Course Specifications

Revised November 2019

Course Title:	**Industrial Microbiology**
Course Code:	**4014441-4**
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: 4th Year / Level 7)
4. Pre-requisites for this course (if any): Microbial Physiology (4012452-3)
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

This course aims to enable the students to enter industry with an appropriate level of understanding of the need for both science and business aspects to be achievable to make a viable product. The course will help the students to develop their ability to apply the techniques used in the different phases of industrial microbiology. These include:

a. Discovery, production (including fermentation and scale-up), bioprocessing and cell banking.

b. Principles and practices in the main applications of micro-organisms to the industrial production of foods, pure chemicals, proteins and other useful products, including the use of genetically modified organisms.

2. Course Main Objective

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

- Describe the main steps and processes used to produce biological products in industry.
- List several present day applications of genetic engineering in industrial microbiology and biotechnology.
- Isolation of new useful microorganisms, improve their production of useful products and store them reliably for later use.
- Produce the desired microorganism containing a product on an industrial scale, including the choice of carbon source and other nutrients.
- Use batch, fed-batch and continuous culture fermentation and monitor relevant parameters, e.g. oxygen, pH, heat, CO_2, OD.
- Decide which techniques are applicable in bioprocessing particular products, e.g. alcohols, organic and amino acids, polymers, vaccines, proteins, secondary metabolites (including antibiotics, insecticides etc.)
- Understand ethical issues in production microbiology, such as standards of laboratory and in-plant behaviour and etiquette.
- understand commercial issues in production microbiology, such as confidentiality of information and the need for licensing, e.g. Good Manufacturing Practice
- Perform microbiological investigations, observe, evaluate and Interpret the data obtained, report the findings accurately and precisely.
- Work cooperatively with a small group of peers
- Developing a new product on a large-scale commercial basis.

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge:**	
	Upon successful completion of this course The student will be able to: • Familiarized with industrial application of microorganisms • Define basic concepts of industrial microbiology • Distinguish between upstream and Downstream for any microbial products • List the valuable microbial products • Define types of membrane transport for nutrient uptake and protein excretion. • Describe fermentation process for any microbial products • Outline Genetic engineering and their application in biotechnology.	
2	**Skills:**	
2.1	**Cognitive skills to be developed** Having successfully completed the course students should be able to: • Estimate the capability of different microorganisms to produce valuable product. • Explain why the aeration process (oxygen) and pH are very important during fermentation process. • Summarize the role of the genetic engineering in industrial microbiology and biotechnology • Write briefly about the factors influence the fermentation process of any microbial product • Compare between production of the enzyme from microorganisms and the higher organisms (plants or animals) • Diagram the gene cloning steps of interesting gene • Calculate the amount of the final products from fermentation batch • Differentiate between batch fermentation and fed batch fermentation • Analyse and interpret the fermentation data for any product • Design new and chip media for fermentation any product	
2.4.	**Psychomotor Skills** Upon successful completion of this course, the student is expected to be able to: • Perform the laboratory experiments precisely. • Demonstrate any experiment for production any microbial products. • Perform any technique used in fermentation process. • Operate any device in the biotechnology lab. .	
3	**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.	

CLOs		Aligned PLOs
	• Use of needed precautions when dealing with pathogen microorganisms • Demonstrate professional attitudes and behaviors towards others. • Propose the smart questions • Understand and dissecting the problem so that it is fully solved understood. • Demonstrate the assertiveness for his decision. • Demonstrate his capability for the responsibility and Accountability • 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.	

C. Course Content

Topics to be Covered		
Topic	No of Weeks	Contact hours
❖ **Introduction: to Industrial Microbiology:** - History and Scope of Industrial Microbiology - Growth of Industrial fermentations; -The Chronological development of Fermentation industry. -Strain Isolation and screening	**1**	**2**
❖ **Microbial fermentations:** - Definition of Microbial fermentation Exploitation of microorganisms and their products, screening, strain development strategies, immobilization methods, fermentation media, raw material used in media production, antifoaming agents, buffers, downstream processing. - Types of Fermentations: - Alcohol -Glycerin - Mixed acids (Citric acid, Fumaric acid, Gluconic acid, Acetic acid) - Glycerin -Acton -Butanol - Lactic acid etc. -Biofuels: ethanol, methane, biogas. -Fermentation equipment and its uses, fermentor design, Types of fermentors and fermentations- single, batch, continuous, multiple, surface, submerged and solid state.	**3**	**6**

❖ **Production of Antibiotics:** -Study of production processes for various classes of low molecular weight secondary metabolites: Antibiotics-beta-lactams (Penicillin), semi synthetic Pencillins and Cephalosporins amino-glycosides (streptomycin), macrolids (erythromycin) and quinines.	**1**	**2**
❖ **Production of Microbial Enzymes:** Enzymes and their classification, Enzymes purification methods. -Proteases, Amylases Lipases, Cellulases, Pectinases, Isomerases and other commercially important. Enzymes for the food pharmaceutical industries. -Enzymes downstream processing (recovery and purification) - Enzyme kinetics, factors affecting rates of enzyme mediated reactions (pH, temperature, substrate concentration, enzyme concentration and reaction time). -Derivation of Michaelis -Menton equation and its significance in enzyme kinetic studies. Enzyme inhibitors and regulation.	**3**	**6**
❖ **Production of Vitamins** **-Production of B2, B12 and bet carotene:** -Microorganisms produced vitamin B12:(*Propionibacterium freudenreichi*, *Pseudomonas denitrificans*, *Streptomyces olivaceus*). -pathway for vitamin biosynthesis -Fermentation process (upstream processing) -Downstream processing of vitamin B12 (recovery and purification) - Problems associated with the production of vitamin B12.	**1**	**2**
❖ **Production of Amino acids** - Uses of amino acids in industrial applications - Microbial production of amino acids. -Strains produced glutamic acid (such *Corynebacterium glutamicum*, *Brevibacterium flavum*, and *Brevibacterium lactofermentum*) -Glutamic acid biosynthesis pathway. -Fermentation process for L-glutamic acid production (Upstream processing) -Downstream of glutamic acid production (purification and recovery). -Methods for separation of amino acids (Centrifugation, Filtration, Crystallization, Ion exchange chromatography, Solvent extraction, Evaporation) -Factors influencing glutamic acid production.	**1**	**2**
❖ **Microbial production of vaccins:** -Define vaccine -Types of Vaccines and Their Characteristics (Vaccines Used to Prevent Bacterial Diseases, Vaccines Used to Prevent Viral Diseases). -Development of New Vaccines -Conventional antibody production (Antibody production , Polyclonal antibodies, Monoclonal antibodies)	**2**	**4**

❖ **Introduction in Genetic engineering and their application in biotechnology** - mean of genetic engineering -Applications of genetic engineering - general techniques used by genetic engineers to modify DNA Recombinant DNA Technology Restriction Enzymes Cloning Genes in Recombinant Plasmids Genomic Library Reverse transcriptase Mass-Produced Gene Products	**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: • Familiarized with industrial application of microorganisms • Define basic concepts of industrial microbiology • Distinguish between upstream and Downstream for any microbial products • List the valuable microbial products • Define types of membrane transport for nutrient uptake and protein excretion. • Describe fermentation process for any microbial products • Outline Genetic engineering and their application in biotechnology.	-Themethodology includes a combination of lectures by the lecturer, seminar presentation by the 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 microbial ecology. -Availability of the reference books and scientific sites	• Periodical exam and reports 10% • Mid- term theoretical exam 20% • Mid-term practical exam 5% • Final practical exam 15% • Final exam 50%

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
		concerning microbial ecology	
2.0	**Skills**		
2.1	**Cognitive skills to be developed** • Estimate the capability of different microorganisms to produce valuable product • Estimate the capability of different microorganisms to produce valuable product. • Explain why the aeration process (oxygen) and pH are very important during fermentation process. • Summarize the role of the genetic engineering in industrial microbiology and biotechnology • Write briefly about the factors influence the fermentation process of any microbial product • Compare between production of the enzyme from microorganisms and the higher organisms (plants or animals) • Diagram the gene cloning steps of interesting gene • Calculate the amount of the final products from fermentation batch • Differentiate between batch fermentation and fed batch fermentation • Analyse and interpret the fermentation data for any product • Design new and chip media for fermentation any product	- Lectures -Brain storming -Discussion	- Exam must contain questions that can measure these skills. - Quiz and exams - Discussions after the lecture.
2.2	**Psychomotor Skills to be developed** • Perform all laboratory experiments precisely • Diagram growth curve of bacteria. • Prepare different media • Cultivate the bacterial isolates • Demonstrate any experiment for production any microbial products. • Perform any technique used in fermentation process. • Operate any device in the biotechnology 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**		
	• Developing oral presentations.	- Lab work - Case Study	- Oral exams. - Evaluate the efforts

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
	• 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 pathogen microorganisms • Demonstrate professional attitudes and behaviors towards others. • Propose the smart questions • Understand and dissecting the problem so that it is fully solved understood. • Demonstrate the assertiveness for his decision. • Demonstrate his capability for the responsibility and Accountability • 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.	- 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.	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
			Oral exams.

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- Industrial Microbiology: An Introduction byWaites,Morgan, Rockey and Higton, Blackwell Science (2001)
Essential References Materials	1- Brock biology of microorganism, 11th edition, ByMadigan,Michael and Martinko,John, (2005) 2- Elements of Chemical Reaction and Engineering, 4th edition, by H. ScottFogler Pearson Education Inc., (2006). **3.** Any biotechnology, applied microbiology and microbial biotechnology journal will be of great benefits to the student for their assignment
Electronic Materials	www. Prenhall.com/madigan
Other Learning Materials	• **PPT prepared by Dr. Abdelrahman Asaedii**

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, centrifuge, measuring equipment, water bath, digital balances, pH meters, safety facilities. • Glass fermenter, Autmated small fermenter, Shaker incubators, Centrifuge , • Availability of some bacterial and fungal strains used in fermentation lab • Availability different specific media and chemicals used for fermentations

Item	Resources

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

Faculty member responsible for the course:

Prepared by faculty staff: 1.**Dr. Abdulrahman S. Assaeedi** **2. Dr. Khaled Elbanna**	**Signature:**
Date Report Completed: November **2019**	
Revised by: 1. Prof. Dr. Khaled Elbanna 2. Dr. Hussein H. Abulreesh 3. Prof. Dr. Shady Elshahawy	**Signature:**
Date: 20.11.2019	
Program Chair Dr. Hussein H. Abulreesh	**Signature:**
Dean **Prof.**	**Signature:**
Date:	