21 September University for Medical & Applied Sciences

Faculty of Laboratory Medicine

Program Specifications

Master Degree

of

Clinical Biochemistry and Molecular Biology

Code :03-11

2021-2022

Prepared by:	Reviewed by:	Quality Assurance	Dean of Faculty
Assistant. Prof. Dr. Nawal Al-Henhena	Assistant. Prof Dr.Nabeel Al-Oeri	Assistant Prof. Dr. Gamil Abdul-Mughni	Associated Prof. Dr. Ebtesam Al-Zabedei

Contents

1) Basic Information of the program:	
Program Title	Master of Clinical Biochemistry and Molecular Biology.
Awarding Institution	University of 21 September for Applied & Medical Sciences
Division/institute responsible for the program	Biochemistry and Molecular Biology department/ Faculty of Laboratory Medicine
Program type	Single
Language of study	English
Year of study in the program	2022
Mode of delivery	Regular, minimum attendance 75%
Teaching institution	Faculty of Laboratory Medicine
System of study	Semester system
Duration of study	The program is at least two years full time program that includes advanced theoretical for two semesters and Research work for at least a year. The total number of credit hours to obtain a MSc degree is 38 credit hours, including courses and thesis.
Final award/s available	Master Degree in Clinical Biochemistry and Molecular Biology.
Award title	Master of Clinical Biochemistry and Molecular Biology
Qualification for admission to the program	The Bachelor's degree in: Diagnostic and Laboratory medicine.
Grade for admission to the program	As per the admission rules made by Ministry of Higher education and scientific research-Yemen Republic
Other requirements	Satisfactory outcome of an interview evaluating background.
Data of program specification (New program)	2022
Prepared by	- Prof. Dr. Mojahed Ali Measar Associated Prof. Dr. Ebtesam Al-Zabedei Assistant. Prof. Dr. Nawal Al-Henhena Assistant. Prof Dr.Nabeel Al-Oeri Assistant Prof. Dr. Gamil Abdul-Mughni
Program coordinator:	Assistant. Prof. Dr. Nawal Al-Henhena

2) Program Overview:

The program provides students a broad background in Clinical Biochemistry and Molecular Biology and techniques used in advanced researches in the field. It is offered for laboratory medicine students who hold the bachelor degree in Laboratory Medicine or Diagnostic Medicine. The graduate students from this program should be completed 38 credits hours

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, Goals, and Learning Outcomes of the master program
Mission:
To provide highly qualified graduate skilled in the Clinical Biochemistry and Molecular Biology through advanced practical training and conducting scientific research.

the program aim is to
1- Produce health science professionals and in-depth Biochemistry and Molecular Biology knowledge of different metabolic, cellular, and genetic disorders
2- Provide our candidate with the ability to apply different and recent molecular biological and genetic techniques
3- Improve the research skills and productivity relevant to clinical biochemistry and practice
4. Enhance self-development and collaborative practice
5. Promote leadership and teamwork to deliver high-quality health care services
6- Provide opportunities to gain research capacity and publish scientific relevant studies

Graduate Attributes of the program
Upon successful completion of the program in master of Clinical Biochemistry and Molecular Biology, the graduates will reflect
1. Deep discipline advanced knowledge in the fields of Biochemistry and Molecular Biology.
2. Independence of critical and analytical thinking, both within their field of study, and beyond for the use of their knowledge for service to others.
3. Ability to 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.Leadership and competency in the laboratory, including application of the scientific method and appropriate use of basic and state of the art laboratory tools and techniques.
5. Professional written and oral skills necessary for communication of research, knowledge, and ideas to scientists and non-scientists alike.

III. 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 Biochemistry and molecular biology, including molecular genetics and immunology, cellular, and DNA technology coupled with hands on skills and leadership skills for a successful career.
a2	**Describe** the important mechanisms of cellular, molecular genetics and immunology disorders, eliminated, clarify treatment and outcomes of deseases with emphasis on cellular and molecular genetics.
a3	**List** the key considerations and principles in the planning and design of a study on the basis of statistical methods.
a4	**Identify** different metabolic, molecular causes of diseases and deep comprehensive of using different laboratory techniques for proper diagnosis
B. Intellectual Skills:	
At the end of the course the student should be able to	
b1	**Interpret** and explain results of ***Clinical Biochemistry and Molecular Biology*** and effectively to clinicians
b2	**Illustrate** important clinical biochemistry and molecular genetic disease.

b3	**Design** guidelines for the prevention, diagnosis and treatment of genetic disorders
b4	**Classification** of genetic disorders
C. Professional and Practical Skills:	
At the end of the course the student should be able to	
c1	**Demonstrate** diagnostic laboratory tests in clinical biochemistry, molecular genetics, molecular and cellular immunology to offer basic advice on relevant investigations
c2	**Design** laboratory diagnostic experiments in clinical biochemistry and genetic molecular
c3	**Evaluate** hypotheses relevant to the practice of clinical Biochemistry Molecular Biology.
c4	**Perform** quality control and assurance procedures
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/

System of Study	
I-Duration of program	2 years maximum 4 years divided into courses and thesis
II-.Structure of the program:	Total contact number of credit hours 38
-First year	Program-related essential courses and Students ILOs
Thesis	MSc thesis subject should be officially registered after pass the theoretical part and got in minimum 75%. Discussion and acceptance of the thesis could be set at least after 12 months from MSc registering date.

Program Courses

	Courses name	Courses code	Credit hours
1	Analytical Biochemistry I	03,11,311	2
2	Advanced Biochemistry I	03,11,312	2
3	Comparative Biochemistry	03,11,313	2
4	Cellular and Molecular Biology	03,11,314	2
5	Advance Immunology	03,11,315	3
6	Biomedical Statistics & Epidemiology	03,11,316	2
7	Analytical Biochemistry II	03,11,317	2
8	Advanced Biochemistry II	03,11,318	2
9	Advanced Clinical Biochemistry	03,11,319	3
10	Advanced Molecular Genetics	03,11,320	2
11	Biotechnology and Bioinformatics	03,11,321	2
12	Research Methodology	03,11,322	2
13	Thesis		9
	Total		35

The study plan for Master of Biochemistry and Molecular Biology:

Year Semester	Course Title / Description	Courses code	CRIDET HOUR	Number of weeks
First Year/ First Semester	Analytical Biochemistry I	03,11,311	2	**16**
	Advanced Biochemistry I	03,11,312	2	**16**
	Comparative Biochemistry	03,11,313	2	**16**
	Cellular and Molecular Biology	03,11,314	2	**16**
	Advance Immunology	03,11,315	3	**16**
	Biomedical Statistics & Epidemiology	03,11,316	2	**16**
			13	
	Analytical Biochemistry II	03,11,317	2	**16**
First Year/ Second Semester	Advanced Biochemistry II	03,11,318	2	**16**
	Advanced Clinical Biochemistry	03,11,319	3	**16**
	Advanced Molecular Genetics	03,11,320	2	**16**
	Biotechnology and Bioinformatics	03,11,321	2	**16**
	Research Methodology	03,11,322	6	**16**
	Thesis		9	**0**
	Total		35	

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 Strategies	
Written examinations	Final Term 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

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%**

Characters of program graduates:

1. Committed to Islamic traditions.
2. Have the knowledge and skills needed to provide health care services with reliable laboratory findings.
3. Demonstrate professionalism through honesty, integrity and confidentiality of patient results.
4. Demonstrate respect for the dignity and privacy of patients.
5. Communicate effectively and inspire confidence with patients, colleagues, physicians, and other health care team members.
6. Possess basic knowledge in conducting scientific research.
7. Contribute to the general wellbeing of community and respect the religious culture and social constants of society.

Annex-1 Program Structure

No.	Requirements		No. of Courses	Credit Hours	Rational Weight %
1	Program Requirements	Compulsory	11	25	73
		Elective	2	4	10
2		Thesis	1	9	15
	Total:		16	38	

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

	Academic Standards:
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 clinical biochemistry and molecular biology
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 clinical biochemistry and molecular biology 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. 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	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 Biochemistry and Molecular Biology knowledge of different metabolic, cellular, and genetic disorders 2- Provide our candidate with the ability to apply different and recent molecular biological and genetic techniques 3- Improve the research skills and productivity relevant to clinical biochemistry and practice 4. Enhance self-development and collaborative practice 5. Promote leadership and teamwork to deliver high-quality health care services 6- Provide opportunities to gain research capacity and publish scientific relevant studies

Annex-4, Survey of Credit Hours of Similar Programs

Benchmarking		21 September University	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	45
	Percentage	74	80	47	56	67	90	83
Program Electives	Credit Hours	3		9	11	6		
	Percentage	9		26	28	17	-	-
Program Thesis	Credit Hours	6	6	9	6	6	3	9
	Percentage	17	20	26	15	17	10	17
Total Credit Hours		38	30	34	39	36	30	54

Annex-5, 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	√	√	√		
C1	√	√	√	…	
C2	√	√	√	…	
C3	√	√	√		√
C4	√	√	√	√	
D1	√	√	√		√
D2	√	√	√		√
D3	√	√	√		√

Annex-6, 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- 7, Survey on Mission and Objectives of the Program and Similar Accredited Programs

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	To develop and maintain superior educational program in the field of medical laboratory	To preparation of individuals for a variety of career objectives in microbiology and immunology.	

				and deeply prepared courses to expand the knowledge provided by recognized faculty member in their specialty in order to cope with the evolution in the field of laboratory diagnostic techniques	sciences.		
2				1-Learning the fundamental principles and recent advances in Clinical Laboratory. 2-Updating students about the modern technologies in Clinical and		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	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

				Research field. 3-Enable students to understand the principles of laboratory 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		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 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	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

				management, leadership, communication, teamwork, writing and presentation skills.			research, knowledge, and ideas to scientists and non-scientists alike.
3 Program Outcomes:				Enriching educational government institutions, hospitals and research centers with specialists and experts in clinical laboratory sciences. Encourage postgraduate students for Life-long learning, involvement in scientific research and applying ethics on humane aspects of clinical			

				laboratory practices. Enhance the leadership, communication and effectiveness work in team.			

Annex-8 , Matrix of Mapping Program PILO's with Courses

		ILOS														
No.	Course	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	Analytical Biochemistry I	x		x	x							X				X
2	Advanced Biochemistry I	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
3	Comparative Biochemistry	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
4	Cellular and Molecular Biology	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
5	Advance Immunology	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
6	Research Methodology			x				x		x		x			X	
7	Biomedical Statistics			x				x					x		X	
8	Analytical Biochemistry II	x		x						x						
9	Advanced Biochemistry II	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
10	Advanced Clinical Biochemistry	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
11	Advanced Molecular Genetics	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
12	Biotechnology and Bioinformatics	x		x												
13	Special Topics in Cancer biology	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
14	Special Topics in Pharmaceutical Biochemistry	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Annex-9 , 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			
12				**13**				**14**								15				13				30			
35				**30**				**34**				**39**				36				54				8			
Course	**Course Hours**			**Course**	**Course Hours**			**Course**	**Course Hours**			**Course**	**Course Hours**							Course	Course Hours			**Course**	**Course Hours**		
	L	**P**	**T**		**L**	**P**	**T**		**L**	**P**	**T**		**L**	**P**	**T**		**L**	**P**	**T**		**L**	**P**	**T**		**L**	**P**	**T**
Analytical Biochemistry I	2			Analytical Biochemistry I	2		2					*Cellular & Molecular Biology*	**2**	**1**	**3**	Cytology and Cytogenetics	2	1	3					Introduction to Bioinformatics			3
Advanced Biochemistry I	2			Advanced Biochemistry I	2		2	Advanced Biochemistry			3	**Biochemistry** I	2		2					Core Curriculum I Core Curriculum II	2 4		2 4	Graduate Biochemistry Basic Medical Biochemistry			4 3
Comparative Biochemistry	2			Comparative Biochemistry	2		2																				
Cellular and Molecular Biology	2			Cellular and Molecular Biology	2		2	Molecular and Cellular Pathogenesis			**2**	-				Biology and Genetics of Cancer Cells			3	Macromolecular Structure & Function			1	Advanced Cell Biology			**3**
Advance Immunology	2											-				Advanced Clinical Immunology			3								
Analytical Biochemistry II	2			Analytical Biochemistry II	2		2																				

Advanced Biochemistry II	2		2	Advanced Biochemistry II	2		2										Advanced Lab techniques													
Advanced Clinical Biochemistry	2		2	Advanced Clinical Biochemistry	2		2	Advanced Clinical Biochemistry I Advanced Clinical Biochemistry I I Advanced Clinical Biochemistry I II			3 3 3	**Biochemistry of Body Fluids** Endocrinology and Medical Metabolism	**2** **2**	**1** **1**	**3** 3	Advanced Clinical Chemistry	2	1	3	Experimental Approaches to Biochemical Problems	5			Metabolic Biochemistry of Human Disease Medical Biochemistry Grand Rounds Externship		3	3
Cellular and Molecular immunity	2		2																												
Advanced Molecular Genetics	2		2	Advanced Molecular Genetics	2		2	Advanced Molecular Biology	2		**2**	Medical Genetics **Molecular Diagnostics**	**2** **2**	**1** **1**	**3** 3					Advanced Cell Biology Advanced Topics in Biochemistry & Molecular Biology	2 2			Principles of Genetics			3
Biotechnology and Bioinformatics	3															Biomedical Genomics Bioinformatics Networks	2	1	3					Advanced Bioinformatics			3
Biomedical Statistics &Research Methodology	2		2	Biomedical Statistics &Research Methodology	2		2	Research Methods and Research Proposal			2	*Research Methodology*. ***Project proposa***	**2**	**1**	**3** 1	Research Methods			2	Biostatistics Scientific Integrity and Ethics **Scientific Writing for Biomedical Researchers**	2 1			Biomedical Statistics and Data Analysis Research Methods in Biochemistry and Molecular Biology Academic Writing and Critique			2 3 3
Thesis	9			Thesis	6			Thesis	9			Thesis			**6**					Thesis Research									

Special Topics in Cancer biology	2			Special Topics in Cancer biology	2		2	Special Topics in Clinical Biochemistry			3	**Topics in Molecular Medicine**	**2**			Advanced Topics in Human Molecular Genetics				Cancer Biology Advanced Molecular Biology	2 2		2 2	Human Medical Cellular Biochemistry			4
Special Topics in Pharmaceutical Biochemistry	2											*Professional Practice in Medical Laboratory*	**2**		**2**					4 Biochemistry 1st Laboratory Rotation				Biochemistry and Molecular Biology Seminar			**1**
		2						Advanced Medical Microbiology					2		2	Microbial Pathogenesis Hematopathology Graduate Seminar Sp. Topics in Lab Management Selected Topics in Cell Biology	3		4	Biochemistry 2nd Laboratory Rotation4				Biochemistry Workshop			1
	L M 7 2 1							Advanced Clinical Laboratory Management									3			Biochemistry 3rd Laboratory Rotation				Mechanisms of Microbial Pathogenesis			
	L M 7 2 2							Seminar									3			Biochemistry Journal Club				Special Topics in Virology			
								Advanced Clinical Laboratory Training		3			2	1	3		3		1	Biochemistry Seminar Series				Cell & Molecular Pathobiology of Cancer			

																								Advanced Neuroscience			
																								Graduate Physiology			
																								Graduate Pharmacology			