Course Specifications

Revised November 2019

Course Title:	**water and wastewater microbiology**
Course Code:	**4013431 -3**
Program:	**BSc Microbiology**
Department:	**Department of Biology**
College:	**Faculty of Applied Science – Department of Biology**
Institution:	**UM AL – QURA UNIVERSITY**
Revision Date	**November 2019**

Table of Contents

A. Course Identification

1. Credit hours:	**3 hours**
2. Course type	
a.	University ☐ College ☐ Department ☑ Others ☐
b.	Required ■ Elective ☐
3. Level/year at which this course is offered:	**3rd Year / Level 5**
4. Pre-requisites for this course (if any):	**Bacteriology 4012422-3**
5. Co-requisites for this course (if any)**:**	

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	30	50 %
2	Blended		-
3	E-learning		-
4	Correspondence		-
5	Other	30	50 %

7. Actual Learning Hours (based on academic semester)

No	Activity	Learning Hours
Contact Hours		
1	Lecture	30
2	Laboratory/Studio	42
3	Tutorial	-
4	Practical/Field work/Internship	6
5	Others (specify)	30
	Total	102
Other Learning Hours*		
1	Study	30
2	Assignments	8
3	Library	15
4	Projects/Research Essays/Theses	10
5	Others (specify)	-
	Total	63

* The length of time that a learner takes to complete learning activities that lead to achievement of course learning outcomes, such as study time, homework assignments, projects, preparing presentations, library times

B. Course Objectives and Learning Outcomes

1. Course Description

Water and wastewater Microbiology is designed for the students to understand water and wastewater microbiology concepts, water Quality Standards; dri; WHO Guidelines for Drinking Water Quality. Also, it will be covered normal flora in aquatic environments, pollution of natural water sources: types and effects on natural flora, public health issues and water-borne diseases, microbiological assessments of drinking water, detailed study of Bacterial Faecal Indicators, treatment of drinking water, public health issues related to distribution networks and biofilms, criteria for drinking and recreational water quality, introduction to wastewater microbiology, microbiological treatment for wastewater and sewage.

2. Course Main Objective

❖ **After completing this course student should be able to:**

- Understand the principles of a range of water, wastewater and sludge treatment processes.
- Memorize the Standard criteria of drinking water
- Carry out and estimate all microbiological tests that determine the validity of water for human consumption and drinking.
- Demonstrate the link between water and health and show the profound influence of water supply and quality on public health.
- List all the treatments that carry out for the drinking water befor use.
- List the treatments that carry out for the wastewater before use.
- List all the microbiological treatment for wastewater and sewage
- Recognize some important water-related diseases
- Describe how improvements in water supplies will lead to improvements in health and a reduction in morbidity and mortality rates.
- Apply the fundamental microbiological principles behind biological water and wastewater treatment processes
- Describe the Methods used for controlling and removing biofilms from water and possible indicators of the presence of a biofilm problem.

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge:**	
	❖ Upon successful completion of this course The student will be able to: • List the natural microflora in the raw water • Outline the Standard criteria of drinking water • Describe the different biological and chemical treatments that should be carried out for drinking water as well as for wastewater. • List the different water-related diseases. • Recognize the different water resources. • Define biofilms in Drinking Water • Summarize the Risks and hazardous resulting in biofilms • Memorize the microbiological tests that should be done for drinking water	
2	**Skills:**	

	CLOs	Aligned PLOs
2.1	**Cognitive skills to be developed** ❖ Having successfully completed the course students should be able to: • Diagram the purification steps for drinking water • Explain how the biofilm formed in water • Differentiate between raw water and drinking water • Predict with microorganisms which probably find in raw water • Summarize the microbiological treatment for wastewater and sewage • Estimate microbiological and biochemical tests that determine the validity of water for human consumption and drinking. • Write the relation between water microorganisms and water-related diseases. • Write how the improvements in water supplies will lead to improvements in health and a reduction in morbidity and mortality rates. • Evaluate the Health Risks from untreated sewage water.	
2.4.	**Psychomotor Skills** ❖ Upon successful completion of this course, the student is expected to be able to: • Perform the laboratory experiments precisely • Operate all devices in lab • Diagram the water treatments purification. • Prepare the different media used in water microbiology lab	
3	**Competence:**	
3.1	❖ Upon successful completion of this course, the student is expected to be able to • Developing oral presentations. • Communicating personal ideas and thoughts. • Work independently and as part of a team to finish some assignments. • Communicate results of work to others. • Use of needed precautions when dealing with microbes in sewage water • Demonstrate professional attitudes and behaviors towards others. • Demonstrate his capability for the responsibility and accountability • Show Effective verbal communication with clarity. • Propose the smart questions. • Understand and dissecting the problem so that it is fully solved understood. • Demonstrate the assertiveness for his decision. • Show Effective verbal communication with clarity and must be characterize with the following interpersonal attributes; (verbal communication, non-verbal communication, good listening for the others, questioning, good manners, problem solving, social awareness, self-management, responsibility and accountability). • Enhancing the ability of students to use computers and internet.	

CLOs		Aligned PLOs
	• Interpret the laboratory data • Know how to write a report	

C. Course Content

1 Topics to be Covered

Topic	No of Weeks	Contact hours
❖ **General Introduction:** - An historical Aspects of air, water and sewage microbiology -water resources	**1**	**2**
❖ **Drinking Water Quality Standards** Water Quality Standards Treatment Objectives; WHO Guidelines for Drinking Water Quality; Estimation of Water Demand.	**1**	**2**
❖ **Normal flora in aquatic environments** - Cyanobacteria - Green algae - Diatoms - Red algae - Other types of algae - Bacteria - Viruses - Zooplankton (microscopic invertebrates) Aquatic Macrophytes (Floating weeds, Submergent weeds, Emergent weeds)	**1**	**2**
❖ **Water quality and pollution of natural water sources:** - Types and effects on natural flora: - Quality of surface waters - Water quality in flowing waters - Groundwater quality - Microbiological quality of drinking water - Chemical quality of drinking water	**1**	**2**

❖ **Public health issues and water-borne diseases** - Microbiological drinking-water quality and human health -Water-related disease incidence worldwide. - Morbidity and mortality rates of some important water-related diseases such: Amebiasis, Campylobacteriosis, Cholera, Cryptosporidiosis, Giardiasis, Hepatitis, Shigellosis, Typhoid fever, Viral gastroenteritis, Cyanobacterial Toxins.) -Bacterial Pathogens Capable of Causing Waterborne Disease: *Salmonella, Shigella, Vibrio cholera,* Enterovirulent *E. coli, Yersinia enterocolitica, Campylobacter jejuni, Legionella pneumophila, Helicobacter pylori.*) - Opportunistic and other water-associated pathogens (Examples of opportunistic pathogens of this type include *Pseudomonas aeruginosa,* certain species of *Flavobacterium, Acinetobacter, Klebsiella, Serratia, Aeromonas* and some 'slow growing' mycobacteria).	**2**	**4**
Microbiological assessments of drinking water: Water sampling, Total count, presumptive test ,Confirmatory Test, Completed Test, IMVIC tests: (Indol Production test, Methyl Red test, Voges – Proskauer test, Citrate utilization test), Eckman test**.**	**1**	**2**
❖ **Detailed study of Bacterial Faecal Indicators:** -Why Coliforms are Chosen as Indicators **(**(Escherichia coli, Faecal streptococci, Sulfite reducing clostridia**).** -Features and condition of organisms selected as indicators.	**1**	**2**
❖ **Treatment of drinking water:** -Surface-water intakes - Mixing and flocculation Sedimentation - Flocculator-clarifiers - Filtration - Turbidity removal - Taste and odor control - Synthetic organic chemical removal - Iron and manganese removal Precipitation Softening - Fluoridation - Chlorination - Chlorination by-products - Ozone - Disinfection - Ion exchange softening and nitrate removal - Removal of dissolved salts - Sources of wastes in water treatment - Dewatering and disposal of wastes from water treatment plants	**2**	**4**

❖ **Public health issues related to distribution networks and biofilms** - Biofilms in Drinking Water Distribution - Microorganisms forming biofilms (Microbes in or associated with biofilms that may present a public health risk in the distribution system). - Factors related to biofilms formation -Corrosion control and Pipe Materials -Risks and hazardous resulting in biofilms -Health Risks from microbial Growth -Methods used for controlling and removing biofilms and possible indicators of the presence of a biofilm problem.	**1**	**2**
❖ **Criteria for drinking and recreational water quality** -Standard criteria for drinking water according WHO -Microbiological criteria -Chemical criteria (anions and cations, pH, oder) -Physical criteria (such color, turbidity …..)	**1**	**2**
Introduction to wastewater microbiology **Microbiological treatment for wastewater and sewage** -Domestic wastewater -Industrial wastewater -Infiltration and inflow Considerations in plant design - Preliminary treatment -Pumping stations -Clarification -Biological filtration -Rotating biological contactors Biological aeration -Stabilization ponds -Effluent disinfection -Individual household disposal systems -Characteristics and quantities of waste sludges -Selection and arrangement of sludge processes -Gravity sludge thickening -Thickening of waste activated sludges -Anaerobic and Aerobic digestion Agricultural land application	**2**	**4**
	14 weeks	**28hrs**

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	**Knowledge**		
1.1	Upon successful completion of this course The student will be able to: • List the natural microflora in the raw water • Outline the Standard criteria of drinking water	• The methodology includes a combination of lectures by the lecturer, seminar presentation by the	• Periodical exam and reports 10% • Mid- term theoretical exam 20%

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
	• Describe the different biological and chemical treatments that should be carried out for drinking water as well as for wastewater. • List the different water-related diseases. • Recognize the different water resources. • Define biofilms in Drinking Water • Summarize the Risks and hazardous resulting in biofilms • Memorize the microbiological tests that should be done for drinking water	students and web-interactions. • At the end of the programme, students will be divided into groups for seminar presentation on important areas of the course to assess their understanding and comprehension of the course. • All students will be involved in on-line learning process and each student is required to create an E-mail address to facilitate student web interactions. • Using images and movies • Encouraging students to collect the new information about what the new in water and wastewater microbiology. Availability of the reference books and scientific sites concerning water and wastewater microbiology	• Mid-term practical exam 5% • Final practical exam 15% • Final exam 50%
2.0	**Skills**		
2.1	**Cognitive skills** ❖ Having successfully completed the course students should be able to: • Diagram the purification steps for drinking water • Explain how the biofilm formed in water • Differentiate between raw water and drinking water • Predict with microorganisms which probably find in raw water • Summarize the microbiological treatment for wastewater and	• Lectures. • Brain storming. • Discussion.	• Exam must contain questions that can measure these skills. • Quiz and exams. • Discussions after the lecture.

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
	sewage • Estimate microbiological and biochemical tests that determine the validity of water for human consumption and drinking. • Write the relation between water microorganisms and water-related diseases. • Write how the improvements in water supplies will lead to improvements in health and a reduction in morbidity and mortality rates. • Evaluate the Health Risks from untreated sewage water.		
2.2	**Psychomotor Skills** Upon successful completion of this course, the student is expected to be able to: • Perform the laboratory experiments precisely • operate all devices in lab • Diagram the water treatments purification. • Prepare the different media used in water microbiology lab	- Follow up students the students in lab and during carryout all the laboratory experiments	-Giving additional marks for the students they have accurate laboratory results and good seminar presentation -Practical exam.
3.0	**Competence**		
3.1	• Developing oral presentations. • Communicating personal ideas and thoughts. • work independently and as part of a team to finish some assignments. • Communicate results of work to others. • use of needed precautions when dealing with microbes in sewage water • Demonstrate professional attitudes and behaviors towards others. • demonstrate his capability for the responsibility and accountability • Show Effective verbal communication with clarity. • Propose the smart questions. • Understand and dissecting the problem so that it is fully solved understood. • Demonstrate the assertiveness for his decision.	• Lab work • Case Study • Active learning • Small group discussion • Homework (preparing a report on some topics related to the course depending on web sites). • Seminars presentation • Practical during carryout the experiments in the lab.	• Oral exams. • Evaluate the efforts of each student in preparing the report. • Evaluate the scientific values of reports. • Evaluate the work in team • Evaluation of the role of each student in lab group assignment • Evaluation of students presentations

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
	• show Effective verbal communication with clarity and must be characterize with the following interpersonal attributes; (verbal communication, non-verbal communication, good listening for the others, questioning, good manners, problem solving, social awareness, self-management, responsibility and accountability). • Enhancing the ability of students to use computers and internet. • Interpret the laboratory data. • Know how to write a report.		

2. Assessment Tasks for Students

5. Schedule of Assessment Tasks for Students During the Semester				
Assessment	Assessment task (eg. essay, test, group project, examination etc.)	Week due	Exam duration	Proportion of Final Assessment
1	**Periodical Exam (s)**	**4**	**15 min**	**10 %**
2	**Mid Term Exam (Theoretic)**	**8**	**60 min**	**20 %**
3	**Mid Term Exam (practical)**	**9**	**30 min**	**10 %**
4	**Reports and essay**	**11**	**--**	**5 %**
5	**Final Practical Exam**	**15**	**60 min**	**15 %**
6	**Final Exam**	**16**	**120 min**	**40 %**
Total Marks				**100%**

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice :

Office hours: 10hrs.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	(1)- Mara, D. and Horan, N. (2003) The Handbook of Water and Wastewater Microbiology. Academic Press, San Diego, CA, USA.
Essential References Materials	1. American Public Health Association (APHA) (1998) Standard Methods for the Examination of Water and Wastewater 20th edition. American Public Health Association, Washington DC, USA.

	2. Leclerc, H., Mossel, D. A. A., Edberg, S.C. and Struijk, C. B. (2001) Advances in the bacteriology of the coliform group: their suitability as markers of microbial water safety. Annual Reviews of Microbiology, 55: 201-234. 3. Tallon, P., M agajna, B., Lofranco, C. and Leung, K. T. (2005) Microbial indicators of faecal contamination in water: a current perspective. Water, Air, and Soil Pollution, 166: 139-166. 4. Percival, S. L., Chalmers, R. M., Embrey, M., Hunter, P. R., Sellwood, J. and Wyn-Jones, P. (2004) Microbiology of Waterborne Diseases. Academic Press, San Diego, CA, USA. 5. Leclerc, H., Schwartzbrod, L. and Dei-Cas, E. (2002) Microbial agents associated with waterborne diseases. Critical Reviews in Microbiology, 28: 371-409. 6. Theron, J. and Cloete, E. (2002) Emerging waterborne infections: contributing factors, agents, and detection tools. Critical Reviews in Microbiology, 28: 1-26. 7. Edberg, S. C., Rice, E. W., Karlin, R. J. and Allen, M. J. (2000) Escherichia coli: the best biological drinking water indicator for public health protection. Journal of Applied Microbiology, 88: 106S-116S. 8. Godfree, A., Kay, D. and Wyer, M. D. (1997) Faecal streptococci as indicators of faecal contamination in water. Journal of Applied • Microbiology, 83: 110S-119S.
Electronic Materials	http://www.epa.gov/safewater/disinfection/tcr/regulation_revisions.html
Other Learning Materials	• **Book note prepared by Associate professor Dr. Hussien Hassan Abulreesh**

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	• Class room is already provided with data show • The area of class room is suitable concerning the number of enrolled students (68) and air conditioned
Technology Resources (AV, data show, Smart Board, software, etc.)	• Digital lab containing 15 computers.
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	• Incubators, autoclaves, measuring equipment, water bath, digital balances, pH meters, safety facilities. • Availability of some reference bacterial strains • Different media • All chemicals and reagents that needed • Availability all kits for identification of the

Item	Resources
	microorganisms isolated from different habitates • Availability of **VITEK** device for rapid identification of microorganisms in water

G. Course Quality Evaluation

1. Strategies for Obtaining Student Feedback on Effectiveness of Teaching • Questionaries • Open discussion in the class room at the end of the lectures.
2. Other Strategies for Evaluation of Teaching by the Instructor or by the Department • Revision of student answer paper by another staff member. • Analysis the grades of students.
3. Processes for Improvement of Teaching • Preparing the course as PPT. • Using scientific movies. • Coupling the theoretical part with laboratory part • Periodical revision of course content.
4. Processes for Verifying Standards of Student Achievement (eg. check marking by an independent faculty member of a sample of student work, periodic exchange and remarking of a sample of assignments with a faculty member in another institution) • After the agreement of Department and Faculty administrations
5 Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement. • Periodical revision by Quality Assurance Units in the Department and institution

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

H. Specification Approval Data

Prepared by faculty staff: 1. **Dr. Hussein Hassan Abulreesh**	**Signature:**
Date Report Completed: November **2019**	
Revised by: 1. Dr. Khaled Elbanna 2. Dr. Hussein H. Abulreesh 3. Dr. Shady Elshahawy	**Signature:**
Date: November **2019**	
Program Chair Dr. Hussein H. Abulreesh	**Signature:**
Dean	**Signature:**
Date:	