General information about the course: 3

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods: 4

C. Course Content: 4

D. Students Assessment Activities: 5

E. Learning Resources and Facilities: 5

F. Assessment of Course Quality: 5

G. Specification Approval Data: 6

A. General information about the course:

1. Course Identification:

1. Credit hours: 2(Lecture 2 + lab 0)

2. Course type

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

3. Level/year at which this course is offered: (Undetermined level)

4. Course general Description:

in this course, as an introduction, we will explore the impact of environmental toxins on living organisms and ecosystems.
This course delves into the critical biological tools and techniques used to monitor and assess these risks.
Unravel the secrets of biomonitoring: Discover how we use both community surveys (observing ecological changes) and bioassays (testing on living organisms) to measure the presence and impact of toxins.
Master the art of the bioassay: Learn about the diverse range of bioassays, from assessing genotoxicity (DNA damage) to cytotoxicity (cell damage), and explore model test systems like bacteria, algae, and invertebrates.
Dive into the realm of biomarkers: Uncover the powerful tools known as biomarkers, which act as early warning signals for environmental toxicity within organisms. You'll explore different types of biomarkers, from genetic alterations to cellular stress responses.
Shine a light on environmental genotoxicity and cytotoxicity: Investigate the specific biomarkers used to track these forms of cellular damage caused by environmental toxins.
Confront the silent threat of radiation: Learn about the unique challenges of monitoring radiation pollution and the specific biomarkers employed to assess its impact.
Embrace the future with "Omics" technologies: Discover cutting-edge tools like genomics, transcriptomics, and proteomics that are revolutionizing our understanding of ecotoxicological risks.
By the end of this course, you will be equipped to:
Apply biomonitoring tools and techniques to assess environmental health.
Interpret and communicate complex ecotoxicological data for informed decision-making.
Contribute to the development and implementation of strategies for environmental protection and risk mitigation.
This course is ideal for anyone interested in environmental science, biology, toxicology, or public health.

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

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

7. Course Main Objective(s):

1-Understand the key principles of ecotoxicology and its implications for environmental health.

2-Master the concepts and applications of biomonitoring tools, including bioassays and community surveys, for assessing ecotoxicological risks.

3-Gain in-depth knowledge of different types of bioassays used to measure genotoxicity, cytotoxicity, and other cellular responses to environmental toxins.

4-Explore the diverse range of biomarkers available for detecting and monitoring environmental toxicity in organisms.

5-Analyze the specific challenges and approaches for assessing environmental genotoxicity, cytotoxicity, and radiation exposure using biomarkers.

6-Discover the potential and limitations of emerging "Omics" technologies in ecotoxicological risk assessment

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**	-
3.	**Field**	-
4.	**Tutorial**	-

5.	**Others (specify) ……**	
	Total	30

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	**Ecotoxicology Essentials:** Define and explain the key concepts of ecotoxicology. Identify different types of environmental toxins and their sources. Analyze the pathways of exposure and mechanisms of action of environmental toxins in living organisms. Assess the potential health impacts of environmental toxins on individuals and ecosystems. Evaluate the regulatory frameworks and policies pertaining to ecotoxicological risk management.		Two credits weekly lectures	-Quizzes -Presentations -Assignments -written exams
1.2	**Biomonitoring Tools and Techniques:** Explain the principles and applications of biomonitoring for assessing ecotoxicological risks. Differentiate between community surveys and bioassays as biomonitoring methods.		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 design and implementation of different types of bioassays (acute, chronic, genotoxicity, cytotoxicity). Interpret and analyze bioassay data to assess the toxicity of environmental samples. Evaluate the strengths and limitations of various biomonitoring tools for specific environmental contexts.			
1.3	**Bioassay and Biomarker Expertise:** Define and classify bioassays based on their target organisms, endpoints, and applications. Explain the basic principles of cell biology and toxicology underlying bioassay responses (genotoxicity, cytotoxicity). Differentiate between biomarkers of exposure, effect, and susceptibility. Identify and characterize different types of biomarkers used in ecotoxicological risk assessment (genetic, protein, enzymatic). Interpret and analyze biomarker data to assess the presence and impact of environmental toxins in individual organisms and populations.		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams
1.4	**Environmental Genotoxicity and Cytotoxicity:**		Two credits weekly lectures	Quizzes -Presentations -Assignments

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	Explain the mechanisms of genotoxicity and cytotoxicity induced by environmental toxins. Identify specific biomarkers used to detect and quantify environmental genotoxicity (DNA damage, mutations). Analyze the effects of environmental cytotoxicity on cell function and viability. Evaluate the potential consequences of genotoxicity and cytotoxicity for individual organisms and ecosystems.			-written exams
1.5	**Specific Threats and Technologies:** Explain the unique challenges of monitoring and assessing the impact of environmental radiation using biomarkers. Describe the principles and applications of "Omics" technologies (genomics, transcriptomics, proteomics) in ecotoxicological risk assessment. Evaluate the potential of "Omics" technologies for improving sensitivity, specificity, and early detection of environmental toxicity.		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams
2.0	Skills			
2.1	**Biomonitoring Design and Implementation:** Design and implement appropriate biomonitoring strategies for specific		-Two credits weekly lectures -Tutorials	-Presentations -Assignments -written exams

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	environmental concerns and contaminants. Select and adapt suitable bioassays and biomarker analyses based on the environmental context and research goals. Collect and process environmental samples using proper protocols to ensure data integrity. Perform basic bioassay procedures and laboratory techniques for biomarker analysis. Maintain accurate records and document biomonitoring activities as per scientific standards.			
2.2	**Data Analysis and Interpretation:** Analyze bioassay and biomarker data using appropriate statistical tools and software. Interpret biomonitoring results in the context of established ecotoxicological knowledge and relevant environmental guidelines. Identify and analyze potential confounding factors and limitations in biomonitoring data. Draw conclusions and inferences from biomonitoring studies to inform environmental risk assessment and management decisions.		-Two credits weekly lectures -Tutorials	-Presentations -Assignments -written exams

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
2.3	**Critical Thinking and Problem-Solving:** Critically evaluate existing knowledge and apply it to address new ecotoxicological challenges. Develop creative solutions for improving biomonitoring strategies and interpretation of data. Recognize ethical considerations and potential biases in environmental research and data analysis. Contribute to the advancement of biomonitoring techniques and technologies for effective ecotoxicological risk assessment		-Two credits weekly lectures -Tutorials	-Presentations -Reports
2.4	**Continuous Learning and Professional Development:** Stay updated with the latest advancements in ecotoxicology, biomonitoring techniques, and "Omics" technologies. Seek out opportunities for professional development and collaboration with other ecotoxicologists and environmental professionals. Adapt and expand your skillset to address emerging environmental challenges and contribute to innovative solutions			
3.0	Values, autonomy, and responsibility			
3.1	**Values**		Group discussions	-Presentations -Reports

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	Environmental Stewardship: Develop an understanding of the intrinsic value of ecosystems and a commitment to their protection from ecotoxicological threats. Sustainability: Integrate principles of sustainability into biomonitoring practices, considering long-term consequences and minimizing environmental impact. Precautionary Principle: Apply the precautionary principle when assessing potential ecotoxicological risks, favoring caution and proactive measures even in the face of uncertainty. Social Justice: Recognize the unequal distribution of environmental risks and advocate for equitable access to safe environments for all communities.			
3.2	**Autonomy**: Critical Thinking and Problem-Solving: Foster independent thinking skills for evaluating biomonitoring data, interpreting results, and proposing innovative solutions to environmental challenges. Scientific Integrity: Uphold the principles of scientific integrity by conducting research with honesty, transparency, and accountability. Lifelong Learning: Develop a passion for continuous learning		Group discussions	-Presentations -Reports

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	and self-directed research to stay current with advances in ecotoxicological knowledge and techniques. Professional Communication: Hone effective communication skills to share complex ecotoxicological data and analyses with diverse audiences, influencing informed decision-making.,			
3.3	**Responsibility**: Data Quality and Ethics: Ensure adherence to ethical research practices and maintain high standards of data quality control throughout the biomonitoring process. Risk Communication: Effectively communicate risks and uncertainties associated with environmental toxins to stakeholders, empowering them to make informed decisions about their health and environment. Policy Advocacy: Engage in responsible advocacy for effective environmental policies and regulations based on sound scientific evidence, promoting informed risk management strategies. Professional Accountability: Recognize and take responsibility for the potential impacts of biomonitoring activities on the environment and surrounding communities.		Group discussions	-Presentations -Reports

C. Course Content:

No	List of Topics	Contact Hours
1	Introduction of ecotoxicology and its health implications	2
2	Biomonitoring and Community Surveys as Tools in Ecotoxicology	3
3	Bioassay Definition, Classification and model test systems	3
4	Bioassay of environmental Genotoxicity and cytotoxicity	3
5.	Biomarker Definition, Classification	3
6	Environmental Genotoxicity and Cytotoxicity Biomarkers	3
7	Biomarkers of Radiation in the Environment	3
8	applications of “Omics" technologies	4
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- Gross, Elisabeth M and Garric, Jeanne .2019. Ecotoxicology : new challenges and new approaches. London : ISTE Press Ltd ; Kidlington, Oxford : Elsevier Ltd. 2- Wood, Michael D., Carmel Emelia Mothersill., Tsakanova, Goher., Cresswell, Tom and Woloschak, Gayle E. 2002. Biomarkers of radiation in the environment : robust tools for risk assessment. Dordrecht : Springer. 3- Menone, Mirta L and Chris D. Metcalfe. 2023. The ecotoxicology of aquatic macrophytes. Cham, Switzerland : Springer. 4-
Supportive References	Standard Methods for the Examination of Water and Wastewater, 24th Edition American Public Health Association (APHA) 1015 15th Street NW Washington, DC 20005 USA 2022
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)

Course Specification

(Postgraduate Programs)

Course Title:	Advanced Biotechnology
Course Code:	BIO-6130
Program:	Master of Science in Applied Biology (Common Course)
Department:	Biology
College:	Science
Institution:	Imam Mohammad Ibn Saud Islamic University
Version:	1
Last Revision Date:	*Pick Revision Date.*

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D. Students Assessment Activities: 7

E. Learning Resources and Facilities: 7

F. Assessment of Course Quality: 7

G. Specification Approval Data: 8

A. General information about the course:

1. Course Identification:

1. Credit hours: 4 (Lecture 3 + 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 course establishes a solid foundation in biotechnology for the students. An overview of the principles and methodologies underlying molecular and applied genetic engineering in relation to the genetic modification of organisms and their byproducts. It would encompass contemporary biotechnology techniques that are being applied in industrial, agricultural, and medicinal settings.					
5. Pre-requirements for this course (if any)**:**					
None					
6. Co-requisites for this course (if any)**:**					
None					
7. Course Main Objective(s):					
The objective of this course is to provide the students with a fundamental theoretical understanding of complex genetic manipulation. The course familiarizes the student with the current technology and drives principles of Biotechnology. Among the course aims is to allow the students to identify the state-of-the-art experimental approaches in "Biotechnology Research".					

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	16	75%
2	E-learning		
3	Hybrid ● Traditional classroom ● E-learning	8	25%
4	Distance learning		

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

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	30
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify) ……**	
	Total	75

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	**Demonstrate comprehensive knowledge and understanding of biotechnology, and a critical awareness of current and**		Two credits weekly lectures	-Quizzes -Presentations -Assignments -written exams

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	emerging problems with insights at the forefront of the discipline.			
	Demonstrate expertise in fundamental and specialized biotechnological methodologies and an understanding of their advantages, limitations and applications;		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams
1.2	**Identify and resolve scientific and technical problems associated with the applications of biotechnology**		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams
2.0	Skills			
2.1	**Deal with complex scientific issues with confidence, independence, and originality**		-Two credits weekly lectures -Tutorials	-Presentations -Assignments -written exams
2.2	**Continue to advance knowledge and understanding, and develop new skills in the application of biotechnology**		-Two credits weekly lectures -Tutorials	-Presentations -Assignments -written exams
2.3	**Understand and adopt to future developments in biotechnology and their practical application.**		-Two credits weekly lectures -Tutorials	-Presentations -Reports
3.0	Values, autonomy, and responsibility			
3.1	**Show independence and responsibility and cooperate effectively in a team to carry out research work**		Group discussions	-Presentations -Reports
3.2	**Discuss the scientific issues and present research results via oral presentations and in written format.**		Group discussions	-Presentations -Reports

C. Course Content:

No	List of Topics	Contact Hours
1.	**Introduction and DNA transcription** - The structure and foundation of DNA and RNA - DNA transcription to RNA	6
2.	**DNA Translation** - The process of translation - The genetic code and its degeneracy - Introns/Exons	6
3.	**Gene cloning: tools of the trade** - Materials and methods of Gene cloning Classes and properties of the enzymes used in gene cloning - Polymerase chain reaction principle.	6
4.	**Gene Cloning: how it is done** - Listing the different types of cloning vectors - Basic properties of a plasmid - Outlining the methods of DNA introduction into cells - Outline the methods used for the selection of transformants including being able to describe the use of insertional inactivation, blue/white selection and replica plating	6
5.	**Gene cloning: finding the gene** - Outlining the strategies and methodologies for identifying a gene of interest. - Including marker rescue/ complementation and its limitations - Including the features of genomics and cDNA libraries showing why one or other is used. - Hybridization probing and detection of translation proteins.	6
6.	**Industrial enzymes:** - Major industrial sectors - Food enzymes - Producer organisms - Impact of genetic modification - Enzyme manufacture - Downstream processing	6
7.	**Medical Biotechnology:** - Importance of pharmaceutical production of recombinant proteins - Synthesis of recombinant enzymes from bacteria and fungi - Synthesis of recombinant enzymes from mammal cells	6
8	**Agricultural Biotechnology**	3

	- Understand the importance of plant biotechnology - Learn about gene delivery into plants and their various methods	
Total		**45**

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 semester 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	-Gene Cloning and DNA analysis, An Introduction, T.A.Brown seventh edition, ISBN-13-978-1119072560 - Fundamentals of Biotechnology, James Allen, ISBN-13-978-1639872442
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**

Course Specification

(Postgraduate Programs)

Course Title:	Environmental Sustainability
Course Code:	BIO-6132
Program:	Master of Science in Applied Biology: Industrial and Environmental Biotechnology & sustainability
Department:	Biology
College:	Science
Institution:	Imam Mohammad Ibn Saud Islamic University
Version:	1
Last Revision Date:	*Pick Revision Date.*

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F. Assessment of Course Quality: 8
G. Specification Approval Data: 8

A. General information about the course:

1. Course Identification:

1. Credit hours: 2 (Lecture 2 + Lab 0)				
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:				
Sustainability is a compelling notion rooted on the idea that environmental, economic, and social issues are interconnected. The key to finding answers is in comprehending the interconnection between these systems and recognizing how human actions have compromised the integrity of the natural systems we depend on. This course examines a range of critical sustainability concerns and provides illustrations of how they are being tackled. This course acquaints students with the notion of environmental sustainability and its use in resolving practical issues. This study examines the interconnections of natural, rural, industrial, and urban ecosystems, and investigates the influence of human activities on nature. The course also examines how environmental sustainability can be employed to tackle environmental, economic, and social concerns in a holistic manner.				
5. Pre-requirements for this course (if any):				
None				
6. Pre-requirements for this course (if any):				
None				
7. Course Main Objective(s):				
The objective of this course is to familiarize students with the concept of environmental sustainability in order to enable them to: • Define the meaning of environmental sustainability; • Assess the influence of physical, economic, social,				

and technological factors on the environment; • Provide an elucidation of fundamental scientific elements related to environmental issues; • Describe the necessary procedures for establishing a society that is environmentally sustainable; • Apply the principles of sustainability to practical challenges in the real world.

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**	0
3.	**Field**	0
4.	**Tutorial**	0
5.	**Others (specify)……**	0
	Total	30

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods:

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Describe the principles of environmental		Lecture and take-home research assignment	Quizzes, midterm exam and final exam

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	sustainability, encompassing factors that influence it, consequences, objectives, and obstacles.			
1.2	Outline the theoretical foundation that supports environmental sustainability concerns.		Lecture and take-home research assignment	Quizzes, midterm exam and final exam
1.3	Recognize the legislative and regulatory measures pertaining to environmental sustainability concerns.		Lecture and take-home research assignment	Quizzes, midterm exam and final exam
2.0	**Skills**			
2.1	Evaluate the influence of human actions and technological advancements on the preservation of the environment at both local and global levels, employing suitable qualitative and quantitative tools and approaches.		Take-home research assignment	Reports
2.2	Use scientific and technological expertise to create innovative solutions for environmental sustainability issues at both local and		Take-home research assignment	Reports

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	global levels. This involves applying applicable theories, analysis frameworks, and prediction scenarios or quantitative models.			
2.3	Employ information technology, geographical information systems, cartographic methods, statistical analysis, and other data analytical tools to examine and understand various forms of environmental data.		Take-home research assignment	Reports
3.0	**Values, autonomy, and responsibility**			
3.1	Demonstrate effective communication of knowledge, ideas and solutions.		Lecture and take-home research assignment	Quizzes, midterm exam, project presentations, and final exam
3.2	Develop proficient project management and organizational abilities by engaging in both independent work and collaborative teamwork.		Lecture and take-home research assignment	Quizzes, midterm exam, project presentations, and final exam
3.3	Use critical thinking principles to analyze intricate sustainability-related issues.		Lecture and take-home research assignment	Quizzes, midterm exam, project presentations, and final exam

C. Course Content:

No	List of Topics	Contact Hours
1.	Sustainability and Global Environmental Outlook	3
2.	Understanding the Sustainability Problem	3
3.	Sustainability as a Solution	3
4.	Climate Change & Sustainable Energy	3
5.	Biodiversity Loss & Sustainable Food	3
6.	Air Pollution & Sustainable Transport	3
7.	Water Pollution & Sustainable Manufacturing	3
8.	Resource Depletion & Sustainable Materials	3
9.	Waste & Sustainable Settlements	3
10.	Sustainable Economy & Government	3
11.	Sustainable Society	3
12.	Conclusions	3
Total		**30**

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm 1	5th week	20%
2.	Midterm 2	10th week	20%
3.	Quizzes, Participation, presentations, reports, attendance	During the semester	20%
4.	Final Exam	16th week	40%
Total			100%

*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	Dhiman, S. (2023). Sustainable Development and Environmental Stewardship: Global Initiatives Towards Engaged Sustainability (1st ed.). Springer Cham. https://doi.org/10.1007/978-3-031-28885-2 Modak, P. (2017). Environmental Management towards Sustainability (1st ed.). CRC Press. https://doi.org/10.1201/9781315156118

Supportive References	Laurent, É. (2023). Toward Social-Ecological Well-Being: Rethinking Sustainability Economics for the 21st Century (1st ed.). Palgrave Macmillan Cham. https://doi.org/10.1007/978-3-031-38989-4
Electronic Materials	Web-based environmental sustainability tools and software
Other Learning Materials	None

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classrooms
Technology equipment (Projector, smart board, software)	Projector and Smart board
Other equipment (Depending on the nature of the specialty)	Environmental sustainability-related instruments

F. Assessment of Course Quality:

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Direct
Effectiveness of students assessment	Program Leaders	Direct
Quality of learning resources	Peer Reviewer	Indirect
The extent to which CLOs have been achieved	Program Leaders	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**

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.*

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C. Course Content:.....**Error! Bookmark not defined.**

D. Students Assessment Activities: 10

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F. Assessment of Course Quality: 12

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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**

Course Specification

(Postgraduate Programs)

Course Title:	**Research Principles and Ethics**
Course Code:	**BIO-6200**
Program:	**Master of Science in Applied Biology (Cell and Molecular Biology)**
Department:	**Biology**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	**1**
Last Revision Date:	*Pick Revision Date.*

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F. Assessment of Course Quality: 9

G. Specification Approval Data: 9

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A. General information about the course:

1. Course Identification:

1. Credit hours: (Lecture 2+Lab 0)				
2. Course type				
A.	☐University	☐College	☐Department	☒ Track
B.	☒ Required		☐Elective	
3. Level/year at which this course is offered: (Level 2 / first year)				
4. Course General Description:				
This course introduces the research principles and ethics to the graduate students. Research principles are those that should be considered when conducting research work. The fundamental research ethics are those rules to which the researchers should adhere to ensure the ethical conduct of the research. The course emphasizes topics such as confidentiality and protection of data, conflict of interest, avoiding deceptive practices, and minimization of risks. The significance of obtaining official approval before carrying out the research work is also emphasized.				
5. Pre-requirements for this course (if any)**:**				
None				
6. Pre-requirements for this course (if any)**:**				
None				
7. Course Main Objective(s):				
This graduate course aims to provide the students with the basic knowledge of research principles and ethical rules related to research activities. The course objectives are mainly centred on adherence to the relevant ethical rules and research principles while performing research work. The identification of topics such as beneficence and non-maleficence, merit and integrity of research, justice, and the right to withdraw are among the objectives of this graduate course. The various types of conflict of interest and the differences between deceptive and non-deceptive practices in the research activities are also targeted.				

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**	0
3.	**Field**	0
4.	**Tutorial**	0
5.	**Others (specify) ……**	
	Total	30

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods:

Code	Course Learning Outcomes	Code of CLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	List the steps essential to recruit research participants to share in a particular research work, and measures taken to maintain the research confidentiality	K1	Two credits weekly involving lectures and tutorials	-Quizzes -Written exams -Assignments -Lecture discussions

Code	Course Learning Outcomes	Code of CLOs aligned with the program	Teaching Strategies	Assessment Methods
1.2	Describe the forms of conflict of interest that may compromise the flow of the research work	K2	Two credits weekly involving lectures and tutorials	-Quizzes -Written exams -Assignments -Lecture discussions
1.3	Explain the significance of obtaining the approval of an "Institutional Review Board"(IBR) to conduct a research work	K3	Two credits weekly involving lectures and tutorials	-Quizzes -Written exams -Assignments -Lecture discussions
1.4	Outline the measures taken to care for and use of experimental	K4	Two credits weekly involving lectures and tutorials	-Quizzes -Written exams -Assignments -Lecture discussions
2.0	Skills			
2.1	Relate a certain research principle and an ethical rule to a particular research study	S1	-Presentations -Group discussions	-Direct observation -Lab Reports
2.2	Design and conduct experimental research work in a way that maximizes benefits and minimizes the potential risks of the research study	S2	--Presentations -Group discussions	-Direct observation -Lab Reports
3.0	Values, autonomy, and responsibility			
3.1	Perform research work independently and effectively cooperate in a team with the	V1	--Presentations -Group discussions	-Direct observation -Lab Reports

Code	Course Learning Outcomes	Code of CLOs aligned with the program	Teaching Strategies	Assessment Methods
	consideration of confidentiality and data protection			
3.2	Adhere to the relevant ethics while performing research work in the various disciplines of biology	V2	-Presentations -Group discussions	-Direct observation -Lab Reports

C. Course Content:

No	List of Topics	Contact Hours
1.	**Approval of Ethics Board:** Approval of the "Institutional Review Board" (IBR) to conduct the research in compliance with national and international rules and regulations.	2
2.	**Research Participants:** **Recruit participants:** Ethical rules should be followed to recruit participants in a research study **Respect to persons:** Autonomy and protection of those with diminished autonomy **Justice:** Equal treatment is the core principle of justice concerning research **Avoiding deceptive practices:** Everyone in a particular research setting knows the design and objectives of the research **Providing the right to withdraw:** Research participants should always have the right to withdraw from the research process **Confidentiality and data protection:** Respect the confidentiality nature of information and protect anonym **Conflict of interest:** Independence of research and declaration of any conflict of interest	4
3.	**Animal Research (Use and Care of Lab Animals):** Humanity in the housing of experimental animals, and their anaesthesia and euthanasia.	2
4.	**Publishing Ethics (Author duties and rights):** **Duties:** Originality, concurrent publication, confidentiality, authorship, declarations, and image integrity **Rights:** using data freely, receiving attribution and credit, and sharing published work	2
5.	**Research Theory and Basics:**	4

	Research theory: Assumptions of researchers about findings in reality, how to detect changes, and how to extract conclusions **Research basics:** Research design(descriptive, correlation, comparative, experimental, simulation, evaluation); Research methods (conduction of research, collecting data, organizing data, analyzing data) **The integrity of research:** Proper design and reviewing of the research work to ensure the standards of integrity, quality, and transparency **Beneficence and non-maleficence:** maximizing the benefits of research and minimizing the potential risks to researchers	
6.	**Structuring the Research Project:** **Proposal and research plan:** Testing a particular hypothesis, Preparation and approving a proposal, and planning of research work **Searching and reviewing the literature:** Finding information and extended literature review **Collecting and analyzing data:** Quantitative and qualitative data analysis, reasoning, and conclusions	6
7.	**Writing up the Research:** Organizing notes on the literature, showing results, and discussing findings	2
8.	**Researchers' Rights**: Intellectual Property Intellectual Property Rights Types of Intellectual Property Rights (IPR)	2
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	-Congiunti L, Francesco FL, Russo A, Serio M. Ethics in Research. Principles and Practical Considerations. Springer Cham. ISBN: 978-3-031-24059-1 ISSN: 2366-7516
Supportive References	https://www.city.ac.uk/research/support/integrity-and-ethics/ethics/principles https://uraf.harvard.edu/researchers-principles-policies https://research.virginia.edu/compliance/research-regulations https://research.illinoisstate.edu/ethics/human-subjects/policy/ https://www.nih.gov/health-information/nih-clinical-research-trials-you/guiding-principles-ethical-research https://www.apa.org/monitor/jan03/principles https://www.mcgill.ca/research/about/ran/research-policies-and-regulations https://www.dpi.nsw.gov.au/dpi/animals/animal-ethics-infolink/legislation-and-the-australian-code/animal-research-regulation
Electronic Materials	
Other Learning Materials	

2. Educational and Research Facilities and Equipment Required:

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

F. Assessment of Course Quality:

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Student	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**

Course Specification

(Postgraduate Programs)

Course Title:	**Cell Culturing Technology**
Course Code:	**BIO-6201 (Lab Course)**
Program:	**Master of Science in Applied Biology (Cell and Molecular Biology)**
Department:	**Biology**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	**1**
Last Revision Date:	*Pick Revision Date.*

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G. Specification Approval Data: 8

عبد الملك بن عبد العزيز بن عبد الله الرحيمي الناصر

A. General information about the course:

1. Course Identification:

1. Credit hours: (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 2 / First year)				
4. Course General Description:				
This graduate course serves as an introductory guide, providing insights into the enhancement of biological research, specifically in the transition from basic research to modern approaches in cell biology, through the application of cell culture technologies. This course covers foundational aspects such as biosafety levels, laboratory equipment, subculture various methods and a short introduction to the three-dimensional cell culture technique. In addition, cell counting methods and viability assessment are among the topics that the course will cover. The course offers an accessible opportunity to unravel the intricate pathways of biomedical research, where cell culture stands out as a powerful tool.				
5. Pre-requirements for this course (if any)**:**				
None				
6. Co-requisites for this course: (if any)**:**				
None.				
7. Course Main Objective(s):				
The primary objective of this graduate course is to provide the students with both theoretical and practical experience necessary to carry out experimental work using cell and tissue cultures as inevitable *in vitro* tools of research. The course content aims to foster an understanding of the noteworthy progress made in the techniques of cell culturing. The knowledge acquired from this course empowers the students to perform their research work independently in cell culture laboratories. By the end of the course, students will be equipped with the professional skills to maintain animal cells and tissues under *in vitro* conditions.				

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 (CLOs), Teaching Strategies and Assessment Methods:

Code	Course Learning Outcomes	Code of CLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Outline the principles of cell culture techniques, encompassing biosafety levels, culture conditions, and key characteristics of cell lines.	K1	-Lab Presentations and group discussions to introduce the cell culture techniques	-Active participation -Lab reports -Lab exam

Code	Course Learning Outcomes	Code of CLOs aligned with the program	Teaching Strategies	Assessment Methods
1.2	List the differences between finite and continuous cell lines, and the distinctions between adherent and suspension cell cultures.	**K2**	-Lab Presentations and group discussions to introduce the various types of cell lines.	-Active participation -Lab reports -Lab exam
1.3	Describe cryopreservation including freezing mediums, and the protocols for both preserving and thawing cultured cells.	**K3**	-Lab Presentations and group discussions to introduce cryopreservation	-Active participation -Lab reports -Lab exam
2.0	**Skills**			
2.1	Apply the cell culture techniques in a professional manner to support the various research purposes.	**S1**	-Guided Lab work -Lab tutorials	-Active participation -Lab reports -Lab exam
2.2	Design and conduct experimental assay by employing critical practical skills and the proper cell culturing methods	**S2**	-Guided lab experiments -Group discussions	-Lab reports -Presentations
2.3	Interpret and analyze the experimental data by applying the appropriate statistical methods, and derive meaningful conclusions through evaluation.	**S3**	-Guided analysis of research data -Group discussions	-Lab reports -Presentations
3.0	**Values, autonomy, and responsibility**			
3.1	Demonstrate responsibility for research reliability by upholding the highest standards of accuracy in all cell culture-related experiments and data reporting.	**V1**	-Guided lab research work –Group discussions	-Lab reports -Presentations by research groups
3.2	Participate in discussion of scientific issues and recognize the importance of effective	**V2**	-Tutorials on presenting research data	-Presentations -Lab reports

Code	Course Learning Outcomes	Code of CLOs aligned with the program	Teaching Strategies	Assessment Methods
	communication orally or in a written format to achieve successful outcomes in cell culture experiments.		-Seminars -Group discussions	
3.3	Follow the principles of ethical conduct of research in handling cell cultures.	V3	-Tutorials on research ethics	-Lab reports

C. Course Content:

No	List of Topics	Contact Hours
1.	**Cell culture laboratory:** Biosafety levels, Basic equipment, and laboratory safety practices.	3
2.	**Introduction to cell culture:** Cell culture, Finite vs. continuous cell line, and culture conditions.	2
3.	**Cell culture basics:** Acquiring cell lines, Adherent vs. suspension culture, media and Cell culture plastics.	3
4.	**Subculturing of Adherent Cells:** Media recommendations and Protocol for passaging adherent cells.	3
5.	**Subculturing Suspension Cells:** Passaging suspension cultures, suspension culture vessels, and Protocol for passaging suspension cells.	3
6	**Freezing Cells:** Guidelines for cryopreservation, freezing medium, and Protocol for cryopreserving cultured cells.	2
7.	**Thawing Frozen Cells:** Guidelines for thawing, materials needed, and Protocol for thawing frozen cells.	2
8.	**Cell Counting Methods:** Hemocytometer, automated cell counters.	2
9.	**Cytotoxic studies:** MTT Assay, LDH assay	2
10.	**The Third Dimension in Cell Culture** Fundamentals, types and applications of 3D-Cell Cultures.	2
Total		**60**

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm exam	5th & 10th weeks	30 %
2.	Quizzes, presentations, lab reports, participation, attendance, data search, assignments	Throughout the semester duration	30 %
4	Final lab 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	-Kasper, C.; Charwat, V.; Lavrentieva, A.(2018). Cell Culture Technology, 1st ed.; Springer International Publishing: Berlin/Heidelberg, Germany, 2018; ISBN 978-3-319-74854-2. -Davis JM. (2011). Animal Cell Culture: Essential Methods. Wiley-Blackwell, John Wiley & Sons: Chichester, UK. Doi:10.1002/9780470669815.
Supportive References	https://www.kbcc.cuny.edu/academicdepartments/bio/documents/Bio_57_syllabus.pdf https://education.ki.se/course-syllabus/1BA017/6305 https://www.btec.ncsu.edu/academic/courses/bit466-566.php
Electronic Materials	
Other Learning Materials	

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Well-equipped lab
Technology equipment (Projector, smart board, software)	Projector and 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:

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

Course Specification

(Postgraduate Programs)

Course Title:	**Techniques in Cell and Molecular Biology**
Course Code:	**BIO-6202**
Program:	**Master of Science in Applied Biology (Cell and Molecular Biology)**
Department:	**Biology**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	**1**
Last Revision Date:	*Pick Revision Date.*

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G. Specification Approval Data: 8

عبد الملك بن عبد العزيز بن عبد الله الرحيلي الناصر

A. General information about the course:

1. Course Identification:

1. Credit hours: 3 (Lecture 1+ Lab 4)				
2. Course type				
A.	☐University	☐College	☐ Department	☒ Track
B.	☒ Required		☐Elective	
3. Level/year at which this course is offered: (Level 2 / first year)				
4. Course general Description:				
This graduate course provides the students with the principal and practical applications of both conventional and modern techniques in cell and molecular biology. The course covers a variety of topics of interest to students who study and do research work in the area of molecular biology as well as cell-related issues. Practical skills in fundamental techniques such as DNA and RNA extraction, quantification and electrophoresis are focused in this course. Through the course study, the student's lab skills are upgraded to encompass the advanced relevant techniques including standard Polymerase chain reaction (PCR), primer design and real-time PCR. The course emphasizes experimental design, execution, and data analysis. The acquired knowledge and skills enable the students to perform research work independently and share in collaborative projects culminating in a comprehensive understanding of fundamental methodologies in molecular biology. Upon successful completion of the course, the students become competent to contribute professionally in the disciplines of molecular biology.				
5. Pre-requirements for this course (if any)**:**				
None				
6. Co-requisites for this course: (if any)**:**				
None				
7. Course Main Objective(s):				
This course is designed to equip students with a set of recognizable skills and knowledge to conduct impactful molecular biology research. Starting with an acquaintance of introductory techniques such as DNA and RNA extraction and quantification, students progressively manage to master complex methodologies such as polymerase chain reaction (PCR) and real-time PCR. The course aims to build up student ability in experimental design, execution, and data analysis; and simultaneously strengthens students' capability to independently or collaboratively undertake projects within a research context. Through hands-on experience with modern laboratory equipment, students will develop a robust understanding of the practical applications and significance of molecular biology in scientific exploration.				

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**	15
2.	**Laboratory/Studio**	60
3.	**Field**	
4.	**Tutorial**	0
5.	**Others (specify).....**	
	Total	75

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods:

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Outline the principles of nucleic acids extraction and quantification methods.	K1	-Lab demonstrations -Tutorials -Guided hands-on practice	-Active participation in lab discussions. -Lab reports -lab exam

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.2	Describe the advanced molecular biology techniques, such as PCR and real-time PCR, and identify the necessary lab equipment.	**K2**	-Lab demonstrations -Tutorials -Guided hands-on practice	-Active participation in lab discussions. -Lab reports -Lab exam
1.3	Explain the considerations and list the essential tools related to primer design.	**K3**	-Lab demonstrations -Tutorials	-Active participation in lab discussions. -Lab reports -Lab exam
2.0	**Skills**			
2.1	Employ hands-on skills to conduct experimental work in molecular biology using the proper methods and techniques.	**S1**	-Guided Lab work -Lab tutorials	-Direct observations -Lab reports -Lab exam
2.2	Design experimental work and relate the theoretical knowledge to the applicable methodology as a mode of carrying out professional research work.	**S2**	-Guided lab experiments -Group discussions	-Lab reports -Presentations
2.3	Evaluate, interpret, and analyze the results of molecular research using the appropriate analytical methods.	**S3**	-Guided analysis of research data -Group discussions	-Lab reports -Presentations
3.0	**Values, autonomy, and responsibility**			
3.1	Show independence in performing lab work and collaborating effectively in teamwork.	**V1**	-Monitored lab research work –Group discussions	-Lab reports -Presentations by research groups
3.2	Participate in the discussions of specialized molecular issues, and present scientific data professionally as oral	**V2**	-Tutorials on presenting research data -Seminars -Group discussions	-Active participation -Presentations

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	presentations as well as in written format			
3.3	Practice the ethical conduct of research and follow the approved research principles.	**V3**	-Tutorials on research ethics and principles	-Lab reports

C. Course Content:

No	List of Topics	Contact Hours
1.	**Introduction to Molecular Biology Laboratory:** -Solution preparation and dilution -Pipetting	4
2.	**Genomic DNA Extraction:** -Phenol Chloroform Extraction -DNA Extraction Kits	8
3.	**RNA Extraction:** -RNA Isolation with Extraction Kits.	4
4.	**DNA and RNA quantification by Spectrophotometric Assay:** -Determination of DNA Purity and Concentration by Spectrophotometric Assay.	8
5.	**Electrophoresis:** -Separation of DNA Fragments in Agarose Gel	8
6.	**Primer Design:** -General Considerations in Primer Design. -Web-Based Tools for Primer Design.	4
7.	**Polymerase Chain Reaction (PCR) Optimization:** -Principles of PCR -Amplification of a target gene. -Gel electrophoresis to analyze PCR products	8
8.	**RNA Extraction and Reverse Transcription:** -RNA extraction from cells with Trizol Reagent -Reverse transcription of RNA to cDNA.	8
9.	**Real-time PCR (qPCR):** -Principles of real-time PCR -Designing qPCR primers and probes	8

	-Setting up a qPCR reaction.	
10.	**Analysis of qPCR data and quantification of target gene expression**: -Absolute and relative quantification -2^(–delta delta CT).	4
Total		**60**

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm exams	5th and 10th weeks	30 %
2.	Quizzes, presentations, lab reports, participation, attendance, data search, assignments	Throughout the semester duration	10 %
	Final lab exam	15th week	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	Wilson K., Walker J. (2018). Principles and Techniques of Biochemistry and Molecular Biology. 8th Edn. Cambridge University Press.
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.)	Well-equipped lab
Technology equipment (Projector, smart board, software)	Projector and smart board

Items	Resources
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**

Course Specification

(Postgraduate Programs)

Course Title: Bioinformatics
Course Code: BIO-6230
Program: Master of Science in Applied Biology (Industrial and Environmental Biotechnology & Sustainability)
Department: Biology
College: Science
Institution: Imam Mohammad Ibn Saud Islamic University
Version: 1
Last Revision Date: *Pick Revision Date.*

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C. Course Content: ..... **Error! Bookmark not defined.**

D. Students Assessment Activities: 7

E. Learning Resources and Facilities: 7

F. Assessment of Course Quality: 9

G. Specification Approval Data: 9

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 2 / first year)				

4. Course General Description:

This postgraduate course provides the candidates with a comprehensive understanding of the theoretical foundations, practical skills, and applications of bioinformatics in the field of molecular biology and genomics. Through a combination of lectures, hands-on exercises, and projects, students will acquire various knowledge and skills. Understand the fundamental principles of bioinformatics and its role in biological research. Explore the relationship between molecular biology and computational methods. Master sequence alignment techniques for DNA, RNA, and protein sequences. Learn to identify homologous genes and analyze evolutionary relationships. Gain proficiency in predicting and analyzing protein structures. Understand the relationship between protein structure and function. Explore tools and methods for analyzing gene expression data. Understand the principles of functional annotation and pathway analysis. Learn to handle and analyze high-throughput sequencing data. Acquire skills in variant calling and genomic variant interpretation. Explore widely used bioinformatics databases (e.g., NCBI, Ensembl) for retrieving biological information. Learn to query and extract relevant data from diverse databases. Gain hands-on experience with popular bioinformatics software and tools. Understand the functionalities of tools used in sequence analysis, structural bioinformatics, and genomics. Learn to critically evaluate bioinformatics results and troubleshoot analysis issues. Apply problem-solving skills to address complex biological questions through computational methods.

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

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

7. Course Main Objective(s):

The objective of this course is to provide the students with a with a comprehensive understanding of the theoretical foundations, practical skills, and applications of bioinformatics in the field of molecular biology and genomics. Through a combination of lectures, hands-on exercises, and projects, students will acquire various knowledge and skills.

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	**Understand the basic principles and concepts of bioinformatics.**		Two credits weekly lectures	-Quizzes -Presentations -Assignments -written exams
1.2	**Explore protein structure and function through structural bioinformatics.**		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams
1.3	**Gain hands-on experience in utilizing bioinformatics software and databases**		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams
2.0	Skills			
2.1	**Analyze biological sequences using computational tools.**		-Two credits weekly lectures -Tutorials	-Presentations -Assignments -written exams
2.2	**Apply tools for functional genomics, including gene expression analysis.**		-Two credits weekly lectures -Tutorials	-Presentations -Assignments -written exams
2.3	**Critically evaluate and interpret bioinformatics results**		-Two credits weekly lectures -Tutorials	-Presentations -Reports
3.0	Values, autonomy, and responsibility			
3.1	**Show independence and responsibility and cooperate effectively in a team to carry out research work**		Group discussions	-Presentations -Reports
3.2	**Discuss the scientific issues and present research results**		Group discussions	-Presentations -Reports

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	via oral presentations and in written format.			

C. Course Content:

No	List of Topics	Contact Hours
1.	**Fundamental principles of Bioinformatics:** • Definition and scope of bioinformatics • Historical development and milestones • Overview of bioinformatics applications in various biological fields • Introduction to databases and bioinformatics resources (e.g., NCBI, Ensembl)	4
2.	**Sequence analysis:** • Basics of biological sequences (DNA, RNA, proteins) • Sequence alignment algorithms (pairwise and multiple sequence alignment) • Database searching and similarity analysis (BLAST, FASTA) • Evolutionary analysis using sequence data	4
3.	**Structural Bioinformatics** • Protein structure basics • Predicting protein structures (homology modeling, ab initio methods) • Structure visualization and analysis tools (PyMOL, Swiss-PdbViewer) • Relationship between protein structure and function	4
4.	**Functional Genomics** •Introduction to functional genomics •Gene expression analysis (microarrays, RNA-seq) •Pathway and functional enrichment analysis •Functional annotation of genes and gene products	4
5.	**Genomic Data Analysis** • Introduction to high-throughput sequencing technologies • Handling and preprocessing of next-generation sequencing data • Variant calling and interpretation • Genomic data visualization tools (e.g., IGV)	4
6.	**Bioinformatics Databases and Tools:** • Exploration of popular bioinformatics databases (NCBI, Ensembl, UniProt)	4

	• Use of bioinformatics software for data analysis (BioPython, Bioconductor) • Hands-on exercises with data retrieval and manipulation	
7.	**Advanced Topics** • Network biology and systems biology • Personalized medicine and pharmacogenomics • Synthetic biology and gene editing technologies • Emerging trends and future directions in bioinformatics	4
8	**Research Project** • Formulation of a bioinformatics research project • Data collection, analysis, and interpretation • Project presentation and discussion	2
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	15%
2.	**Midterm exam-2**	10th week	15%
3.	**Assignments, presentations, attendance, data search, participation**	Throughout the course duration	10%
	Final lab exam	15th week	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	* Mount, D. W. (2004). Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press. * Compeau, P., & Pevzner, P. (2014). Bioinformatics Algorithms: An Active Learning Approach. Active Learning Publishers. * Lesk, A. M. (2017). Introduction to Bioinformatics (4th ed.). Oxford University Press.

	Wünschiers, R. (2013). Computational biology: A practical introduction to biodata processing and analysis with Linux, MySQL, and R (Second edition). Springer.
Supportive References	• **NCBI Bookshelf:** Offers a variety of free online books and documents on bioinformatics and related topics. (https://www.ncbi.nlm.nih.gov/books/) • **Bioconductor Documentation:** Essential for those working with R in bioinformatics. (https://www.bioconductor.org/help/documentation/) • **Rosetta Code - Bioinformatics Category:** Provides code snippets in various programming languages for common bioinformatics tasks. (https://rosettacode.org/wiki/Category:Bioinformatics)
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**

Course Specification

(Postgraduate Programs)

Course Title:	**Industrial Microbiology 1**
Course Code:	**BIO-6234**
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.*

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A. General information about the course: 3

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods: ..... **Error! Bookmark not defined.**

C. Course Content: ..... **Error! Bookmark not defined.**

D. Students Assessment Activities: 10

E. Learning Resources and Facilities: 10

F. Assessment of Course Quality: 11

G. Specification Approval Data: 12

A. General information about the course:

1. Course Identification:

1. Credit hours: 3(2 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 2 / first year)

4. Course General Description:

Throughout this course, you will:

Demystify the world of microorganisms: Discover the diverse roles of bacteria, fungi, and yeast in food production, understanding their interactions and metabolic pathways.

Uncover the secrets of fermented delights: From cheese and yogurt to bread and kimchi, explore the intricate processes of microbial fermentation that bring flavor, texture, and nutritional benefits to our food.

Investigate the power of added microbes: Learn about the exciting developments in microbial protein production, probiotics, and their potential to revolutionize the food chain.

Dive into the animal feed frontier: Discover how microorganisms are enhancing animal feed, exploring options like methanotrophic bacteria, microalgae, and biofloc technology in aquaculture.

Gain practical insight: Throughout the course, you'll encounter real-world case studies, industry insights, and opportunities to connect the theoretical with the practical applications of industrial microbiology.

By the end of this course, you will be equipped to:

Understand the fundamental principles of industrial microbiology and its applications in food and feed production.

Analyze and evaluate different microbial processes used in food fermentation and preservation.

Explain the potential and challenges of incorporating novel microbial sources into the food chain.
Critically assess the sustainability and ethical considerations of industrial microbiology practices.
Prepare for a career in this dynamic field, contributing to the development of innovative and sustainable food and feed solutions.

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

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

7. Course Main Objective(s):

- Develop a comprehensive understanding of the role microorganisms play in various food and feed production processes.
- Analyze the principles of microbial fermentation and their applications in diverse food products like dairy, bread, fermented vegetables, and beverages.
- Evaluate the potential of adding microorganisms to the food chain, including microbial protein production, probiotics, and their impact on nutritional value and gut health.
- Examine the use of specific microorganisms like methanotrophic bacteria, microalgae, and biofloc technology in enhancing animal feed quality and sustainability.

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	Gain a comprehensive understanding of the role of microorganisms in food and feed production processes.		Two credits weekly lectures	-Quizzes -Presentations -Assignments -written exams
1.2	Master the principles of microbial fermentation and its applications in various food products.		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams
1.3	Explore the potential and limitations of adding microorganisms to the food chain, including microbial protein, probiotics, and biofloc technology		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams
1.4	Analyze the use of specific microorganisms in animal feed production, like methanotrophic bacteria and microalgae.		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams
1.5	Evaluate the sustainability and ethical considerations associated with industrial microbiology practices. Evaluate the potential of "Omics" technologies for		Two credits weekly lectures	Quizzes -Presentations -Assignments

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	improving sensitivity, specificity, and early detection of environmental toxicity.			-written exams
2.0	Skills			
2.1	Develop critical thinking and problem-solving skills to analyze and troubleshoot microbial processes in food and feed production.		-Two credits weekly lectures -Tutorials	-Presentations -Assignments -written exams
2.2	Design and interpret experiments related to microbial growth, fermentation, and product quality.		-Two credits weekly lectures -Tutorials	-Presentations -Assignments -written exams
2.3	Effectively communicate the principles and applications of industrial microbiology to diverse audiences.		-Two credits weekly lectures -Tutorials	-Presentations -Reports
2.4	Stay updated with the latest advancements and trends in the field of industrial microbiology.		-Two credits weekly lectures -Tutorials	-Presentations -Reports
2.5	Apply theoretical knowledge to solve practical problems encountered in food and feed industries		-Two credits weekly lectures -Tutorials	-Presentations -Reports
3.0	Values, autonomy, and responsibility			
3.1	**Values** Food Security and Sustainability: Develop an awareness of the role industrial microbiology plays in addressing global food security challenges and promoting		Group discussions	-Presentations -Reports

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	sustainable food production practices. Environmental Stewardship: Foster a commitment to reducing the environmental footprint of industrial microbiology practices by minimizing waste, optimizing resource use, and exploring renewable energy sources. Animal Welfare: Encourage responsible and ethical use of microorganisms in animal feed production, prioritizing animal health and well-being while promoting efficient nutrient utilization. Public Health and Safety: Emphasize the importance of adhering to rigorous safety standards and regulations in industrial microbiology applications to ensure consumer health and product safety.			
3.2	**Autonomy**: Critical Thinking and Innovation: Encourage students to think critically about the implications of different industrial microbiology practices, propose innovative solutions to address food and feed challenges, and contribute to the advancement of the field.		Group discussions	-Presentations -Reports

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	Lifelong Learning: Cultivate a passion for continuous learning and professional development, encouraging students to stay updated with the latest research and advancements in industrial microbiology. Independent Research and Problem-Solving: Provide opportunities for students to conduct independent research projects, analyze data, and develop solutions to real-world problems in the field. Effective Communication and Collaboration: Enhance communication skills to convey complex scientific concepts to diverse audiences, fostering collaboration and knowledge exchange within the food and feed industry.			
3.3	**Responsibility**: Ethical Research and Development: Instill a commitment to ethical research practices in industrial microbiology, ensuring transparency, integrity, and responsible use of microorganisms.		Group discussions	-Presentations -Reports

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	Risk Assessment and Management: Promote awareness of potential risks associated with industrial microbiology practices, emphasizing the importance of risk assessment and effective safety measures. Social Responsibility and Equity: Encourage students to consider the social and economic implications of their work, advocating for equitable access to safe and nutritious food for all. Professional Accountability and Transparency: Emphasize the responsibility of industrial microbiologists to contribute to sustainable solutions, transparency in food production processes, and accountability for the environmental and social impacts of their work.			

C. Course Content:

No	List of Topics	Contact Hours
1	Introduction	2
2	Microorganisms in food production process - microbiology of dairy product	6

	- baking and Fermented Vegetables	
3	Added microorganisms in food chain, applications and production - microbial protein - probiotic industry	6
4	Added microorganism in an animal feed, applications and production - Methanotrophic bacteria as a protein source - Microalgae as protein source. - Biofloc and life feed production in aquacultures industry	10
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	15%
2.	**Midterm exam-2**	10th week	15%
3.	**Assignments, presentations, attendance, data search, participation**	Throughout the course duration	10%
	Final lab exam	15th week	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- Ingvar Sundh., Andrea Wilcks and Mark S. Goettel.2013. Beneficial microorganisms in agriculture, food and the environment: safety assessment and regulation. CABI. 2- David Wilson., Hermann Sahm., Peter Stahmann and Mattheos Koffas . 2019. Industrial Microbiology. Wiley-VCH. 3- Nduka Okafor and Benedict C. Okeke . 2017. Modern Industrial Microbiology and Biotechnology. CRC Press. 4- Anderson de Souza Sant'Ana. 2016. Quantitative Microbiology in Food Processing: Modeling the Microbial Ecology. Wiley. 5- El-Enshasy, Hesham Ali and Yang Shang-Tian. 2021. Probiotics, the Natural Microbiota in Living Organisms: Fundamentals and Applications. CRC Press. 6- Felix. S and Menaga. M. 2021. Applied Aquaculture Biofloc Technology. CRC Press. 7- Divya. K.R and Ramasubramanian. V. 2019. Mass production of fresh water live feed: The laboratory culture and Nutritional evaluation of the freshwater copepod Thermocyclops decipiens. LAP LAMBERT Academic Publishing.
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**

Course Specification

(Postgraduate Programs)

Course Title:	**Agricultural Biotechnology**
Course Code:	**BIO-6332**
Program:	**Master of Science in Applied Biology (Industrial and Environmental Biotechnology & Sustainability)**
Department:	**Biology**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	**1**
Last Revision Date:	***Pick Revision Date.***

Table of Contents

A. General information about the course: 3

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods: 4

C. Course Content: 4

D. Students Assessment Activities: 5

E. Learning Resources and Facilities: 5

F. Assessment of Course Quality: 5

G. Specification Approval Data: 6

A. General information about the course:

1. Course Identification:

1. Credit hours: 3(Lecture 2+ Lab 2)					
2. Course type					
A.	☐ University	☐ College	☐ Department	x ☒ Track	
B.	☒ Required			☐ Elective	
3. Level/year at which this course is offered: (Level 3 / second year)					
4. Course General Description:					
This postgraduate course provides the candidates with a comprehensive understanding of the theoretical foundations, practical skills, and applications of Agricultural biotechnology. Welcome to the Agricultural Biotechnology course, where cutting-edge science meets the world of farming and cultivation. This course is designed to provide a comprehensive exploration of the principles and applications of biotechnology in agriculture, aiming to equip students with the knowledge and skills needed to address the challenges and opportunities in the rapidly evolving field. From understanding the fundamentals of molecular biology and genetics to exploring advanced genetic engineering techniques, we delve into the intricate mechanisms that govern plant and microbial life. The course will cover the ethical, legal, and social dimensions of biotechnology, ensuring a well-rounded perspective. As we navigate the landscape of genetic modification, plant breeding, and microbial biotechnology, we also examine the crucial role of biotechnology in enhancing crop yield, nutritional content, and overall food security. Through a blend of theoretical knowledge and hands-on laboratory experiences, students will gain practical insights into the world of agricultural biotechnology and its transformative impact on sustainable farming practices. Get ready to embark on a journey that merges scientific innovation with the imperative of feeding a growing global population.					
5. Pre-requirements for this course (if any):					
6. Co-requisites for this course (if any):					
7. Course Main Objective(s):					
The objective of this course is to provide the students with a with a comprehensive understanding of the theoretical foundations, practical skills, and applications of bioinformatics in the field of molecular biology and genomics. Through a combination of lectures, hands-on exercises, and projects, students will acquire various knowledge and skills.					

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	**Demonstrate a comprehensive understanding of the fundamental principles of biotechnology, molecular biology, and genetics, and their relevance to agriculture.**		Two credits weekly lectures	-Quizzes -Presentations -Assignments -written exams
1.2	**Understand and navigate the regulatory frameworks governing the development, testing, and release of genetically modified organisms (GMOs) in agriculture.**		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams
1.3	**Understand the role of microorganisms in agriculture, and microbial biotechnology techniques to enhance soil health, nutrient cycling, and plant growth.**		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams
2.0	Skills			
2.1	**Apply genetic engineering techniques, such as recombinant DNA technology and genome editing, to manipulate the genetic makeup of organisms for agricultural purposes.**		-Two credits weekly lectures -Tutorials	-Presentations -Assignments -written exams
2.2	**Analyze and apply principles of plant genetics and breeding to develop improved crop varieties with desirable traits, considering factors such as yield, resistance to pests and diseases, and environmental adaptability.**		-Two credits weekly lectures -Tutorials	-Presentations -Assignments -written exams
2.3	**Critically Evaluate the role of microorganisms in agriculture, and apply microbial biotechnology techniques to enhance soil health, nutrient cycling, and plant growth.**		-Two credits weekly lectures -Tutorials	-Presentations -Reports

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
3.0	Values, autonomy, and responsibility			
3.1	**Show independence and responsibility and cooperate effectively in a team to carry out research work**		Group discussions	-Presentations -Reports
3.2	**Discuss the scientific issues and present research results via oral presentations and in written format.**		Group discussions	-Presentations -Reports

C. Course Content:

No	List of Topics	Contact Hours
1.	**Introduction to Biotechnology:** Overview of biotechnology and its applications in agriculture. Historical development of biotechnology in agriculture. Basic principles of molecular biology and genetics.	4
2.	**Plant Genetics and Breeding:** Principles of plant genetics. Techniques in plant breeding. Genetic modification and its role in crop improvement.	4
3.	**Microbial Biotechnology:** Role of microorganisms in agriculture. Microbial genetics and genetic engineering. Applications of microorganisms in crop production and soil health.	3
4.	**Genetic Engineering Techniques:** Recombinant DNA technology. Gene cloning and expression. Genome editing techniques (e.g., CRISPR-Cas9).	3
5.	**Biotechnology in Crop Improvement:**	3

	Development of genetically modified (GM) crops. Traits introduced in GM crops (e.g., pest resistance, herbicide tolerance). Regulation and safety considerations in GM crop development.	
6.	**Environmental Biotechnology:** Bioremediation and phytoremediation. Biotechnology for sustainable agriculture. Genetic modification for environmental benefits.	3
7.	**Biotechnology and Food Security:** Role of biotechnology in addressing global food security. Biotechnological approaches to enhance crop yield and nutritional content.	2
8	**Emerging Trends in Agricultural Biotechnology:** Nanotechnology in agriculture. Synthetic biology applications. Precision agriculture and data-driven farming.	2
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	15%
2.	**Midterm exam-2**	10th week	15%
3.	**Assignments, presentations, attendance, data search, participation**	Throughout the course duration	10%
1.	**Final lab exam**	15th week	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	*Srividhya Venkataraman, Kathleen Hefferon (2023). Agricultural Biotechnology*. Elsevier; 2023. doi:10.1016/C2020-0-00515-3.

(https://www.sciencedirect.com/science/article/pii/B9780323884761010018)

1.Tyczewska A, Twardowski T, Woźniak-Gientka E. *Agricultural Biotechnology for Sustainable Food Security*. Vol 41.; 2023. Accessed January 25, 2024. https://www.sciencedirect.com/science/article/pii/S0167779922003419

Qaim M. *Genetically Modified Crops and Agricultural Development*. Palgrave Macmillan US; 2016. doi:10.1057/9781137405722

Wünschiers, R. (2013). Computational biology: A practical introduction to biodata processing and analysis with Linux, MySQL, and R (Second edition). Springer.

Supportive References

For an Agricultural Biotechnology course, there are several reputable online resources that cover a wide range of topics in the field. Here are some valuable online resources that you may find useful:

1. **National Center for Biotechnology Information (NCBI)**
   - Website: NCBI
   - NCBI provides access to a vast collection of biological databases, including GenBank and PubMed, which can be valuable for researching genetic information and scientific literature.
2. **International Service for the Acquisition of Agri-biotech Applications (ISAAA)**
   - Website: ISAAA
   - ISAAA is a global organization that provides information on biotechnology applications in agriculture, including biotech crop statistics and publications.
3. **The World of Genetically Modified Organisms (GMOs) - BIO**
   - Website: GMO Answers
   - GMO Answers, by the Biotechnology Innovation Organization (BIO), offers information on genetically modified organisms (GMOs) in agriculture, addressing common questions and concerns.
4. **FAO Biotechnology Forum**
   - Website: FAO Biotechnology Forum
   - The Food and Agriculture Organization (FAO) Biotechnology Forum provides information on the use of biotechnology in agriculture, including discussions, documents, and expert opinions.
5. **Genetic Literacy Project**
   - Website: Genetic Literacy Project

	• The Genetic Literacy Project provides articles and resources on genetics, biotechnology, and related topics, aiming to promote scientific literacy. 6. **AgBioForum** • Website: AgBioForum • AgBioForum is an international, peer-reviewed journal that publishes research on the economic, social, and environmental aspects of agricultural biotechnology. 7. **BioTech Primer** • Website: BioTech Primer • BioTech Primer offers online courses and resources covering various biotechnology topics, including those related to agriculture. 8. **United States Department of Agriculture (USDA) Biotechnology Resources** • Website: USDA Biotechnology • The USDA provides resources on biotechnology, including regulations, policies, and information on biotech crops.
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**

Course Specification

(Postgraduate Programs)

Course Title:	**Industrial Microbiology 2**
Course Code:	**BIO-6334**
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.*

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B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods: ..... **Error! Bookmark not defined.**

C. Course Content: ..... **Error! Bookmark not defined.**

D. Students Assessment Activities: 10

E. Learning Resources and Facilities: 11

F. Assessment of Course Quality: 11

G. Specification Approval Data: 12

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 3/ Second year)

4. Course General Description:

In this course, we will highlight some of the natural microbial metabolic pathways that produce compounds of high economic value, making it feasible to employ these organisms in bioreactors to produce these compounds "valuable biomolecules" such as antibiotics, enzymes that catalyze reactions and antibodies that target specific antigens, opening doors to countless industrial and medical uses.
also, we will discuss Harness the power of microbial fuel cells: Discover how microbes can generate electricity, paving the way for a greener future powered by these miniature powerhouses. and Dive into the science behind bioethanol production, understanding how microorganisms transform biomass into a sustainable fuel alternative. Cultivation of green energy from microalgae. we will Explore the potential of microalgae as a biofuel source, unlocking the power of photosynthesis for a cleaner and greener future.
one of this course scopes is Empower agriculture with microbial solutions or discover how microbes can be our allies in sustainable agriculture, improving soil health, enhancing crop yields, and protecting food after harvest.
This course also deals with biological methods for extracting minerals by biofiltration. This provides a less environmentally harmful alternative to traditional mining methods.

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

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

7. Course Main Objective(s):

- Explore the diverse applications of industrial microbiology beyond food production, delving into the fascinating world of microbial metabolic pathways and their potential for innovative solutions.
- Gain comprehensive knowledge of how physiological and genomic principles govern the production of valuable biomolecules like enzymes and antibodies by microorganisms.
- Evaluate the potential of microbial fuel cells as a sustainable energy source, analyzing their technological advancements and future implications.
- Critically assess the feasibility and environmental impact of bioethanol production using diverse microbial resources.

- Investigate the potential of microalgae as a renewable biofuel source, considering current challenges and future opportunities in this emerging field.
- Discover and analyze the multifaceted ways microorganisms can contribute to sustainable agriculture practices and post-harvest food protection.
- Understand the principles and applications of bioleaching as a cleaner alternative to traditional metal extraction methods, evaluating its environmental benefits and limitations.

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	Gain a deep understanding of the physiological and genomic principles underlying various industrial microbiology applications.		Two credits weekly lectures	-Quizzes -Presentations -Assignments -written exams
1.2	Master the science behind the production of important biomolecules like enzymes and antibodies by microorganisms.		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams
1.3	Analyze the principles and potential of microbial fuel cells and their role in sustainable energy generation.		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams
1.4	Comprehend the biological processes involved in bioethanol production and evaluate its economic and environmental implications.		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams
1.5	Explore the potential of microalgae as a renewable source of biofuel and analyze the current challenges and opportunities in this field.		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.6	Evaluate the diverse microbial solutions that contribute to sustainable agriculture practices and post-harvest food protection.		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams
1.7	Understand the principles and applications of bioleaching as a more environmentally friendly approach to metal extraction.		Two credits weekly lectures	Quizzes -Presentations -Assignments -written exams
2.0	Skills			
2.1	Develop critical thinking and problem-solving skills to analyze data, propose solutions, and address challenges in different industrial microbiology applications.		-Two credits weekly lectures -Tutorials	-Presentations -Assignments -written exams
2.2	Design and interpret experiments related to microbial growth, biomolecule production, and energy generation.		-Two credits weekly lectures -Tutorials	-Presentations -Assignments -written exams
2.3	Effectively communicate complex scientific concepts and technological advancements in industrial microbiology to diverse audiences.		-Two credits weekly lectures -Tutorials	-Presentations -Reports
2.4	Stay updated with the latest research and developments in the field through scientific literature and professional resources. Apply theoretical knowledge to solve practical problems		-Two credits weekly lectures -Tutorials	-Presentations -Reports

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	encountered in industries utilizing industrial microbiology techniques.			
3.0	Values, autonomy, and responsibility			
3.1	**Values** Sustainability and Environmental Stewardship: Instill a strong commitment to using industrial microbiology practices that minimize environmental impact, conserve resources, and promote renewable solutions. Social Responsibility and Equity: Encourage students to consider the broader societal implications of their work, ensuring equitable access to the benefits of industrial microbiology advancements and addressing potential ethical concerns. Scientific Integrity and Transparency: Foster a culture of ethical research and development, promoting data integrity, transparency in communication, and responsible use of scientific knowledge.		Group discussions	-Presentations -Reports
3.2	**Autonomy**: Critical Thinking and Innovation: Challenge students to go beyond established practices, encouraging them to critically analyze current applications, propose innovative		Group discussions	-Presentations -Reports

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	solutions, and contribute to the advancement of the field. Lifelong Learning and Professional Development: Cultivate a passion for continuous learning, encouraging students to stay updated with the latest research, developments, and ethical considerations in industrial microbiology. Independent Research and Problem-Solving: Provide opportunities for students to conduct independent research projects, analyze data, and develop solutions to real-world challenges presented by industrial microbiology applications. Effective Communication and Collaboration: Enhance communication skills to convey complex scientific concepts to diverse audiences, fostering collaboration and knowledge exchange within the field.			
3.3	**Responsibility**: Risk Assessment and Management: Emphasize the importance of identifying and mitigating potential risks associated with various industrial		Group discussions	-Presentations -Reports

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	microbiology applications, ensuring safety for humans, animals, and the environment. Ethical Research and Development: Promote responsible research practices and ethical considerations in the development and implementation of new industrial microbiology technologies. Resource Management and Optimization: Foster an awareness of the resource demands of different industrial microbiology applications, encouraging efficient resource utilization and minimizing waste generation. Public Engagement and Transparency: Encourage students to engage with the public, addressing concerns, providing transparent information about their work, and promoting responsible uses of industrial microbiology.			

C. Course Content:

No	List of Topics	Contact Hours

1	Physiological and genomic principles behind applications of industrial microbiology	4
2	Important Biomolecules Production , enzymes and antibodies.	6
3	Microbial fuel cell (MFC) applications	2
4	Bioethanol production	2
5	Biofuel from micro algae	2
6	Microbial products for Sustainable Agriculture and Post-Harvest Food Protection	6
7	Bioleaching " biomining".	2
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	15%
2.	**Midterm exam-2**	10th week	15%
3.	**Assignments, presentations, attendance, data search, participation**	Throughout the course duration	10%
	Final lab exam	15th week	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- David Wilson., Hermann Sahm., Peter Stahmann and Mattheos Koffas . 2019. Industrial Microbiology. Wiley-VCH. 2- Zvi Cohen and Colin Ratledge. 2010. Single Cell Oils, Microbial and Algal Oils. Academic Press and AOCS Press. 3- Venkataraman S., Prabhakaran M and Kiyoshi O. 2018. Microbial Fuel Cell Technology for Bioelectricity. Singapore : Springer 4- Johnson B.D., Bryan C.G., Schlömann M and Roberto. F. 2023. Biomining Technologies, Extracting and Recovering Metals from Ores and Wastes. Singapore : Springer.
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**

Course Specification

(Postgraduate Programs)

Course Title:	**Project Planning and Proposal Writing**
Course Code:	**BIO-6391**
Program:	**Master of Science in Applied Biology (Cell and Molecular Biology)**
Department:	**Biology**
College:	**Science**
Institution:	**Imam Mohammed Ibn Saud Islamic University**
Version:	**1**
Last Revision Date:	*Pick Revision Date.*

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F. Assessment of Course Quality: 8

G. Specification Approval Data: 8

عبد الملك بن عبد العزيز بن عبد الله الرحيمي الناصر

A. General information about the course:

1. Course Identification:

1. Credit hours: (Lecture 2 + Lab 0)				
2. Course type				
A.	☐University	☐College	☐Department	☒ Track
B.	☒ Required		☐Elective	
3. Level/year at which this course is offered: (Level 3/ second year)				
4. Course General Description:				
This graduate course is designed to provide the students with the basic guidelines for writing research proposals and planning research projects. The course focuses on the key points that render the proposal and project plan in an integrated form which undoubtedly reflect the outcomes of the intended research work. The course content emphasizes that proposal writing and project planning are an aforethought process that requires employing background knowledge and writing skills. It is explained that the proposal should reveal the biological problem in question and how this problem is addressed through performing the research work. It is stressed in the course content that the expected research outcomes should be clarified in the proposal objectives. It also emphasizes the additive impact of the anticipated research results on the current knowledge in the relevant biology disciplines. The course explains how project planning is strongly related to the quality of proposal writing.				
5. Pre-requirements for this course (if any)**:**				
None				
6. Co-requirements for this course (if any)**:**				
None				
7. Course Main Objective(s):				
The course's main objectives are centred on the process of proposal writing and project planning. The course aims to equip the students with the necessary knowledge and the required skills to reach a well-written research proposal and a well-planned research project. Elements of a high-quality proposal and fundamentals of an integrated project plan are key objectives of the course. The course aims also encompass paying the student attention to the importance of involving the biological problem that needs to be addressed in the proposal content. In addition, the course aims to provide the students with the skills necessary to plan a well-organized research project to address the problem in question using the most convenient research tools.				

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**	-
3.	**Field**	-
4.	**Tutorial**	-
5.	**Others (specify) .....**	
	Total	30

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods:

Code	Course Learning Outcomes	Code of CLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	**Describe the major considerations in writing an acceptable research proposal in compliance with the relevant biology speciality**	**K1**	-Two-hour credit lectures -Demonstrations -Tutorials	-Assignments -Reports -Data Search -Participations -Written exams
1.2	**Outline the proposal elements and the finalizing steps to**	**K2**	-Two-hour credit lectures -Demonstrations	-Assignments -Reports -Data Search

Code	Course Learning Outcomes	Code of CLOs aligned with the program	Teaching Strategies	Assessment Methods
	submit a research proposal as a crucial step preceding conducting a research work		-Tutorials	-Participations -Written exams
1.3	**Explain the key points in planning a research project and how to maintain the research integrity**	**K3**	-Two-hour credit lectures -Demonstrations -Tutorials	-Assignments -Reports -Data Search -Participations -Written exams
2.0	Skills			
2.1	**Employ the acquired knowledge, critical thinking, and skills to reach a well-written research proposal**	**S1**	-Two-hour credit lectures -Demonstrations -Tutorials -Class discussions	-Assignments -Reports -Data Search -Participations -Presentations -Written exams
2.2	**Design a well-planned research project and select the most convenient research methods and techniques to solve a biological problem**	**S2**	-Two-hour credit lectures -Demonstrations -Tutorials -Class discussions	-Assignments -Reports -Data Search -Participations -Presentations -Written exams
2.3	**Relate between the plan of the project and the objectives of the approved research proposal**	**S3**	-Two-hour credit lectures -Demonstrations -Tutorials -Class discussions	-Assignments -Reports -Data Search -Participations -Presentations -Written exams
3.0	**Values, autonomy, and responsibility**			
3.1	**Perform research work independently and cooperate effectively with a teamwork**	**V1**	-Group discussions	-Reports -Presentations
3.2	**Communicate scientific issues**	**V2**	-Group discussions	-Reports -Presentations

Code	Course Learning Outcomes	Code of CLOs aligned with the program	Teaching Strategies	Assessment Methods
	professionally with peers and present a research proposal clearly as an oral presentation or written format			
3.3	**Adhere to the relevant ethical rules while writing a proposal or planning a research project**	**V3**	-Group discussions	-Reports -Presentations

C. Course Content:

No	List of Topics	Contact Hours
1.	**Objectives of a Research Proposal Writing:** -Showing how the intended research work fits into the topic of research -Clarifying the biology question(s) that will be answered -Explain what findings will be added to the current knowledge	**4**
2.	**Proposal Narrative:** Generation of an outline, choosing a meaningful title, and resources	**4**
3.	**Essential Proposal Elements (Composing a research proposal):** -A discernible logic flow from the introduction to references -Title, introduction, background literature, objectives (goal statement), experiment or field study, materials, methods and techniques, analysis of results, expected outcomes, references, and appendices (documents supporting proposal)	**4**
4.	**Enhancing the Impact of a Research Proposal:** -Showing an in-depth understanding of the existing literature -Employing writing skills and using diagrammatic representations -Preparing research proposal to be persuasive and achievable	**4**
5.	**Utilizing the Relevant Resources:** Utilizing the resources to prepare a research proposal (internet resources, search engines, textbooks, etc.)	**4**
6.	**Finalizing the proposal format and proposal submission:** Proofreading and editing of the proposal draft	**2**
7.	**Proposal Evaluation and Approval:** -Convincing evaluators about the significance and outcomes of the intended research work	**4**

	- Obtaining approvals from various evaluation committees	
8.	**Planning Research Project:** Project objectives, background knowledge, design of experiment or field study, methods, analysis tools, showing results, and discussing findings	**4**
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.	**Attendance, assignments, reports, presentations, participation**	Throughout the course duration	20%
...	**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	-Your Research Project Designing, Planning, and Getting Started. 2018. Nicholas Walliman. 4th Ed. Oxford Brookes University, UK. ISBN: 1526441209 -General Guide to Writing Research Proposal. 2019. Oso WY, -Onen D. The Jorno Kenyatta Foundation. ISBN: 9789966227164 -Research Projects and Research Proposals. 2009. A Guide for Scientists Seeking Funding. Paul G. Chapin. ISBN: 9780511500084
Supportive References	http://www.libguides.usc.edu/writingguide . https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5037942/
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	Student	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**

Course Specification

(Postgraduate Programs)

Course Title:	**Research Project**
Course Code:	**BIO-6499**
Program:	**Master of Science in Applied Biology (Cell and Molecular Biology)**
Department:	**Biology**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	**1**
Last Revision Date:	*Pick Revision Date.*

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G. Specification Approval Data: 11

عبد الملك بن عبد العزيز بن عبد الله الرحيمي الناصر

A. General information about the course:

1. Course Identification:

1. Credit hours: (4)				
2. Course type				
A.	☐University	☐College	☐Department	☒ Track
B.	☒ Required		☐Elective	
3. Level/year at which this course is offered: (Level 4 / second year)				
4. Course General Description:				

This graduate course provides students with the opportunity to conduct independent research projects with the guidance of academic supervisors. A research project for students is an extended essay that presents a research question for analysis and evaluation. Conduction of the research work is the subsequent step to project planning and submission of research proposals. Assigned research projects enable students to explore areas of interest across various biology disciplines, under the supervision of academic staff members. Through the independent conduction of planned projects, students are encouraged to develop and employ a range of research skills such as a collection of data from diverse sources and systematic reviewing of the relevant literature. Proper keeping of records, interpretation and analysis of research results, safe practices under laboratory and field conditions, and presentation of scientific issues are among the targeted skills. Given these skills, the students have the chance to develop a deeper understanding of research topics that are targeted in their projects. Through this course, the students are equipped with the experience of research and project management as well as the professional skills that are crucial to performing future research work. Successful completion of this course represents the cornerstone to qualify the enrolled students for graduation.

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

None

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

None

7. Course Main Objective(s):

The major course objectives are centred on research planning, research conducting, and research reporting. According to course aims, the students are engaged in practical independent research focusing on their specializations to achieve the planned proposal objectives. The research project is planned and formulated in a proposal in terms of research purpose, background, methods, analysis of research results, and documentation. One of the major course objectives is to allow the students to independently manage research projects within a scheduled work-frame. The students should comply with the relevant ethical rules, and the safety measures appropriate to their research work. The course also aims to provide the students with practical skills concerning the selection and employment of the appropriate research methods.

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	-	0
2	E-learning	-	0
3	Hybrid • Traditional classroom • E-learning	-	0
4	Distance learning	-	0

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

No	Activity	Contact Hours
1.	**Lectures**	0
2.	**Laboratory/Studio**	30
3.	**Field**	30
4.	**Tutorial**	0
5.	**Others (specify)**	
	Total	60

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods:

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Outline the sequence of preliminary steps, including topic approval, project planning and proposal submission, that precede the launch of a research project	K1	-	-Presentations -Reports
1.2	Explain how to balance the sections of description and analysis in scholarly writing and how to implement them in the final research report	K2	-	-Presentations -Reports
1.3	Describe how to prepare a checklist for the research project by listing the research resources and identifying the data sources, along with other requirements	K3	-	-Presentations -Reports

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
2.0	**Skills**			
2.1	Relate the intended original research to the proposal objectives and current trends to execute experimental or field research work.	S1	-	-Presentations -Reports
2.2	Employ the theoretical knowledge and practical experience to apply the research methodologies for generating reliable data	S2	-	-Presentations -Reports
2.3	Apply critical thinking and professional skills to test research hypotheses and address the research questions	S3	-	-Presentations -Reports
2.4	Formulate the final research report, by including the applied methods, results, and analysis, in a way that reflects in-depth knowledge and practical skills.	S4	-	-Presentations -Reports

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
3.0	**Values, autonomy, and responsibility**			
3.1	Demonstrate a strong sense of independence and, an attitude of accountability and responsibility while carrying out the research project.	V1	-	-Presentations -Reports
3.2	Participate in discussions relevant to the research project, communicate scientific issues, and present research results orally and in written formats to varied audiences	V2	-	-Presentations -Reports
3.3	Adhere to the relevant ethical rules and demonstrate the ability to comply with safety procedures appropriate to the research project	V3		-Presentations -Reports

C. Course Content:

No	List of Topics	Contact Hours
1.	**Preliminary steps of the research project:** -The nature of the research area -Finding a research topic -Feasibility of research topic -Validity of research area -Formulating a research question, statement, or hypothesis	8
2.	**Planning and designing a research project:** -Methods for testing hypotheses -Experimental models and field studies -Experimental design -Research methods and techniques	8
4.	**Finding and evaluating sources:** -Locating, collecting and evaluating information for a specific research purpose - Acquisition of technical information - Methods of collecting information -Credible sources to make up a literature review -Up-to-date information -Relevance of sources -Validity of sources	8
5.	**Conducting research:** -Primary research (lab experiments and field studies) -Execution of research plan to achieve research goals	24
6.	**Formulating a research report:** **-Research report format** **-Components of a research report:** **Introduction:** Presenting the hypothesis and purpose of the project **Literature review:** Description of the publications, evaluating the existing research, and validating the research aims. **Methodology:**	8

	Application of Research methods to test hypothesis Quantitative (description and observation) Qualitative (Numerical) **Results and findings** **Analyzing and interpreting research data:** Statistical analysis of research data Interpretation of research results **Discussion:** Relating results to the research hypothesis, Explaining results Validating results by published data Significance of the research **Conclusion:** Summarizing the research report **References:** Listing of correctly cited references	
7.	**Presentation and evaluation of the research report:** -Presentation of research report (oral and written formats) -Evaluation of research report (supervisors and examiners)	4
Total		**60**

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Oral presentation**	At the end of the project	25%
2.	**Reports**	Throughout the course duration	75%
3.	-	-	-
...	-	**Total**	**100%**

*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	Thomas G. (2022). How to Do Your Research Project: A Guide for Students. 3rd Ed. SAGE Publications Ltd. ISBN 10: 1529757711 Berry R. (2004). The Research Project. How to Write It, 5th Ed. ISBN 9780415334457 Ewart J, Ames K. (2020). Managing Your Academic Research Project. Springer Singapore. ISBN: 978-981-15-9194-5
Supportive References	https://www.gla.ac.uk/coursecatalogue/course/?code=BIOL513P https://ocasys.rug.nl/current/catalog/course/WBCH901-15
Electronic Materials	
Other Learning Materials	

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Laboratories, equipment, instruments
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	-	-
Effectiveness of students' assessment	-	-
Quality of learning resources	Supervisor (s)	Direct
The extent to which CLOs have been achieved	Department and 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**

Elective. Track -III

عبد الملك عبد العزيز بن عبد الله الرحيمي الناصر

عبد الملك عبد العزيز بن عبد الله الرحيمي الناصر

Course Specification
(Bachelor)

Course Title:	**Statistical Analysis of Biological Data**
Course Code:	**STA 6118**
Program:	**Master of Science in Applied Biology**
Department:	**Biology**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	**2023 – V1**
Last Revision Date:	**None**

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E. Learning Resources and Facilities 6

F. Assessment of Course Quality 7

G. Specification Approval 7

A. General information about the course:

1. Course Identification

1. Credit hours:					
3 (2 Lectures, 2 Lab, 0 Tutorial)					
2. Course type					
A.	☐University	☐ College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered:					
Level 1 / Year 1					
4. Course general Description:					
This course comprehensively introduces statistical methods and their application in biological research (in Molecular Biology, Biodiversity, and Biotechnology). It is designed for graduate students in the Master of Science in Applied Biology program who seek to develop a solid foundation in statistical analysis relevant to biological data. The course offers the students the necessary skills to compute and analyze measurements of location and deviations, frequencies, and covariation. The course also emphasizes the utilization of sample data to estimate population parameters. The course focuses on applying univariate and multivariate statistical approaches and explaining statistical ideas without requiring intricate mathematical proofs.					
5. Pre-requirements for this course (if any):					
None					
6. Co-requisites for this course (if any):					
None					
7. Course Main Objective(s):					
This course comprehensively introduces statistical methods and their application in biological research (in Molecular Biology, Biodiversity, and Biotechnology). It is designed for graduate students in the Master of Science in Applied Biology program who seek to develop a solid foundation in statistical analysis relevant to biological data. The course offers the students the necessary skills to compute and analyze measurements of location and deviations, frequencies, and covariation. The course also emphasizes the utilization of sample data to estimate population parameters. The course focuses on applying univariate and multivariate statistical approaches and explaining statistical ideas without requiring intricate mathematical proofs..					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	60	100%

No	Mode of Instruction	Contact Hours	Percentage
2	E-learning	0	0%
3	Hybrid • Traditional classroom • E-learning	**0**	**0%**
4	Distance learning	**0**	**0%**

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	**30**
2.	**Laboratory/Studio**	**30**
3.	**Field**	**0**
4.	**Tutorial**	**0**
5.	**Others (specify)**	**0**
Total		**60**

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	*Course Learning Outcomes*	*Code of CLOs aligned with program*	*Teaching Strategies*	*Assessment Methods*
1.0	**Knowledge and understanding**			
1.1	**Describe the basic statistical methods related to principal statistical inference, linear models, and probability-based methods.**	**K1**	**Lectures, problem-solving, Classroom discussions**	**Direct: Regular Exams, Lab Assignments, Practical exam**
1.2	**Identify the statistical analyses meeting the data analysis demands in biological research work.**	**K1, K2**	**Lectures, problem-solving, Classroom discussions**	**Direct: Regular Exams, Lab Assignments, Practical exam**
1.3	**Recognize the common biological types and the principles of data collection and generating descriptive statistics.**	**K1**	**Lectures, problem-solving, Classroom discussions**	**Direct: Regular Exams, Lab Assignments, Practical exam**
1.4	**Use computer programs to solve problems in Applied Biology.**	**K1, K2**	**Lectures, problem-solving, Classroom discussions**	**Direct: Regular Exams, Lab Assignments, Practical exam**
2.0	**Skills**			

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
2.1	**Design experiments in varied Applied Biology disciplines and test a generated hypothesis.**	**S1**	**Lectures, problem-solving, Classroom discussions**	**Direct: Regular Exams, Lab Assignment, Practical exam**
2.2	**Formulate the necessary approaches to problems relevant to biological data analysis.**	**S2, S3**	**Lecturing, Interactive learning.**	**Direct: Assignments, Practical exam**
2.3	**Evaluate the significance of critical analysis and interpretation and draw the appropriate conclusions.**	**S3, S4**	**Lecturing, Interactive learning.**	**Direct: Assignments, Practical exam**
2.4	**Utilize the appropriate statistical methods and computer analyzing packages.**	**S1**	**Lectures, problem-solving, Classroom discussions.**	**Direct: Regular Exams, Lab Assignment, Practical exam**
3.0	**Values, autonomy, and responsibility**			
3.1	**To show the ability to work independently and cooperate with a team to collect and analyze biological data.**	**V1**	**Lectures, problem-solving, Classroom discussions**	**Direct: Regular Exams, Lab Assignments, Practical exam**
3.2	**To share in specialized meetings and professionally present statistical analyses' outputs to varied audiences.**	**V2**	**Lectures, problem-solving, Classroom discussions**	**Direct: Regular Exams, Lab Assignments, Practical exam**
3.3	**To demonstrate the ability to communicate effectively varied statistical methods and their applications.**	**V4**	**Lectures, problem-solving, Classroom discussions**	**Direct: Regular Exams, Lab Assignments, Practical exam**

C. Course Content

No	List of Topics	Contact Hours
1	**Introduction:** The Meaning of Statistics, The Uses of Statistics, Descriptive and Inferential Statistics, Sources of Data: Surveys and Experiments, Retrospective and Prospective Studies, Demographic Data, Population and Sample, Qualitative and Quantitative Data, Scales of Measurement.	**10**
2	**Exploring Data with Tables and Graphs:** Frequency Distributions for Organizing and Summarizing Data; Histograms; Graphs That Enlighten and Graphs That Deceive; Scatterplots, Correlation, and Regression. ***Applications using statistical software.***	**12**

No	List of Topics	Contact Hours
3	**Describing, Exploring, and Comparing Data:** Measures of Center; Measures of Variation; Measures of Relative Standing and Boxplots. ***Applications using statistical software.***	**12**
4	**Probability and Probability Distributions:** Basic Probability Concepts, Normal Probability Distribution, Discrete Probability Distributions: Binomial and Poisson. ***Applications using statistical software.***	**10**
5	**Estimating Parameters and Determining Sample Sizes:** Sampling and Sampling Distribution; Estimation of mean, variance and proportion for a single population; Error of estimation; Sample size determination; Estimation of the difference between 2 means, ratio of 2 variances and difference of 2 proportions for two populations. ***Applications using statistical software.***	**16**
Total		**60**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Homeworks, Mini projects**	**During the semester**	**15%**
2.	**First Midterm**	**Week 6**	**25%**
3.	**Lab exam**	**Week 12**	**20%**
4.	**Final Exam**	**Week 15**	**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. ***Experimental Design and Data Analysis for Biologists,*** 2nd Editions; Gerry P. Quinn, Michael J. Keough, Cambridge University Press, 2023. **(Main Reference).** 2. ***The Analysis of Biological Data,*** 3rd Edition; Michael C. Whitlock; Dolph Schluter, W. E. Freeman, 2020.
Supportive References	***Analyzing Environmental Data,*** Walter W. Piegorsch, A. John Bailer, John Wiley & Sons, Ltd., 2005. ***Statistics for Environmental Science and Management,*** 2nd Edition, Bryan F. J. Manly, CRC Press, 2009.
Electronic Materials	**None**
Other Learning Materials	**None**

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	▪ Each classroom should be equipped with a whiteboard and a projector. ▪ Laboratories should be equipped with computers and an internet connection.
Technology equipment (projector, smart board, software)	The rooms should be equipped with a data show and Smart Board. All computers should be equipped with the following software: • Microsoft Excel • IBM SPSS • R-Project
Other equipment (depending on the nature of the specialty)	None

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Each student will complete two evaluation forms during the semester and at the end of the course.
Effectiveness of Students' assessment	Instructor	At the end of each semester, the course instructor should complete the course report, which includes a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary.
Quality of learning resources	Students	Each student will complete two evaluation forms during the semester and at the end of the course.
The extent to which CLOs have been achieved	Instructor	At the end of each semester, the course instructor should complete the course report, which includes a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary.
Other	None	

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

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL
REFERENCE NO.	4/1446
DATE	06/03/1446 (09/09/2024)