Republic of Yemen
Ministry of Higher Education & Scientific Research
21 September University for Medical & Applied Sciences
Faculty of Laboratory medicine
Department of Medical Microbiology and Immunology

الجمهورية اليمنية
وزارة التعليم العالي والبحث العلمي
جامعة ٢١ سبتمبر للعلوم الطبية والتطبيقية
كلية الطب المخبري

21 September University for Medical & Applied Sciences

Faculty of Laboratory Medicine

Program Specifications

Master Degree

of

Medical Microbiology and Immunology

Code: 03,02

2021/2022

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Prepared by:	Reviewed by:	Head of the Department:	Quality Assurance	**Dean**
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Content

Program Specification

1- Program Identification and General Information:

Program Identification and General Information:		
1	Program title:	Master degree in Medical Microbiology & Immunology
2	Department responsible for the program:	Medical Microbiology & Immunology
3	Degree offered	Master of Medical Microbiology & Immunology
4	The Institute responsible for granting the degree:	21 September University of Medical & Applied Sciences
5	Study system:	Single
6	Study language of the program:	English
7	Entry requirements:	Bachelor's degree Laboratory Medicine or other equal degrees
8	Departments participating in the program:	Medical Microbiology & Immunology Faculty of Faculty of Laboratory Medicine
9	Starting year of the program:	2022-2023
10	Study methods in the program:	
11	Location of delivery:	21 September University of Medical & Applied Sciences, Faculty of Faculty of Laboratory medicine , Medical Microbiology & Immunology
12	The program resources:	21 September University of Medical & Applied Sciences
13	Minimum grade requirements:	As per regulations of the Ministry of Higher education and Scientific Research
16	Other admission requirements:	According to the University rules and regulations
14	Date of current development of the program :	February 2022
15	Prepared by :	- Prof. Dr. Mojahed Ali Measar - Prof. Dr. Khaled A. Al-Moyed - Associate Prof. Dr. Ebtesam Al-Zabedi - Assistant Prof. Dr Ghamdan Al-Tahish - Assistant Prof. Dr. Gamil Abdul-Mughni
16	Program coordinator:	Assistant Prof. Dr. Gamil Taher Abdul-Mughni

2) Program Overview:
The Master program provides students a broad background in microbiology, immunology and the techniques used in microbiology and immunology research. The average amount of time to completion is two years. The Main Areas of Research are **Medical Microbiology, Immunology with Molecular Biology**

3-University Vision, Mission, and Goals:
University vision 2025:
A contemporary university with national responsibility and a faith identity
University mission:
Leading the transformation in the management and delivery of health care with all partners by setting a standard of excellence in education and medical and applied research in a way that meets the needs of Yemeni society, its privacy and regional influence.
University objective:
1- Ensuring the application of quality standards and setting standards of excellence in medical and applied sciences, scientific research and community service.
2. The centrality of the student in the educational process, the partnership with them for life, the consolidation of the principles of national responsibility and faith identity, their care and the development of their capabilities after graduation and during work.
3. Attracting, employing and retaining scholars, cadres and highly specialized talents to gain minds and reverse the trend of "brain drain" in a way that enhances and ensures the creation of thinkers, businessmen and good citizens.
4. Continuous development of the distinguished academic infrastructure and the establishment of modern research and service centers with high efficiency and capable of making a real impact locally and regionally.
5. Enhancing the university's position as a preferred partner for local, regional and international partnership through implementing innovative models of education, exchanging research and knowledge and providing real and effective outcomes for developing professional practices to benefit from them locally and regionally

B. Mission, Objective, and Learning Outcomes of the master program
I. Mission :
To prepare highly qualified graduate skilled in the medical microbiology and immunology through advanced leaning, practices and conducting scientific research.
II. General objectives of the program:
1- Produce health science professionals and in-depth medical microbiological and immunology knowledge of different emerging infectious disease and clinical immunology.
2- Promote our students to practice health care associated infection monitoring and prevention in academic and clinical settings.
3- Provide our candidate with the ability to apply different and recent molecular biological and immunological techniques in the field of microbiology
4- Give the candidate the ability to assess immunological status in different pathological condition with gaining knowledge about immunological role in development of different disease and how to target by immunotherapy
5- Provide opportunities to gain research capacity and publish scientific relevant studies.
6. Promote community partners and stakeholders for program development, evaluation and improvement and active participation in professional societies.

III. Graduate Attributes of the program
Upon successful completion of the program in master of Medical Microbiology and Immunology, the graduates will be able to:
1. Demonstrate advanced knowledge in the fields of Medical Microbiology and Immunology.
2. Demonstrate independent critical and analytical thinking, both within their field of study, and beyond for the use of their knowledge for service to others.
3. Identify and suggest possible solutions to ethical dilemmas that occur in their work and field of study, and understand the importance of professional ethics in all aspects of scientific communication and laboratory work.
4. Demonstrate competence in the laboratory, including application of the scientific method and appropriate use of basic and state of the art laboratory tools and techniques.
5. Demonstrate written and oral skills necessary for communication of research, knowledge, and ideas to scientists and non-scientists alike.

4. Intended Learning Outcomes from the program:	
A. Knowledge and understanding:	
At the end of the course the student should be able to	
a1	**Understand** the basic Specific knowledge in medical microorganisms and immunology, including molecular biology, immunology and DNA technology coupled with hands on skills and leadership skills for a successful career.
a2	**Describe** the important mechanisms of microbial pathogenesis, modes of transmission, eliminated, clarify treatment and outcomes of infections with emphasis on cellular and molecular immunology and immunity to infections
a3	**List** the key considerations and principles in the planning and design of a study on the basis of statistical methods.
a4	**Discuss** the different microbial and immunology diseases and the principle different laboratory techniques, including the isolation, characterization of specific microbes, seroimmunology and nucleic acid in clinical specimens
B. Intellectual Skills:	
At the end of the course the student should be able to	
b1	**Interpret** and explain results simply and effectively to clinicians and patients
b2	**Illustrate** important mechanisms of microbial pathogenesis, basic concepts of molecular immunology, immunity to infection, risk of infection, outcomes of infections and vaccines for individual infectious or immunological disease.
b3	**Design** guidelines for prevention, control of infection/disease and antibiotic treatment regimens used for managing microbial and immunological diseases.
b4	**Categorize** health risk factors associated with working in a research diagnostic laboratory
C. Professional and Practical Skills:	
At the end of the course the student should be able to	
c1	**Demonstrate** important mechanisms of microbial pathogenesis, basic concepts of molecular immunology, immunity to infection, risk of infection and outcomes of infections
c2	**Perform** diagnostic laboratory tests in medical bacteriology, virology, mycology and immunology to offer basic advice on relevant investigations, interpretation of results and infection control procedures in association with quality assurance and control procedure.

c3	**Applied** laboratory data relevant to the cases of medical microbiology, immunology and identified the pathogen by the isolation and its specific growth characteristics if any, distinguishing biochemical tests, its morphological and/or staining characteristics, immunological or nucleic acid-based tests..
D. General and Transferable outcomes:	
At the end of the course the student should be able to	
d1	**Communicate** effectively through oral presentations, computer processing and presentations, and written reports.
d2	**Respect** the role of staff and co-staff members regardless of degree or occupation.
d3	**Write** scientific article according to the basics of scientific research

Program Standards & Benchmarks
Academic Standards:
-NARS (National Academic References Standard) for medical education in Yemen
-Academic Standards Curriculum Criteria of Accreditation Board
-Unified Regulations for Student Affairs, Ministry of Higher Education and Scientific Research
Benchmarks
1-Faculty of medicine and health Sciences, Sana'a university, Yemen
2- Jordan University of Science and Technology (JUST) Jordan https://www.just.edu.jo/FacultiesandDepartments/FacultyofAppliedMedScs/Depts/MedLabSciences/Documents/MSc%20in%20Medical%20Laboratory%20Sciences%20Program%20Information.pdf https://www.just.edu.jo/FacultiesandDepartments/FacultyofAppliedMedScs/Pages/viewplan.aspx?planno=278
3- UNIVERSITY OF SHARJAH https://www.sharjah.ac.ae/en/academics/Colleges/healthsciences/dept/mls/Pages/Master-of-Science-in-Medical-Laboratory-Sciences.aspx
4- Majmaah University https://www.mu.edu.sa/en
5- Tulane university https://medicine.tulane.edu/departments/microbiology-immunology/masters
6- Drexel University https://drexel.edu/medicine/academics/graduate-school/microbiology-immunology/curriculum/

Teaching and Learning Strategies:
• Lectures • Seminars • Lab experiments • Training • Discussion • Presentations • Self-learning • Case study

Teaching strategy:	
Teaching Strategy	Description of how it will be used
Lectures	It is the most frequently employed teaching method to convey knowledge and explain theories to students in large groups or in sessions, which consist of more than one group gathered in one classroom.
Seminars	These are mainly used with small groups of students in which they find better chances for discussing and negotiating the different concerns of their studies.
Lab experiments	Students doing practices in medical labs individually or in small groups.
Training	This is a practical kind of course where the students are required to plan and execute some field visits to hospitals, corporations or institutions where the process of clinical pharmacy is essential.
Discussion	This is done by allowing the students to ask questions during the lecture and respond to them by the lecturer or other students for the purpose of establishing and clarify the subject of the lecture strongly and increase the concentration and absorption of the student and the attention and not to enter the boredom.
Presentations	Helps the students to be more confident with themselves and make them to show the others what knowledge they have acquired. It can be followed in many types of courses and tasks.
Self-learning	Self-learning is the process by which learners teach themselves using any materials or resources to achieve clear goals without the direct help of the teacher
Case study	Case studies are defined as the scientific documentation of a single clinical observation which is so important study design in advancing medical scientific knowledge especially of rare disease.
Office Hours	Office hours are hours determined by the faculty member (professor of the course) to which the student studies. The hours allocated by the professor to meet with his students to help them and answer their queries in the event of any questions they may not be enough time for the lecture to answer it.

Assessment Methods:
• Written examinations • Oral exams • Technical or practical reports /Presentations • Assignments including problem-solving exercises • Individual and group project work • Quizzes • Home work

Assessment Strategies:	
Assessment Strategy	Its description (in which course it will be used and in which rate)
Written examinations	Mid-term test is conducted between 6th to 8th Class and final exam is conducted at the end of each course.
Oral exams	For selected courses
Technical or practical reports /Presentations	As indicated in the course specification
Assignments including problem-solving exercises	The entire assignments including problem-solving exercises of coursework activities during the teaching period of each course. (which includes group and individual work, tests and presentations, etc.)
Individual and group project work	As indicated in the course specification
Quizzes	For all courses except for project
Home work	For all courses except for project

1. Alignment of Program Intended Learning Outcomes (PILOs) to Teaching Strategies and Assessment Methods:

PILOs	Teaching Strategy	Assessment Methods
Knowledge and Understanding A1, A2, A3, A4	Lectures, Interactive class discussions, Tutorials.	Written exams, assignment work, quizzes, submission of reports.
Intellectual Skills B1, B2, B3, B4	Lectures, Tutorial, Interactive class discussions, and group work, presentation.	Written exams, Project, Case studies and assignment work.
Professional & practical skills C1, C2, C3,	Short lectures, case study, Laboratory experiments, Project, and group work, Field training, Drawing sessions.	Written exams, quizzes, Practical exam assignment and report submission.
General & Transferable Skills D1, D2, D3	Group work, Self-study, Interactive class discussions, Tutorials, Seminar/ project/presentation, Laboratory experiments, Project, and Art Gallery	Project presentation, Laboratory exam, Report/Project

1. **Project Assessment:**	
Each project will be assessed by a committee of three members as follows:	
Item	**Marks Distribution**
Project supervisor	60%
Internal examiner: a member of the department staff.	20%
External examiner: a qualified external examiner (either from other departments of the faculty or from another university)	20%
Total	**100%**

Program Structure and Contents

Study System	
I-Duration of program	2 – 4 years maximum 4 years divided into courses and thesis
II. Structure of the program:	Total contact number of credit hours
-First year	Program-related essential courses and Students ILOs
Thesis	MSc thesis subject should be officially registered within 6 months from application of the MSc degree, Discussion and acceptance of the thesis could be set after 12 months from MSc registering date.

Program course:

	Course Compulsory	**Code**	**Credits hours**
1	Advanced Molecular Microbiology	03.12. 311	3
2	Biomedical Statistics & Epidemiology	03.12. 312	3
3	Advanced Medical Bacteriology	03.12. 313	3
4	Advanced Medical Immunology I	03.12. 314	2
5	Advanced Medical Virology	03.12. 315	2
6	Advanced Medical Immunology II	03.12.319	2
7	Advanced Medical Mycology	03.12. 316	2
8	Research Methodology	03.12. 317	2
9	Advanced Diagnostic and Molecular Microbiology	03.12. 318	4
10	Advanced Medical Parasitology	03.12. 320	2
11	Advanced Medical Entomology & Vector Control **(only for parasitology master students)**	03.12. 321	2
12	Advanced Diagnostic parasitology **(only for parasitology master students)**	03.12. 322	2
13	Thesis		6
	Total credit hours for microbiology program master		31
	Total hours for parasitology master students		35

Study Plan

Distribution of Courses according to Semesters (36 credit hours)

	First semester	Code	Credit Hour	Number of weeks
1	Advanced Molecular Microbiology	03.12. 311	3	16
2	Biomedical Statistics &	03.12. 312	3	16
3	Advanced Medical Bacteriology	03.12. 313	3	16
4	Advanced Medical Immunology I	03.12. 314	2	16
6	Advanced Medical Mycology	03.12. 316	2	16
	Total hour for first semester		**13**	

	Second semester	Code	Credit Hour	Number of weeks
1	Research Methodology	03.12. 317	2	16
2	Advanced Diagnostic and Molecular	03.12. 318	4	16
3	Advanced Medical Parasitology	03.12. 320	2	16
4	Advanced Medical Virology	03.12. 315	2	16
5	Advanced Medical Immunology II	03.12. 319	2	16
2	Thesis		6	
	Total hour for Second semester		**18**	

	Third semester(only for parasitology master students)	Code	Credit Hour	Number of weeks
1	Advanced Medical Entomology & Vector Control	03.12. 321	2	16
2	Advanced Diagnostic parasitology	03.12. 322	2	16
3	Thesis		6	

Annex-1:Program Structure:

No.	Requirements		No. of Courses	Credit Hours	Rational Weight %
1	Program Requirements	Compulsory	10	25	85
2		Thesis	1	6	15
	Total:			31	

Annex-2, Academic Standards Curriculum Criteria of Accreditation board.

	Academic Standards:
1	1. NARS for medical education in Yemen
2	Annex- 2, Academic Standards Curriculum Criteria of Accreditation Board
3	Annex- 3, Unified Regulations for Student Affairs, Ministry of Higher Education and Scientific Research

Annex-3, Alignment Program vision, mission and Objectives with University and Faculty

	University	Postgraduate studies and scientific research	Faculty of laboratory Medicine Vision, Mission and Goals:	Medical Microbiology and Immunology
Vission	A contemporary university with national responsibility and a faith identity	Scientific research and contemporary postgraduate studies according to quality standards that meet the needs of the labor market locally and regionally	Contemporary and competitive faculty in Laboratory medicine.	
Mission	Leading the transformation in the management and delivery of health care with all partners by setting a standard of excellence in education and medical and applied research in a way that meets the needs of Yemeni society, its privacy and regional influence.	to prepare and implement scientific programs Qualitative application in order to prepare distinguished research leaders that contribute to the treatment of Community problems.	Contribute to improving health services in laboratory medicine by achieving standards of excellence in education and scientific research in a way that meets the needs and privacy of society and contributes to addressing global health problems.	To prepare highly qualified graduate skilled in the medical microbiology and immunology through advanced practical and conducting scientific research.

Objectives	1- Ensuring the application of quality standards and setting standards of excellence in medical and applied sciences, scientific research and community service. 2. The centrality of the student in the educational process, the partnership with them for life, the consolidation of the principles of national responsibility and faith identity, their care and the development of their capabilities after graduation and during work. 3. Attracting, employing and retaining scholars, cadres and highly specialized talents to gain minds and reverse the trend of "brain drain" in a way that enhances and ensures the creation of thinkers, businessmen and good citizens. 4. Continuous development of the distinguished academic infrastructure and the establishment of modern research and service centers with high efficiency and capable of making a real impact locally and regionally.	1-Establishing quality postgraduate programs that attract local and regional university graduates 2- Continuous development and updating of postgraduate programs in accordance with comprehensive quality standards 3- Preparing distinguished researchers through continuing education programs and developing research skills. 4- Partnership with similar scientific institutions in scientific research. 5- Developing the infrastructure, human and financial for graduate studies programs and scientific research in accordance with the standards of academic accreditation. 6- Automating the system of postgraduate studies and scientific research and activating electronic links. 7- Attracting expertise from faculty members and researchers from the internal and external environment.	1. Preparing a highly qualified and skilled cadre in the field of laboratory medicine. 2. Building an educational system that keeps pace with development and conforms to academic quality standards. 3. Adopting, supporting and investing scientific research programs to meet the requirements of sustainable development and to contribute to solving global health problems. 4. Developing a culture of community partnership in the field of laboratory medicine and research. 5. Enhancing the facility position as a preferred partner for local, regional and international partnership through implementing innovative models of education, exchanging research and knowledge and providing real and effective outcomes for developing professional practices to benefit from them locally and regionally	1- Produce health science professionals and in-depth medical microbiological and immunology knowledge of different emerging infectious disease and clinical immunology. 2- Promote our students to practice health care associated infection monitoring and prevention in academic and clinical settings. 3- Provide our candidate with the ability to apply different and recent molecular biological and immunological techniques in the field of microbiology 4- Give the candidate the ability to assess immunological status in different pathological condition with gaining knowledge about immunological role in development

	5. Enhancing the university's position as a preferred partner for local, regional and international partnership through implementing innovative models of education, exchanging research and knowledge and providing real and effective outcomes for developing professional practices to benefit from them locally and regionally			of different disease and how to target by immunotherapy 5- Provide opportunities to gain research capacity and publish scientific relevant studies. 6. Promote community partners and stakeholders for program development, evaluation and improvement and active participation in professional societies.

Annex-4, Survey of Credit Hours of Similar Programs

Benchmarking		21 UMAS	Sana'a university	Jordan University (JUST)	Majmaah University	UNIVERSITY OF SHARJAH	Tulane university school of medicine	Drexel University
Program Requirements	Credit Hours	26	24	16	22	24	27	36
	Percentage	74	80	47	56	67	90	67
Program Electives	Credit Hours	3		9	11	6		
	Percentage	9		26	28	17	0	0
Program Thesis	Credit Hours	6	6	9	6	6	3	18
	Percentage	17		26	15	17	10	33
Total Credit Hours		35	30	34	39	36	30	54

Annex-5, Survey on Mission and objectives of the program and Similar accredited program

University	21 September	Sana'a university	Jordan University	Majmaah University	UNIVERSITY OF SHARJAH	Drexel University	Tulane university school of medicine
Faculty	Laboratory Medicine	Faculty of medicine	Applied Medical Sciences	College of Applied Medical Sciences	College of Health Sciences	School of Medicine	
Department	Medical Microbiology & Immunology	Medical micobiology	Medical Laboratory Sciences		Medical Lab Sciences	Microbiology and Immunology	Department of Microbiology and Immunology
Program	Medical Microbiology & Immunology	degree program in medical microbiology	Clinical Microbiology, Immunology and Serology	Clinical Laboratory Sciences	*Master of Science (MS)*	Master Science Microbiology and Immunology	Masters Program in Microbiology and Immunology
Country	Yemen	Yemen	Jordan	Saudi Arabia	UAE	USA	USA
Program Mission:				To prepare competencies in Clinical laboratory field to enhance learners scientific research skills and deeply prepared courses to expand the	To develop and maintain superior educational program in the field of medical laboratory sciences.	To preparation of individuals for a variety of career objectives in microbiology and immunology.	

				knowledge provided by recognized faculty member in their specialty in order to cope with the evolution in the field of laboratory diagnostic techniques			
2				1-Learning the fundamental principles and recent advances in Clinical Laboratory. 2-Updating students about the modern technologies in Clinical and Research field. 3-Enable students to understand the principles of laboratory		1-The program is designed to provide students with the skills required to advance to positions as bioscience researchers and trainers in a broad spectrum of positions. 2-The structure of the program provides a framework for the progressive development of a mastery of the current state of the subject matter of bioscience, an ability to synthesize this information and apply this foundation to the identification of key areas of investigation/experimentation in bioscience. 3-The program relates the above framework to the development of the ability to	1. Demonstrate advanced knowledge in the fields of Medical Microbiology and Immunology. 2. Demonstrate independent critical and analytical thinking, both within their field of study, and beyond for the use of their knowledge for service to others. 3. Identify and suggest possible solutions to ethical dilemmas that occur in their work and

				management, safety, quality control, research and statistical approach. 4-Motivate students to commit to life-long learning and scientific research to solve health problems of the community. 5-Allow students to develop their management, leadership, communication, teamwork, writing and presentation skills.		design, implement and interpret experimental approaches which address the questions identified. 4-In addition, the program will develop skills in the various means of communicating both the core of bioscience knowledge and the expression of experimental design, results and interpretation to a variety of potential audiences.O10	field of study, and understand the importance of professional ethics in all aspects of scientific communication and laboratory work. 4. Demonstrate competence in the laboratory, including application of the scientific method and appropriate use of basic and state of the art laboratory tools and techniques. 5. Demonstrate written and oral skills necessary for communication of research, knowledge, and ideas to scientists and non-scientists alike.
3 Program Outcomes:				1-Enriching educational government institutions, hospitals and			

				research centers with specialists and experts in clinical laboratory sciences. 2-Encourage postgraduate students for Life-long learning, involvement in scientific research and applying ethics on humane aspects of clinical laboratory practices. 3-Enhance the leadership, communication and effectiveness work in team.			

Annex-6, Alignment Program Intended Learning Outcomes (PILOs) to Faculty Educational Objectives (FObj).

1. Program PILOs	Goals Objectives				
	FObj1	FObj2	FObj3	FObj4	FObj5
A1	√	√	√	√	√
A2	√	√	√	√	√
A3	√	√	√	√	√
A4	√	√	√	√	√
B1	√	√	…	√	√
B2	√	√	…		
B3	√	√	…		
B4	√	√	√		
B5	√	√	√	…	
C1	√	√	√	…	
C2	√	√	√	…	
C3	√	√	√		√
C4	√	√	√	√	
D1	√	√	√		√
D2	√	√	√		√
D3	√	√	√		√

Annex-7, Alignment of Program Intended Learning Outcomes (PILOS) to Program Objectives (POs)

1. Program PILOs	Program Objectives					
	PObj1	PObj2	PObj3	PObj4	PObj5	PObj6
A1	√	√	…	…	√	
A2	√	√	…	√	√	
A3	√	√	√	√	√	√
A4	√	√	√	√	√	√
B1	√	√	…	√	√	√
B2	√	√	…	√		√
B3	√	√	…	√		√
B4	…	√	√	√	√	√
C1	√	√	…	…	√	√
C2	…	…	…	…	√	√
C3	…	…	…	√	√	√
C4	√	√	…	√		
D1	√	√	√	√	√	√
D2	√	√	…	√	√	√
D3	√	√	√	√	√	√

Annex-8 , Survey of Course Names per Academic Semesters of Similar Programs

	21-Sep				Sana'a university				Jordan University of Science and Technology (JUST)				Majmaah University				UNIVERSITY OF SHARJAH				Drexel University				Tulane university school of medicine			
C.N	**12**				**13**				**14**				**8**				15				13				8			
T.Cr	35				**30**				**34**				**39**				36				54				30			
	Course	**Course Hours**			**Course**	**Course Hours Course Hours**			**Course**	**Course Hours**			**Course**	**Course Hours**			**Course**	**Course Hours**			Course	Course Hours			**Course**	**Course Hours**		
		L	**P**	**T Ch**		**L**	**P**	**T Ch**		**L**	**P**	**T Ch**		**L**	**P**	**T Ch**						**L**	**P**	**T Ch**		**L**	**P**	**T Ch**
1	Advanced Molecular Microbiology			3	Molecular biology I and II			2	**Advanced Molecular Biology**	2		2	*Cellular & Molecular Biology*	2	1	3										3		
2	Advanced Biostatistics and Epidemiology			3	Biostatistics Epidemiology			2	Advanced Biostatistics and Computer Application			2	*Biostatistics*	2		2					Biostatistics I	2		2				
3	Advanced Bacteriology			3	Medical Bacteriology I and II			3	**Bacteriology**			3	**Microbiology I** **Microbiology II**	2 2	1	3 3	Microbial Pathogenesis			3	Molecular Pathogenesis II	3		3	Medical Microbiology Microbiology Lab		4 3	
4	Advanced immunology			3	Advanced immunology I and II			3	**Immunology**			3	**Immunology**	2	1	2	Advanced Clinical Immunology			3	Immunology I	3		3	Medical Immunology Vaccine Biology		3	
5	Advanced Medical Virology			2	Advanced medic			2	**Virology and Parasitology**			3	**Viral Pathogenesis and**	2	1	3					Molecular Pathogenesis I (Viral	2		2	Advanced Virology			

					al virology I and II									**infection**								Pathogenesis)							
6	Advanced Medical Mycology			2	Mycology			2																		Medical Mycology			
7	Research Methodolog and Scientific Writing			2						**Research Methods and Research Proposal**			2	*Research Methodology.*	2	0	2	Research Methods			2	Research				Biomedical Research Basic Research Methods			
8	Advanced Diagnostic microbiology and Molecular diagnostic			3	Diagnostic microbiology I,II,III					**Advanced Clinical Laboratory Training**				**Diagnostic Microbiology**	2	1	3													
9	Advanced Cellular and Molecular Immunology			3																									
10	Advanced Medical Parasitology			2	Medical Parasitology			2																		Medical Parasitology			
11	Thesis			6	Thesis			6		**Thesis**			9	**Thesis**			6	Research Project			6	Thesis	18			Thesis Research Design Scientific writing Master's thesis			
12	Special course (Choose one)																												
13	Special Topics in Immunology and Serology			3						**Special Topics in Immunology and Serology** **Practical Training II / Immunology & Serology**			**3** **3**																
14	Special				-					**Special Topics in**			3																

	Topics in Clinical Microbiology			3					**Clinical Microbiology** **Practical Training I/Clinical Microbiology**			**3**																
15	Special Topics in molecular diagnostic Microbiology			3																								
16					Food and water microbiology			**2**		**Advanced Biochemistry:**			**3**	*Project proposal*	**2**	**0**	**2**	Advanced Clinical Chemistry			3	Molecular Structure and Metabolism	5		5	Seminar in Microbiology			1
17					Seminar					**Advanced Clinical Laboratory Management:**			**2**	**Antimicrobial agents and infection control**	**2**	**1**	**3**	Cytology and Cytogenetics			3	Cells to Systems	5		5	Graduate Journal Club			1
18										**Seminar**			**1**	*Medical Genetics*	**2**		**2**				3					Topics in Microbiology			2
	0									**Advanced Clinical Laboratory Training**			**1**	*Professional Practice in Medical Laboratory.*	**2**	**0**	**3**	Graduate Seminar			1					Human Medical Cellular Biochemistry			1
														Infectious and non-infectious diseases	2	1	3				3					Metabolic Biochemistry of Human Disease*			2
	0																	Hematopathology			3	Responsible Conduct of Research	2						
																					2	Learn Early As Professionals I (LEAP I)	1			Clinical Cases and Underlying Mechanisms			
																		Advanced Laboratory techniques			3	Learn Early and Practice (LEAP II)	1			Cross listed with Masters in Biochemistry program Anatomy & Histology (uptown campus,			

																		Elective course			3	Cells to Systems	5			Molecular Pathogenesis I (Viral Pathogenesis			
																		Special Topics in Laboratory Management			3	Microbiology and Immunology Journal Club *	4			Microbiology and Immunology Thesis Research			
																		Elective course			3	Microbiology and Immunology 1st Rotation	4						
																						Microbiology and Immunology Seminar *	4						
														CLS 601 Cellular & Molecular Biology	2	1	3	**Biology and Genetics of Cancer Cells**											
														CLS 602 Professional Practice in Medical Laboratory.	2	0	2	**Selected Topics in Cell Biology**											
														CLS 603 Biostatistics.	2	1	3	**Biomedical Genomics**											
														Research Methodology.	2	1		**Bioinformatics Networks**											
														Infectious and non-infectious diseases				**Advanced Topics in Human Molecular Genetics**											
														Project proposal				Advanced Clinical Chemistry			3								
																		Microbial Pathogenesis			3								
																		Cytology and Cytogenetics			3								
																		Hematopathology			3	Required Courses	1						
																		Advanced Clinical Immunology			3								

																		Graduate Seminar			1								
																		Advanced Lab techniques			3	Learn Early As Professionals I (LEAP I)	4	1	5				
																		Sp. Topics in Lab Management			3	Molecular Structure and Metabolism							
																		Biology and Genetics of Cancer Cells			3	Cells to Systems Molecular Pathogenesis I	12						
																		Biomedical Genomics			3	Microbiology and Immunology Journal Club *	13						
																		Selected Topics in Cell Biology			3	Microbiology and Immunology 1st Rotation	14						
																		Bioinformatics Networks			3								
																		Advanced Topics in Human Molecular Genetics			3								

Annex-9, Survey of Number of courses and Credit Hours of Similar Programs Compared to Current Program

University	No of Courses	Total Cr. Hrs.
University of 21 September for Medical & Applied Sciences	**13**	36
Faculty of medicine Sana'a university	**13**	30
Beirut Arab University	11	36
Jordan University of Science and Technology (JUST)	25	34
Mahidol University	25	36
University of Michigan		28

Annex-10 , Matrix of Mapping Program PILO's with Courses

Course	No.	Code/ No.	ILOS														
			Knowledge &understanding skills				Intellectual skills				Practical & professional skills				General &Transferable skills		
			A1	A2	A3	A4	B1	B2	B3	B4	C1	C2	C3	C4	D1	D2	D3
1	Advanced Molecular Biology		**x**	x	x	x					x	x	x	x	x	x	x
2	Advanced Biostatistics and Epidemiology		**x**	x	x	x	x	x	x	x	x	x	x	x	x	x	x
3	Advanced Bacteriology (Molecular and Cellular Pathogenesis)		**x**	x	x	x	x	x	x	x	x	x	x	x	x	x	x
4	Advanced immunology		**x**	x	x	x	x	x	x	x	x	x	x	x	x	x	x

5	Advanced Medical Parasitology		**x**	x	x	x	x	x	x	x	x	x	x	x	x	x	x
6	Advanced Medical Virology		**x**	x	x	x	x	x	x	x	x	x	x	x	x	x	x
7	Advanced Medical Mycology		**x**	x	x	x	**x**	**x**	**x**	**x**	x	x	x	x	x	x	x
8	Research Methods, Research Proposal and Scientific Writing		**x**	x	x	x	x	x	x	x	x	x	x	x	x	x	x
9	Advanced Diagnostic microbiology		**x**	x	x	x	x	x	x	x	x	x	x	x	x	x	x
10	Advanced Molecular Immunology and Immunogenetics		**x**	x	x	x	**x**	**x**	**x**	**x**	x	x	x	x	x	x	x

11	Advanced Molecular diagnostic microbiology		**x**	x	x	x	**x**	**x**	**x**	**x**	x	x	x	x	x	x	x
12	Thesis		**x**	x	x	x	x	x	x	x	x	x	x	x	x	x	x
13	ELECTIVE COURSE (Choose one)		**x**	x	x	x	x	x	x	x	x	x	x	x	x	x	x
I	Special Topics in Immunology and Serology		**x**	x	x	x	**x**	**x**	**x**	**x**	x	x	x	x	x	x	x
II	Special Topics in Clinical Microbiology		**x**	x	x	x	**x**	**x**	**x**	**x**	x	x	x	x	x	x	x
III	Special Topics in molecular diagnostic Microbiology		**x**	x	x	x	**x**	**x**	**x**	**x**	x	x	x	x	x	x	x