Course Specification
(Bachelor)

Course Title: Marine Environment
Course Code: BIOE3510
Program: Environmental Sciences
Department: Biology
College: Applied Science
Institution: Umm Al-Qura University
Version: 1447
Last Revision Date: 26 December 2024

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (3 hr)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (3rd Year / 5th Level)					
4. Course general Description:					
This course provides a comprehensive foundation in the science of the modern marine environment, covering key topics such as marine ecology, marine pollution, and the impact of human activities on marine ecosystems. It explores various aspects of marine biology, with a focus on the practical applications of marine biology in the sustainable development of marine resources and the protection of marine environments. The course also examines the challenges and strategies related to the conservation and management of marine ecosystems in the face of environmental threats.					
5. Pre-requirements for this course (if any)**:**					
General Biology (BIO1101) 1st Year / 1st Level					
6. Pre-requirements for this course (if any)**:**					
Principle of Ecology (BIOE1502) 1st Year / 1st Level					
7. Course Main Objective(s):					
The primary objective of this course is to introduce students to the complexities of the marine environment, emphasizing the biological, ecological, and environmental factors that shape marine ecosystems. The course aims to equip students with the knowledge and skills necessary to understand and address the challenges of marine resource exploitation, conservation, and protection. Students will gain insight into the sustainable management of marine environments, fostering an understanding of the role marine biology plays in ensuring the health and preservation of oceanic ecosystems for future generations.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom (V)	**75**	**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**	45
3.	**Field**	10
4.	**Tutorial**	-
5.	**Others (specify)**	-
Total		85

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 fundamental principles of environmental science, including ecosystems, biodiversity, and the impact of human activities on the environment.	K1, K2	- Interactive lectures - Case studies - Group discussions	- Written exams - Assignments - Quizzes - Research papers

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.2	Explain the key environmental issues such as climate change, pollution, conservation, and sustainability, and their global implications.	K1, K2	- Lectures - Multimedia presentations - Guest speakers	- - Written exams - Quizzes - Open-book exam - Group projects
1.3	Identify and analyze the relationships between environmental processes and human societies, including resource management and policy making.	K1, K2, K3	- Lectures - Debates - Case studies	- - Exams - Case study analysis - Assignments- -
2.0	Skills			
2.1	Apply knowledge of environmental science to assess real-world environmental challenges and propose sustainable solutions.	S1, S2	- - Fieldwork - Group discussions - Research projects	- - Field reports - Research papers - Presentations
2.2	Develop critical thinking skills by evaluating environmental data and research findings to support decision-making processes in environmental management.	S2	- - Lectures - Practical exercises - Data analysis	- - Case study evaluations - Written assignments - Exams
2.3	Demonstrate proficiency in using tools and technology for environmental monitoring, data collection, and analysis.	S2, S3	- - Laboratory work - Field trips - Demonstrations	- - Lab reports - Practical exams - Fieldwork assessments
2.4	Work effectively in teams to address environmental issues, emphasizing	S2, S3	- - Group projects - Team-	- - Peer evaluations - Team reports

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	collaboration, time management, and conflict resolution.		based assignments	- Presentations
3.0	**Values, autonomy, and responsibility**			
3.1	Promote ethical decision-making and responsibility in environmental management, focusing on equity, sustainability, and respect for all life forms.	V1, V2	- Group discussions - Ethical dilemma exercises	- Reflection essays - Case study discussions
3.2	Recognize the importance of continuous learning and self-assessment in environmental sciences to remain updated with emerging environmental challenges and solutions.	V3	- Interactive seminars - Independent research	- Self-assessment reports - Research projects
...	Demonstrate leadership in advocating for environmental protection and sustainability in academic, professional, and community settings.	V1, V2, V3	- Community outreach - Campaigns - Public speaking	- Community projects - Campaign plans - Presentations

C. Course Content

No	List of Topics	Contact Hours
1.	**Introduction to the Science of Marine Environment**	**2**
2.	**The Important of Marine Environment**	**2**
3.	**Marine Ecology**	**2**
4.	**Marine Geology**	**2**
5.	**The Sea Floor**	**2**

6.	Marine Biodiversity - Seaweeds and Plants	2
7.	Marine Biodiversity - Animals	2
8.	Marine Microbiology and Bioremediation	2
9.	The Impact of Humans on the Marine Environment	2
10.	Marine Pollution	2
11.	Marine Conservation	2
12.	Marine Environmental Biotechnology	2
13.	Marine Natural Products (Economies)	2
14.	Aquaculture	2
15.	Marine Environmental Monitoring	2
Total		30

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Quizzes, Project, Problem Sets	-	10
2.	Midterm Exam (Lab)	6	10
3.	Exam Midterm (Lecture)	6	20
4.	Final Exam (Lab)	14	20
5.	Final Exam (Lecture)	15	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	Marine Biology, Peter Castro, Michael E. Huber, William C. Ober, Claire E. Ober, 11th Edition, McGraw-Hill Education, 2018, 992 pages.
Supportive References	Marine Biology Journal of Marine Sciences Journal of Experimental Marine Biology and Ecology
Electronic Materials	*Fundamentals of Biology*, ALISON – online learning website. https://alison.com/course/fundamentals-of-biology-revised
Other Learning Materials	• **Course Handouts**: Detailed course notes covering marine ecology, marine pollution, human impacts on marine ecosystems, and conservation strategies.

	• **Lab Manuals**: Practical guides for conducting experiments and fieldwork related to marine environmental monitoring, pollution studies, and biodiversity assessment. • **Research Papers**: Recent scientific papers on marine biodiversity, oceanography, and environmental challenges such as coral bleaching, plastic pollution, and overfishing. • **Case Studies**: Real-world examples of successful marine conservation efforts, such as marine protected areas (MPAs) or restoration of coral reefs. • **Interactive Online Modules**: Access to online learning platforms that include simulations and educational tools for understanding marine ecosystems and human impacts on marine life. • **Documentaries and Videos**: Educational videos or documentaries on marine conservation efforts, marine life behaviors, and environmental threats. • **Marine Species Identification Guides**: Books or digital resources for identifying marine species commonly found in the studied regions (e.g., Saudi Arabia's marine life •

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	**- Lecture room** **- Laboratory** **- Exhibition room for marine samples (if applicable)** **- Simulation rooms for environmental modeling**
Technology equipment (projector, smart board, software)	**- Computers** **- Internet access** **- Smart Board** **- Projector** **- Software for environmental modeling (e.g., GIS, marine simulation software)** **- Marine environmental data collection software**
Other equipment (depending on the nature of the specialty)	**- Display screen** **- White board** **- SDS electrophoresis tanks and its contents** **- DNA electrophoresis tanks and its contents** **- PCR Thermocycler** **- UV rays for DNA visualization** **- Water quality monitoring instruments (pH meters, salinity meters)**

Items	Resources
	- Oxygen meter for water testing **- Marine life sampling tools (nets, traps)** **- Environmental monitoring devices (temperature sensors, tide gauges**

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	**Course instructor**	- Student feedback through written comments - Satisfaction survey at the end of each semester
Effectiveness of Students assessment	**Students**	- - Written feedback by individuals - Satisfaction survey at the end of each semester
Quality of learning resources	**Course instructor**	- - Attending staff development workshops and programs - Continuous education - Implementing student feedback - Variations of teaching strategies including tutorials, Problem-Based Learning (PBL), and emphasizing practical sessions
The extent to which CLOs have been achieved	**Course instructor** **Peer reviewer** **Program director**	- - Course development based on analysis of student feedback - Monitoring students' performance throughout the semester using formative assessments - Analyzing students' progress - Using statistics to analyze students' achievement at the end of each semester and implement data comparison

Assessment Areas/Issues	Assessor	Assessment Methods
		- Peer evaluation of the instructor
Other	Course Instructor Program Director	**- Review of teaching effectiveness based on peer evaluations** **- Evaluation of student engagement and participation** **- Feedback from external examiners or reviewers** **- Post-course evaluations for continuous improvement**

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

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	
REFERENCE NO.	
DATE	

Course Specification
(Bachelor)

Course Title:	**Environmental Animal Physiology**
Course Code:	**BIOE3203**
Program:	**Environmental Sciences**
Department:	**Biology**
College:	Applied **Sciences**
Institution:	**Umm-Alqura University**
Version:	**1447**
Last Revision Date:	*Pick Revision Date.*

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (3 hrs)					
3 hrs					
2. Course type					
A.	☐ University	☐College	☒ Department	☐Track	Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (3rd Year / 5th Level)					
4. Course general Description:					

The course examines how organisms adapt to environmental conditions, focusing on physiological responses to factors like temperature, water, light, and pollutants. The course integrates ecology and biology to explore environmental stressors, climate change impacts, and species survival through case studies, labs, and fieldwork.

PRACTICAL ENVIRONMENTAL PHYSIOLOGY COURSE:

NO	Topics	Contact Hours
1	Measurement of Environmental Stressors: Temperature and Humidity Effects on Organisms	3
2	Osmoregulation in Aquatic Organisms: Practical Investigations of Salt and Water Balance	3
3	Field Sampling Techniques for Studying Physiological Responses in Natural Habitats	3
4	Using Respirometry to Measure Oxygen Consumption in Response to Environmental Changes	3
5	Photoperiod and Circadian Rhythms: Assessing Biological Responses to Light and Dark Cycles	3
6	Thermoregulation: Investigating Heat Shock Proteins in Response to Temperature Stress	3
7	Water Stress and Plant Physiology: Analyzing Transpiration and Stomatal Conductance	3
8	Effects of Pollutants on Aquatic Organisms: Bioassays with Heavy Metals	3
9	Analysis of Blood Glucose and Stress Hormones as Physiological Indicators	3
10	Examining Metabolic Rate Variations in Response to Environmental Stressors	3
11	Ecophysiological Adaptations in Extreme Environments: A Laboratory Simulation	3
12	Investigating the Impact of Hypoxia on Animal Metabolism Using Anoxia Chambers	3
13	Endocrine Responses to Environmental Stress: Practical Use of Hormone Assays	3
14	Field Data Collection: Monitoring Physiological Stress in Terrestrial and Aquatic Environments	3
15	Adaptations to Altitude: Investigating Hemoglobin Levels and Oxygen Transport in High-altitude Organisms	45

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

Eco-biochemistry (BIOE2505)

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

7. Course Main Objective(s):

By the end of the course , the student should be able :

1. **To understand the physiological mechanisms organisms use to adapt to environmental challenges.**
2. To analyze the effects of environmental factors such as temperature, water, light, and pollutants on organismal function.
3. To explore the impact of climate change and human activities on physiological processes across species.
4. To develop skills in experimental design, data analysis, and interpretation through laboratory and field studies.
5. To foster critical thinking in assessing organismal responses to environmental stressors.

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom (√)	(Theoritically) : 30 hrs (Practically) : 45 hrs	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 hrs
2.	**Laboratory/Studio**	45 hrs
3.	**Field**	10 hrs (Tripe)
4.	**Tutorial**	-
5.	**Others (specify)**	-
Total		**85 hrs**

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	Explain the physiological adaptations of organisms to different environmental factors.	CLO-K1	Interactive lectures and multimedia presentations.	Written exams.
1.2	Identify the effects of temperature, water, and pollutants on physiological processes.	CLO-K2	Case studies and problem-based learning.	Case study analysis.
1.3	Describe the mechanisms of organismal responses to environmental stressors.	CLO-K3	Group discussions and collaborative activities.	Group projects and presentations.
1.4	Summarize the role of climate change and human activities in altering physiological functions.	CLO-K4	Interactive lectures and real-world examples.	Reflection essays and written reports.
2.0	**Skills**			
2.1	Analyze environmental factors and their influence on organism physiology.	CLO-S1	Laboratory experiments and hands-on activities.	Laboratory reports and practical exams.
2.2	Apply experimental methods to measure physiological responses in laboratory and field settings.	CLO-S2	Fieldwork and technical demonstrations.	Fieldwork reports and skill assessments.
2.3	Critically evaluate data from experiments and case studies to identify patterns and relationships.	CLO-S3	Group problem-solving tasks and peer review.	Case study analysis and research papers.
2.4	Demonstrate critical thinking to interpret physiological responses in varying environmental contexts.	CLO-S4	Case-based learning and independent problem-solving.	Problem-solving assessments and oral presentations.
3.0	**Values, autonomy, and responsibility**			
3.1	Demonstrate ethical practices in the design and execution of laboratory and field studies.	CLO-V1	Ethical debates and group reflections.	Reflection papers and ethical evaluations.

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
3.2	Recognize the importance of sustainability in studying environmental physiology.	CLO-V2	Discussions on real-world issues and sustainable solutions.	Case study reflections and presentations.
3.3	Take responsibility for collaborative research projects and contribute effectively to group work.	CLO-V3	Group projects and collaborative workshops.	Peer evaluation and group project assessments.
3.4	Value lifelong learning to address emerging challenges in environmental physiology.	CLO-V3	Self-directed learning tasks and literature reviews.	Research papers and self-assessment reports.

C. Course Content

No	List of Topics	Contact Hours
1.	Introduction to Environmental Physiology: Concepts and Importance	2 hrs
2.	Physiological Adaptations to Temperature: Thermoregulation in Animals and Plants	2 hrs
3	Water Balance and Osmoregulation in Aquatic and Terrestrial Organisms	2 hrs
4	Effects of Light on Photosynthesis and Circadian Rhythms in Plants and Animals	2 hrs
5	Adaptations to Extreme Environments: Polar, Desert, and High-Altitude Physiology	2 hrs
6	Physiological Responses to Hypoxia and Anoxia in Aquatic and Terrestrial Species	2 hrs
7	Effects of Pollution and Toxic Substances on Physiological Functions	2 hrs
8	Endocrine and Nervous System Adaptations to Environmental Stressors	2 hrs
9	Energy Metabolism and Nutritional Strategies under Environmental Constraints	2 hrs
10	Seasonal Adaptations: Hibernation, Diapause, and Migration	2 hrs
11	Physiological Responses of Organisms to Climate Change and Global Warming	2 hrs
12	Physiological Mechanisms of Resistance to Pathogens and Environmental Toxins	2 hrs
13	Laboratory Techniques in Environmental Physiology: Measurement of Stress Markers	2 hrs
14	Case Studies in Environmental Physiology: Examples from Marine, Freshwater, and Terrestrial Systems	2 hrs

15	Integrating Environmental Physiology with Conservation Biology and Sustainable Practices	2 hrs
Total		**30 hrs**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm Exam: Assess theoretical understanding of core concepts	Week 7	20%
2.	Laboratory Reports: Evaluate practical skills and data analysis	Weeks 4, 8, and 12	25%
3.	Group Project and Presentation: Analyze case studies and propose solutions	Week 13	25%
4.	Final Exam: Comprehensive assessment of knowledge and application	Week 15	30%

*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. Environmental Physiology of Animals ,3rd ed. Edition , by Pat Willmer (Author), Graham Stone (Author) , Willy.2020 2. - Campbell, N. A., & Reece, J. B. (2020). Biology (12th ed.). Pearson.
Supportive References	1. Pörtner, H. O., Farrell, A. P., & Knust, R. (2022). Climate Change and Physiology. Springer. 2. Environmental Physiology of Animal,Blackwell publishing,2014.
Electronic Materials	• Online journals: Journal of Experimental Biology, Physiological and Biochemical Zoology. • Relevant eBooks and resources available on SpringerLink and ScienceDirect.
Other Learning Materials	• Laboratory manuals and fieldwork guides. • Multimedia materials such as videos, animations, and webinars on environmental physiology topics.

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• Classrooms equipped with seating for interactive discussions. • Laboratories with equipment for physiological measurements (e.g., spectrophotometers, respirometers). • Fieldwork spaces for outdoor experiments and observations. • - Seminar or exhibition rooms for student presentations and group discussions.
Technology equipment (projector, smart board, software)	• Projector and screen for multimedia presentations. • Smart boards for interactive teaching and demonstrations. • Computers with specialized software (e.g., data analysis tools like SPSS, MATLAB, or R). • - Internet access and audio-visual tools for virtual simulations and online resources.
Other equipment (depending on the nature of the specialty)	• Environmental sensors (e.g., temperature, humidity, light intensity, pH meters). • Portable data loggers for fieldwork. • - Specimen containers, microscopes, and basic dissection tools for laboratory activities.

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of Teaching	• Course Instructor, Peer Review	• Student feedback surveys, end-of-course evaluations.
Effectiveness of Students' Assessment	• Course Instructor, Academic Committee	• Review of exam results and assignments for alignment with learning outcomes.
Quality of Learning Resources	• Course Instructor, Librarian	• Review of course materials (textbooks, software, and multimedia).
The extent to which CLOs have been achieved	• Course Instructor, Academic Committee	• Analysis of student performance against the Course Learning Outcomes (CLOs).
Other (e.g., Student Satisfaction)	• Course Instructor, Students	• Student satisfaction surveys and focus group discussions.

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

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**BIOLOGY DEPARTMENT**
REFERENCE NO.	
DATE	**22/6/1446**

Course Specification

(Bachelor)

Course Title:	Environment of Clans and Communities
Course Code:	BIOE3508
Program:	Environmental Sciences
Department:	Biology
College:	Science
Institution:	Umm Al- Qura University
Version:	47
Last Revision Date:	*Pick Revision Date.*

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (2)					
2					
2. Course type					
A.	☐University	☐College	☒ Department	☐ Track	Others
B.	☒ Required		☐ Elective		
3. Level/year at which this course is offered: (3rd Year/ 5th Level)					
4. Course general Description:					
This course explores the biological foundations of clans and communities in the animal and plant kingdoms, focusing on how organisms form groups and interact with their environments. Topics include social structures, interspecies relationships, ecological dynamics, and the impact of environmental changes on these communities. The course integrates fieldwork, and case studies to provide a comprehensive understanding of ecological and evolutionary mechanisms driving community dynamics.					
5. Pre-requirements for this course (if any)**:**					
Ecosystem in Saudi (BIOE1501)					
6. Pre-requirements for this course (if any)**:**					
7. Course Main Objective(s):					
1- provide students with a comprehensive understanding of how organisms, including humans, animals, and plants, form and sustain communities within diverse environmental contexts. 2- Analyze the ecological, biological, and sociocultural dynamics of these communities, exploring their adaptive strategies, interdependent relationships, and the impact of environmental changes on their structure and function. 3- Students will gain theoretical knowledge and practical skills to evaluate the sustainability of these systems and contribute to their preservation and restoration.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	2 hours/ week	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 program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Describe the principles of community ecology and the biological basis of clan formation.	**K1**	**Lectures**	**Exams**
1.2	Identify key interactions among organisms, including mutualism, competition, predation, and symbiosis.	**K2- K3**	**Lectures**	**Exams**
2.0	**Skills**			
2.1	Analyze the roles of biodiversity and environmental factors in shaping communities.	**S1**	**-Lectures. -Discussion**	**Evaluating the discussion and report**
2.2	Evaluate case studies of animal and plant clans adapting to changing environments.	**S4**	**- Internet search - Brain storming. - Discussion.**	**Review the Case study**
2.3	Use data analysis software to interpret ecological patterns and trends.	**S3**	**- Internet search - Brain storming. - Discussion.**	**Evaluating the discussion and report**
2.4	Present research findings effectively in written and oral formats.	**S5**	**Students will be asked for delivering a presentation regarding certain topics related to the course.**	**Evaluating the discussion and report**

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
3.0	**Values, autonomy, and responsibility**			
3.1	Demonstrate ethical responsibility in environmental conservation.	**V1**		**-Evaluating the discussion and the report.**
3.2	Collaborate in group projects to study ecological interactions.	**V3**		**-Evaluating the discussion and the report.**

C. Course Content

No	List of Topics	Contact Hours
1.	**Introduction to Clans and Communities** • **Definitions and principles of ecological communities.**	**2**
2.	**Biological basis of group formation:** • **group formation in animals** • **group formation plants.**	**2**
3.	**Social Structures in Animals** • **Cooperative behaviors (e.g., hunting, defense).** • **Examples: insect colonies, wolf packs, and primate societies.**	**4**
4.	**Community Dynamics in Plants** • **Interactions within plant communities: competition and facilitation.** • **Role of mycorrhizal networks in plant communication and resource sharing.**	**4**
5.	**Mid- term Exam**	**-**
6.	**Ecological Interactions** • **Food webs and trophic dynamics.**	**2**
7.	**Ecological Interactions** • **Symbiosis, parasitism, mutualism, and commensalism.** • **Animal-plant interactions**	**4**
8.	**Environmental Stressors and Community Resilience** • **Types of environmental stressors** • **Impact of climate change, urbanization, habitat destruction, and invasive species.** • **Adaptive strategies for survival in changing environments.**	**4**
9.	**Case Studies in Biodiversity and Ecosystem Health** • **Analysis of specific case studies**	**2**

10.	Conservation Biology and Restoration Ecology • Strategies for preserving ecological communities. • Role of community-based conservation efforts.	2
10.	Case Studies discussions	2
11.	Final Presentations and Review	2
Total		30

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Periodical exam(s)	4 + 12	10%
2.	Mid term Exam	7	30%
3.	Assessment (case study- presentation)	14-15	10%
4.	Final written Exam	16	50%

*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	Begon, M., Townsend, C. R., & Harper, J. L. (2020). Ecology: From Individuals to Ecosystems. Krebs, C. J. (2016). Ecology: The Experimental Analysis of Distribution and Abundance.
Supportive References	Articles from Journal of Ecology
Electronic Materials	Online resources: Ecological Society of America, Global Biodiversity Information Facility.
Other Learning Materials	Articles from Journal of Ecology and Ecological Applications.

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• Classroom: Equipped with multimedia tools for lectures. • Library/Database Access: Access to journals, books, and ecological databases.
Technology equipment (projector, smart board, software)	• Projector • Softwarer

Items	Resources
Other equipment (depending on the nature of the specialty)	• Field Equipment: GPS devices, quadrats, cameras, and data sheets for fieldwork

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	Program Leaders	Direct
The extent to which CLOs have been achieved	Program Leaders	Direct
Other		

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

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	
REFERENCE NO.	
DATE	

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

2023
TP-153

Course Specification

(Bachelor)

Course Title:	Ecological Genetics
Course Code:	BIOE3507
Program:	Environmental Sciences
Department:	Biology
College:	Science
Institution:	Umm Al-Qura University
Version:	1447
Last Revision Date:	9/1/2025

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (3 hrs)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (3rd Year / 5th Level)					
4. Course general Description:					
Ecological Genetics focuses on the interaction between genetic variation and ecological processes. The course covers the principles of genetic diversity in natural populations, how environmental factors drive natural selection, and how evolutionary processes influence species interactions within ecosystems. Emphasis will be placed on both theoretical concepts and practical applications using molecular tools.					
5. Pre-requirements for this course (if any):					
General Biology (BIO1101)					
6. Co-requirements for this course (if any):					
NA					
7. Course Main Objective(s):					
By the end of this course, students will be able to: • Understand genetic variation within populations and its ecological significance. • Analyze how natural selection and genetic drift shape population structure. • Apply molecular techniques to study genetic variation in natural populations. Develop research skills in ecological genetics through data analysis and interpretation.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45 hrs.	%100
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		

No	Mode of Instruction	Contact Hours	Percentage
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	15
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		45

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	Students will understand the causes, effects, and influences of genetic variability in natural populations.	**K1**	1- In-class lecturing where the previous knowledge is linked to the current and future topics. 2- Homework assignments. 3- Discussions (connecting what they learn in the class and applying this information in laboratory). 4-Handout of lecture notes for each topic.	1- homework and quizzes. 2- Midterm and final written exams (theoretical and practical). 3- Evaluation of reports. 4- Oral presentation. 5-Course work reports.
1.2	Students will be able to use a population genetics framework to conceptualize microevolutionary processes.	**K2**		
1.3	Students will understand the four microevolutionary processes that affect genetic change in populations, as well	**K4**		

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	as their impacts and interactions.			
2.0	**Skills**			
2.1	Students will be familiar with typical genetic assessments of populations and gene flow between populations, as well as research applications of ecological genetics.	**S2**	1- Application of essential scientific techniques through lectures, classes and essays. 2- Small group discussion. 3- Ask the students to make small search project during the semester. 4- Making connections between different topics across the course. 5- Class discussions (Engage students in interaction with questions and answers). 6- Homework assignments. 7-Use of microscopic illustrations. 8-Laboratory training. 9-Activities and homework.	1-Evaluation of the topics prepared by students according to the content, arrangement, and covering of the topic. 2-Midterm and final exams. 3-Checking the homework assignments. 4-Course work reports.
2.2	Students will comprehend the relationship between environmental factors and population genetics.	**S4**		
2.3	students will understand the importance of ecological genetics in comprehending the genetic characteristics of uncommon and endangered species.	**S3**		
2.4	Students will comprehend how ecological elements either facilitate or impede gene flow among populations of aquatic, terrestrial, and plant species.	**S5**		
3.0	**Values, autonomy, and responsibility**			
3.1	Demonstrate a dedication to academic and	**V1**	1- Engage student in carrying out internet search.	1- Oral exams. 2- Evaluation of student

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	professional ethics and ideals.		2- The ability to debate the scientific basis of physiological mechanisms of body systems. 3- Writing group reports. 4- Solving problems in groups during tutorial. 5- Checking the homework assignments in groups during discussion. 6- Cooperative learning and application of scientific method in thinking the scientific problem solving. 7- Work as part of a team. 8- Conducting group experiments and writing group reports. Dividing students into groups to cooperate with each other during the experiments.	essays assignments and search work. 3- Observation of student ethical and moral behavior. 4- Students' attendance is recorded during lectures. 5- Assessment of the student reports. 6-Grading homework assignments.
3.2	Make independent decisions and create goals to achieve professional and/or academic self-improvement and social success.	**V2**		
3.3	Work cooperatively and productively in accountable teams.	**V3**		

C. Course Content

No	List of Topics	Contact Hours
1.	Introduction, background, basic vocabulary, and population genetics	**2**
2.	Mendel's Laws of Inheritance	**2**

3.	Macroevolution vs. Microevolution, gene frequency of microevolution, four forces of microevolution, neutral and adaptive microevolution.	4
4.	Molecular markers and their applications	4
5.	Genetic Variation in Natural Populations; Sources of Genetic Variation.	2
6.	Genetic Diversity: Allele Frequencies, Heterozygosity, and Polymorphism.	2
7.	Hardy-Weinberg Equilibrium and Deviations	2
8.	Midterm Exam	2
9.	Natural Selection and Adaptation; • Types of Selection: Directional, Stabilizing, and Disruptive • Fitness and Adaptive Landscapes • Examples of Adaptation to Environmental Pressures	2
10.	Artificial Selection & Selective Breeding	
11.	Genotype-Environment Interaction and Phenotypic Plasticity	2
12.	Types of Correlation Between Traits	2
13.	Epigenetics and Environmental Influence	2
Total		**30**

No	List of Practical Topics	Contact Hours
1.	Tools and Equipment's Used in Genetics Laboratory's	3
2.	Mendel's Experiments Exercises	3
3.	Pipetting	3
4.	DNA extraction	3
5.	Protein Isolation and Purification	3
6.	Gel Electrophoresis	3
7.	Polymerase Chain Reaction (PCR) and Real Time PCR	3
8.	Non-PCR-based tools for studying genetic variation (Allozymes and Electrophoresis, Restriction fragment length polymorphism (RLFP))	3
9.	PCR-based molecular markers	3
10.	Midterm Exam	3
11.	DNA Sequencing, Sanger Method	3
12.	Next Generation Sequencing (NGS)	3
13.	NGS Data Analysis, and some and some repositories for NGS	3
14.	Revision	3
Total		**42**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Lec. Activities	3	10%
2.	Mid Term Exam (Theoretic)	7	20%
3.	Lab Quiz	7	10%
4.	Final Exam (Practical)	15	20%
5.	Final Exam (Theoretic)	16	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	Rowe, G., Sweet, M., & Beebee, T. J. C. (2017). *An introduction to molecular ecology*. Oxford University Press.
Supportive References	Ford, E. B., & Ford, E. B. (1975). *Ecological genetics* (pp. 1-11). Springer Netherlands.
Electronic Materials	Journal review articles, with links available on the ecological genetics field website.
Other Learning Materials	Biosafety system in the lab for practical exercises.

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	1. One classroom 2 hours per week for each section 2. Laboratory 3 hours per week for each practical section
Technology equipment (projector, smart board, software)	3. Computers or internet connection. Active Board. **4.** Data show is required in every room.
Other equipment (depending on the nature of the specialty)	Thermolyze Shaker, Orbital shaking Incubator, Ph Meter, Hot air oven, Flask Shaker, Auto Clave, Portable Autoclave, Horizontal Laminar Flow Cabinet, Water Bath, Microscope Trinocular with Fluorescence attachment and attached Digital camera, Chlorophyll meter, Computerized Microwave digestion system,

Items	Resources
	Comet Assay Tank, PCR machine, gel documentation system Micropipettes, Master mix, DNA Primers, glassware, DNA and RNA isolation kits. Cloning, RT- PCR (one step), PCR and ELISA kits and PCR beads.

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Peer Review, Students	Direct (Independent Reviewer), Indirect (survey)
Effectiveness of Students assessment	Faculty members	Direct (Random Correction)
Quality of learning resources	Students	Indirect (survey)
The extent to which CLOs have been achieved	Faculty members	Direct
Other		

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

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	
REFERENCE NO.	
DATE	

Course Specification
(Bachelor)

Course Title:	Soil Science
Course Code:	BIOE3509
Program:	Environmental Sciences
Department:	Biology
College:	Science
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	9/1/2025

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (3)					
3hrs/ Week (2Lec.+1 lab)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (Fifth level, Second year)					
4. Course General Description:					
An introduction to soils, their components, and their relationship to the environment. The importance of soil to animals, and plants. Important physical properties, the role of soil constituents; origin, nature, and classification of parent materials; soil genesis, classification, and survey; soil fertility and chemical properties.					
5. Pre-requirements for this course (if any)**:**					
Principle of Ecology					
6. Co-requirements for this course (if any)**:**					
Plant Ecology					
7. Course Main Objective(s):					
Provide students with knowledge about soils and their physical, chemical, and biological properties. Provide students with knowledge to understand the relationship of soil to their environment. Provide students with knowledge to recognize the importance of physical properties and the role of soil constituents. Provide students with knowledge to determine the significance of soils' origin, nature, and classification of parent materials. Provide students with the knowledge to describe the soil genesis, classification, and survey; soil fertility and chemical properties; and soils and the world's food.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	72	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**	36
3.	**Field**	6
4.	**Tutorial**	
5.	**Others (specify)**	
Total		72

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	Comprehensive knowledge of rocks and minerals, their composition, and the types of soils formed from different parent materials.	K1	In-class lecturing -Homework assignments -Discussions (connecting what they learn in the class. -Handout of lecture notes for each topic.	-Homework and Quizzes. Midterm and final written exams -Evaluation of reports - Oral presentation
1.2	Understand the role of soil-forming factors and processes in soil formation.	K1		

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.3	Understand various soil physical, chemical, and biological properties and their impact on plant growth.	K1, K4	-Small group discussions.	
2.0	**Skills**			
2.1	Explain how soil surveys are prepared and used.	S1, S4	-Application of essential scientific techniques through lectures and essays. -Small group discussion -Ask the students to make small search projects during the semester -Class discussions (Engage students in interaction with questions and answers). -Homework assignments -Experiments in laboratories	-Evaluation of the topics prepared by students. -Midterm and final exams -Checking the homework assignments - Monitoring applied experiments
2.2	Name and classify the essential elements in soil and explain how the plants absorb them.	S2		
2.3	Describe soil pH, how it develops, and its effects on plant growth.	S1, S3		
2.4	Explain what organic matter is, how it forms, and what it does in the soil.	S1		
3.0	**Values, autonomy, and responsibility**			
3.1	Analyze and evaluate time management, discipline, and also to ethical behavioral, respect from different points of view.	V1		-Assignments (Individual and group) -Presentation (Individual and group) assessments. -Research search assignments
3.2	Learn continuously through self-reflection and or	V2		

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	experience to recognize the value of learning.			
3.3	Perform effective communication and positive relation with others and work as an influential team member.	V3		

C. Course Content

No	List of Topics	Contact Hours
1.	Introduction of soil science, soil definition, soil science branches, Soil phases.	2
2.	Origin of soil, Types of rocks, weathering, and its type.	2
3.	Soil formation processes, soil formation factors.	2
4.	Soil classification, Soil orders, Categories and nomenclature of soil taxonomy, Soil textural classes.	2
5.	Soil physical properties, Texture, Structure, Color, Profiles, Bulk Density Particle density, Pore space, and Soil management as applied to physical properties.	4
6.	Mid-Term	2
7.	Soil chemical properties, Soil pH, Cation Exchange Capacity, Soil Organic Matter, Macronutrients, Micronutrients, Major cations, Electrical Conductivity, Salt-Affected Soils.	4
8.	Diversity of soil organisms, Influence of soil microorganisms, The soil environment and organisms, and organic matter.	4
9.	Soil water.	2
10.	Soil fertility.	2
11.	Major causes of soil degradation.	2
12.	Types of soil in the Kingdom of Saudi Arabia.	2
	Lab topics	
1.	Soil Sampling	3
2.	Soil moisture content	3
3.	Soil Physical Properties: Mechanical analysis (Soil texture).	3
4.	Soil Physical Properties: Soil temperature, color, pore spaces.	3
5.	Soil Physical Properties: Soil particle and bulk density.	3

6.	Types of water in the soil.	3
7.	Water holding capacity.	3
8.	Chemical properties of soil: Soil solution, pH, Electrical conductivity.	3
9.	Chemical properties of soil: Total soluble salts.	3
10.	Chemical properties of soil: Soil Organic Matter.	3
11.	Chemical properties of soil: Determination of Chloride.	3
12.	Chemical properties of soil: Determination of Carbonate, and Bicarbonate.	3
Total		

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Quiz and activities	4th and weekly	10%
2.	Laboratory activities	weekly	10%
3.	Mid-term Exam	8th	20%
4.	Final Exam (written test)	16th and 17th	40 + 20 (Theoretical+ Practical)

*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	Yousuf, M., Tian, ZY., Mansy, A.E., Naseer, M.U.H. (2025). Soil Chemistry. In: Tian, ZY. (eds) Environmental Chemistry: Advanced Concepts and Applications. Springer, Singapore. https://doi.org/10.1007/978-981-96-0073-1_9 Adewara, O.A. et al. (2024). Soil Formation, Soil Health and Soil Biodiversity. In: Aransiola, S.A., Babaniyi, B.R., Aransiola, A.B., Maddela, N.R. (eds) Prospects for Soil Regeneration and Its Impact on Environmental Protection . Earth and Environmental Sciences Library. Springer, Cham. https://doi.org/10.1007/978-3-031-53270-2_5 Innocent, M.O. *et al.* (2024). Soil Microbes and Soil Contamination. In: Aransiola, S.A., Atta, H.I., Maddela, N.R. (eds) Soil Microbiome in Green Technology Sustainability. Springer, Cham. https://doi.org/10.1007/978-3-031-71844-1_1

	Tan, K.H. (2009). Environmental Soil Science (3rd ed.). CRC Press. https://doi.org/10.1201/9781439895016 Yong, R.N., Nakano, M., & Pusch, R. (2012). Environmental Soil Properties and Behaviour (1st ed.). CRC Press. https://doi.org/10.1201/b11658
Supportive References	
Electronic Materials	https://esdac.jrc.ec.europa.eu/ https://www.soils.org/ https://soils.org.uk/ https://www.iuss.org
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Lecture room Library
Technology equipment (projector, smart board, software)	Computers and Internet connection Active Board Data show is required in every room
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	questionnaires
Effectiveness of Students' assessment	Member of staff	Random marking of students' work by another staff member
Quality of learning resources	Student and staff	questionnaires
The extent to which CLOs have been achieved	Quality assurance committee	CLO's form
Other		

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

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	DEPARTMENT OF BIOLOGY
REFERENCE NO.	2
DATE	7/1/2025

Course Specification
(Bachelor)

Course Title:	Renewable Energy Resources
Course Code:	PHYS3706
Program:	Environmental Sciences
Department:	Physics
College:	Sciences
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	*Pick Revision Date.*

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (…2hrs……)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐ Elective		
3. Level/year at which this course is offered: (5th Level / 3rd Year)					
4. Course General Description:					
The main purpose of this course is to introduce the main renewable energy resources to the Environmental science students. Advantages, disadvantages and current challenges of these energy resources are covered in this course.					
5. Pre-requirements for this course (if any)**:**					
Environmental Physics PHYS2801					
6. Co-requisites for this course (if any)**:**					
None					
7. Course Main Objective(s):					
This course gives an overview of the main scientific principles and technologies related to harnessing and conversion of the energy resources, including solar, wind, hydroelectric, geothermal. Also, energy storage technology is covered in this course. Students will be able to: ● Identify the effects that conventional energy systems based on fossil fuels have over the environment and the society. ● Understand the fundamental physical principles underlying energy processes. ● Describe the various renewable energy sources and the possible conversion paths to a useful form of energy. ● Compare and differentiate between the different renewable energy technologies and choose the most appropriate based on local conditions. ● Identify and compare the types of energy storage					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	30	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 PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Describe the fundamentals and principles of renewable energies and its application.	**K2**	Lecturing;	Mid exam. Final exam. Homework. Quizzes.
1.2	Differentiate between different types of renewable energies.	**K3**		
2.0	**Skills**			
2.1	Apply mathematical techniques to solve complex problems	**S1**	Lecturing;	Final exam. Homework. Quizzes.
2.2	Deal with real-world energy problems based	**S2**		

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	on the given energy resources			
3.0	**Values, autonomy, and responsibility**			
3.1	Collaborate effectively within teams	V3		Oral presentation

C. Course Content

No	List of Topics	Contact Hours
1.	Introduction	4
2.	Basic physics of energy	8
3.	Solar energy	4
4.	Wind energy	2
5.	Hydropower	2
6.	Geothermal energy	2
7.	Other form of renewable energy	4
8.	Energy storage	4
Total		**30**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Mid Exam**	**10**	**30**
2.	**Quizzes**	**7, 14**	**10**
3.	**Activities**	**over the term**	**10**
4.	**Final Exam**	**17**	**50**

*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	Fundamentals of Renewable Energy Processes, by Da Rosa, Aldo Vieira and Ordonez, Juan Carlos. Publisher : Academic Press; 4th edition (April 2, 2021)
Supportive References	Physics of energy sources, by King, George C. Publisher : Wiley; 1st edition (June 12, 2017)
Electronic Materials	
Other Learning Materials	

2. Required Facilities and equipment

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

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Questionnaire
Effectiveness of Students assessment	Instructor	Questionnaire, Exams
Quality of learning resources	Instructor	Course report
The extent to which CLOs have been achieved	Instructor	Course report
Other		

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

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**PHYSICS DEPARTMENT, FACULTY OF SCIENCE**
REFERENCE NO.	
DATE	**25/12/2024**