



Course Specification of Biomedical Equipment 1

Course Code (BE263)

I. Course Identification and General Information:						
1	Course Title:	Biomedical Equipment 1				
2	Course Code & Number:	BE263				
3	Credit hours:	C.H				TOTAL
		Th.	Seminar	Pr	Tr.	
		2	--	2	--	3
4	Study level/ semester at which this course is offered:	3 rd Level / 2 nd Semester				
5	Pre –requisite (if any):	Biomedical Sensors and Measurements (BE224), Biochemistry (BE202)				
6	Co –requisite (if any):	Bioelectronics (BE227)				
7	Program (s) in which the course is offered:	Biomedical Engineering Program				
8	Language of teaching the course:	English				
9	Location of Teaching the Course:	Faculty of Engineering				
10	Prepared by:	Dr. Mohammed Al-olofi				
11	Reviewed by:	Dr. Waleed Al-Talbi				
12	Date of Approval:					

I. Course Description:

The course aims to provide basic concepts, operating principles, and block diagrams of several medical laboratory equipment. The students would be learned the skills for analyze, repair, maintenance, and troubleshooting as well as using maintenance, test, and calibration tools. The course includes: An introduction to analytical instruments and bio-analysis devices, design of instrumental analysis, spectrophotometer, colorimeter, flame photometer, blood cell counter, blood gas analyzer, and bio-

University of Sana'a
Faculty of Engineering
Department: Biomedical Engineering
Title of the Program: Biomedical Engineering



chemistry analyzer. The course focuses on practical activities related to operating, calibrations, troubleshooting, and maintenance of medical laboratory equipment.

III. Course Intended learning outcomes (CILOs) of the course (maximum 8CILOs)		Referenced PILOs (Only write code number of referenced Program Intended learning outcomes)
Knowledge and Understanding: Upon successful completion of the undergraduate Biomedical Engineering Program, the graduates will be able to:		
a1	Explain the basic concepts and principles for the analytical instruments and bio-analysis devices.	A1 Describe and explain the underlying mathematical methods and theories; life scientific-principles; and engineering core concepts related to the Biomedical Engineering context.
a2	Identify the operation principles, and design of analytical instruments and bio-analysis devices.	A2 Clarify the design principles and techniques and the engineering materials characteristics and how these are relevant to the developments and technologies in a biomedical systems context.
a3	Describe the clinical applications of medical analytical instruments and bio-analysis devices, their operational theories and their clinical environments.	A3 Recognize and explain the need for a high level of management, professional and ethical behavior, responsibility, quality assurance systems, codes of practice, standards, health and safety requirements, and environmental impacts in biomedical systems.
B. Cognitive/ Intellectual Skills: Upon successful completion of the undergraduate Biomedical Engineering Program, the graduates will be able to:		
b1	Design the analytical instruments and bio-analysis medical devices used in medical laboratory with	B3 Design the biomedical systems or processes within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and

University of Sana'a
Faculty of Engineering
Department: Biomedical Engineering
Title of the Program: Biomedical Engineering



	considerate environmental conditions, health and safety, manufacturability and sustainability.	sustainability.
b2	Categorize the analytical instruments and bio-analysis devices according to their specifications and features.	B5 Distinguish the main characteristics of biomedical systems, apply diagnostic skills and technical knowledge and perform failure analysis to these systems.
C. Professional and Practical Skills: Upon successful completion of the undergraduate Biomedical Engineering Program, the graduates will be able to:		
c1	Use mathematical, simulation models, and IT software packages to analytical instruments effectively.	C2 Use a wide range of analytical tools, techniques, IT, modern engineering tools, software packages and develop required computer programs to solve, modeling and analyzing Biomedical Engineering problems.
c2	Construct, operate and maintain the analytical instruments and bio-analysis devices by using rules and regulations of industrial safety.	C4 Use rules and regulations of industrial safety as well as safe and diagnose systems at work, evaluate performance and observe the appropriate steps to manage risks concerning biomedical systems.
D. Transferable Skills: Upon successful completion of the undergraduate Biomedical Engineering Program, the graduates will be able to:		
d1	Function effectively in different work environments as an individual, and as a member or leader in multi-disciplinary teams.	D1 Lead and motivate individuals, show capability to work in stressful environments and within constraints, collaborate effectively within multidisciplinary team.

University of Sana'a
Faculty of Engineering
Department: Biomedical Engineering
Title of the Program: Biomedical Engineering



(A) Alignment Course Intended Learning Outcomes of Knowledge and Understanding to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
<p>a1 Explain the basic concepts and principles for the analytical instruments and bio-analysis devices.</p>	<ul style="list-style-type: none"> • Interactive lectures & examples, • Tutorials, • Videos demonstrations, • Presentation/seminar, • Interactive class discussions, • Case studies, • Laboratory/Practical experiments based session, • Computer laboratory-based sessions, • Workshops practices, • Directed self- study, • Problem based learning, • Team work (cooperative learning), • Field visits/training, • Mini/major project. 	<ul style="list-style-type: none"> • Written tests (mid and final terms and quizzes), • Short reports, • Lab\Project report • Practical lab performance assessment, • Coursework activities assessment, • Presentations.
<p>a2 Identify the operation principles, and design of analytical instruments and bio-analysis devices.</p>	<ul style="list-style-type: none"> • Interactive lectures & examples, • Tutorials, • Videos demonstrations, • Presentation/seminar, • Interactive class discussions, 	<ul style="list-style-type: none"> • Written tests (mid and final terms and quizzes), • Short reports, • Lab\Project report • Practical lab performance

University of Sana'a
Faculty of Engineering
Department: Biomedical Engineering
Title of the Program: Biomedical Engineering



	<ul style="list-style-type: none"> • Case studies, • Laboratory/Practical experiments based session, • Computer laboratory-based sessions, • Workshops practices, • Directed self- study, • Problem based learning, • Team work (cooperative learning), • Field visits/training, • Mini/major project. 	<ul style="list-style-type: none"> assessment, • Coursework activities assessment, • Presentations.
<p>a3 Describe the clinical applications of medical analytical instruments and bio-analysis devices, their operational theories and their clinical environments.</p>	<ul style="list-style-type: none"> • Interactive lectures & examples, • Tutorials, • Videos demonstrations, • Presentation/seminar, • Interactive class discussions, • Case studies, • Laboratory/Practical experiments based session, • Computer laboratory-based sessions, • Workshops practices, • Directed self- study, • Problem based learning, • Team work (cooperative learning), 	<ul style="list-style-type: none"> • Written tests (mid and final terms and quizzes), • Short reports, • Lab\Project report • Practical lab performance assessment, • Coursework activities assessment, • Presentations.

University of Sana'a
Faculty of Engineering
Department: Biomedical Engineering
Title of the Program: Biomedical Engineering



	<ul style="list-style-type: none"> • Field visits/training, • Mini/major project. 	
--	---	--

(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
<p>b1 Design the analytical instruments and bio-analysis medical devices used in medical laboratory with considerate environmental conditions, health and safety, manufacturability and sustainability.</p>	<ul style="list-style-type: none"> • Interactive lectures & examples, • Tutorials, • Videos demonstrations, • Presentation/seminar, • Interactive class discussions, • Case studies, • Laboratory/Practical experiments based session, • Computer laboratory-based sessions, • Workshops practices, • Directed self- study, • Problem based learning, • Team work (cooperative learning), • Field visits/training, • Mini/major project. 	<ul style="list-style-type: none"> • Written tests (mid and final terms and quizzes), • Short reports, • Lab\Project report • Practical lab performance assessment, • Coursework activities assessment, • Presentations.
<p>b2 Categorize the analytical instruments and bio-analysis devices according to their specifications and features.</p>	<ul style="list-style-type: none"> • Interactive lectures & examples, • Tutorials, • Videos demonstrations, 	<ul style="list-style-type: none"> • Written tests (mid and final terms and quizzes), • Short reports,

University of Sana'a
Faculty of Engineering
Department: Biomedical Engineering
Title of the Program: Biomedical Engineering



	<ul style="list-style-type: none"> • Presentation/seminar, • Interactive class discussions, • Case studies, • Laboratory/Practical experiments based session, • Computer laboratory-based sessions, • Workshops practices, • Directed self- study, • Problem based learning, • Team work (cooperative learning), • Field visits/training, • Mini/major project. 	<ul style="list-style-type: none"> • Lab\Project report • Practical lab performance assessment, • Coursework activities assessment, • Presentations.
--	--	--

(C) Alignment Course Intended Learning Outcomes of Professional and Practical Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
<p>c1 Use mathematical, simulation models, and IT software packages to analytical instruments effectively.</p>	<ul style="list-style-type: none"> • Interactive lectures & examples, • Tutorials, • Videos demonstrations, • Presentation/seminar, • Interactive class discussions, • Case studies, • Laboratory/Practical experiments based session, 	<ul style="list-style-type: none"> • Written tests (mid and final terms and quizzes), • Short reports, • Lab\Project report • Practical lab performance assessment, • Coursework activities assessment, • sPresentations.

University of Sana'a
Faculty of Engineering
Department: Biomedical Engineering
Title of the Program: Biomedical Engineering



	<ul style="list-style-type: none"> • Computer laboratory-based sessions, • Workshops practices, • Directed self- study, • Problem based learning, • Team work (cooperative learning), • Field visits/training, • Mini/major project. 	
<p>c2 Construct, operate and maintain the analytical instruments and bio-analysis devices by using rules and regulations of industrial safety.</p>	<ul style="list-style-type: none"> • Interactive lectures & examples, • Tutorials, • Videos demonstrations, • Presentation/seminar, • Interactive class discussions, • Case studies, • Laboratory/Practical experiments based session, • Computer laboratory-based sessions, • Workshops practices, • Directed self- study, • Problem based learning, • Team work (cooperative learning), • Field visits/training, • Mini/major project. 	<ul style="list-style-type: none"> • Written tests (mid and final terms and quizzes), • Short reports, • Lab\Project report • Practical lab performance assessment, • Coursework activities assessment, • Presentations.

University of Sana'a
Faculty of Engineering
Department: Biomedical Engineering
Title of the Program: Biomedical Engineering



(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
<p>d1 Function effectively in different work environments as an individual, and as a member or leader in multi-disciplinary teams.</p>	<ul style="list-style-type: none"> • Interactive lectures & examples, • Tutorials, • Videos demonstrations, • Presentation/seminar, • Interactive class discussions, • Case studies, • Laboratory/Practical experiments based session, • Computer laboratory-based sessions, • Workshops practices, • Directed self- study, • Problem based learning, • Team work (cooperative learning), • Field visits/training, • Mini/major project. 	<ul style="list-style-type: none"> • Written tests (mid and final terms and quizzes), • Short reports, • Lab\Project report • Practical lab performance assessment, • Coursework activities assessment, • Presentations.

IV. Course Content:					
A – Theoretical Aspect:					
Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	contact hours
1	Introduction to analytical	a1	<ul style="list-style-type: none"> • Introduction of analysis instruments, 	1	2

University of Sana'a
Faculty of Engineering
Department: Biomedical Engineering
Title of the Program: Biomedical Engineering



	instruments and bio-analysis devices.		<ul style="list-style-type: none"> • Medical background on the blood, • Blood purpose, • Blood components, • Types of blood test. 		
2	Design of instrumental analysis.	a1, a2, a3	<ul style="list-style-type: none"> • Basic design of instrumental analysis. • Selecting the analytical instruments. • Introduction to the medical laboratory department. 	1	2
3	Spectrophotometer	a1, a2, a3, b1,b2, c1, c2	<ul style="list-style-type: none"> • Introduction to spectrophotometer. • Types of spectrophotometer. • Operating principles of spectrophotometer. 	1	2
4	Spectrophotometer (Continue)	a1, a2, a3, b1,b2, c1, c2	<ul style="list-style-type: none"> • Design, block diagram, and components of spectrophotometer. • Maintenance and troubleshooting of spectrophotometer. 	1	2
5	Colorimeter	a1, a2, a3, b1,b2, c1, c2	<ul style="list-style-type: none"> • Introduction to colorimeter. • Operating principles of colorimeter. • Design, block diagram, and components of colorimeter. • Maintenance and troubleshooting of colorimeter. 	1	2
6	Flame photometer	a1, a2, a3, b1,b2, c1, c2	<ul style="list-style-type: none"> • Introduction to flame photometer. • Operating principles of flame photometer. • Design, block diagram, and components of flame photometer. • Maintenance and troubleshooting of flame photometer. 	1	2

University of Sana'a
Faculty of Engineering
Department: Biomedical Engineering
Title of the Program: Biomedical Engineering



7	Blood Cell Counter	a1, a2, a3, b1,b2, c1, c2	<ul style="list-style-type: none"> • Introduction to blood cell counter instrument. • Types of blood cell counter. • Operating principles of blood cell counter. 	1	2
8	Mid-Term Theoretical Exam	a1, a2, a3, b1,b2, c1, c2	- All Previous Topics	1	2
9	The Blood Cell Counter (Continue)	a1, a2, a3, b1,b2, c1, c2	<ul style="list-style-type: none"> • Design, block diagram, and components of blood cell counter. • Maintenance and troubleshooting of blood cell counter. 	1	2
10	Blood Gas Analyser	a1, a2, a3, b1,b2, c1, c2	<ul style="list-style-type: none"> • Introduction to blood gas analyzer, • Medical background, • Operating principles of blood gas analyzer. 	1	2
11	Blood Gas Analyser (Continue)	a1, a2, a3, b1,b2, c1, c2	<ul style="list-style-type: none"> • Design, block diagram, and components of blood gas analyzer, • Maintenance and troubleshooting of blood gas analyzer. 	1	2
12	Report & Presentation	a1, a2, a3, b1,b2, c1, c2, d1	<ul style="list-style-type: none"> • 3 to 4 students make a report and presentation about one analytical instrument. 	1	2
13	Report & Presentation (Continue)	a1, a2, a3, b1,b2, c1, c2, d1	<ul style="list-style-type: none"> • 3 to 4 students make a report and presentation about one analytical instrument. 	1	2
14	Bio-Chemistry Analyzer	a1, a2, a3, b1,b2, c1, c2	<ul style="list-style-type: none"> • Introduction to bio-chemistry analyzer, • Medical background. • Operating principles of bio-chemistry analyzer, 	1	2
15	Bio-Chemistry Analyzer (Continue)	a1, a2, a3, b1,b2, c1, c2	<ul style="list-style-type: none"> • Design, block diagram, and components of bio-chemistry analyzer, 	1	2

University of Sana'a
Faculty of Engineering
Department: Biomedical Engineering
Title of the Program: Biomedical Engineering



			• Maintenance and troubleshooting of bio-chemistry analyzer.		
16	Final Theoretical Exam	a1, a2, a3, b1,b2, c1, c2	- All Topics	1	2
Number of Weeks /and Units Per Semester				16	32

B - Practical Aspect: (if any)				
Order	Tasks/ Experiments	Number of Weeks	contact hours	Learning Outcomes
1	- Review on the laboratory department in hospital	1	2	a1, a2
2	- Types of spectrophotometer equipment - Components of spectrophotometer equipment - Operation of spectrophotometer equipment	1	2	a1, a2, a3
3	- Detection of errors, troubleshooting, repair, and maintenance of spectrophotometer equipment	1	2	a1, a2, a3, b1,b2, c1, c2
4	- Components of colorimeter equipment - Operation of colorimeter equipment - Detection of errors, troubleshooting, repair, and maintenance of colorimeter equipment	1	2	a1, a2, a3, b1,b2, c1, c2
5	- Types of blood cell counter	1	2	a1, a2, a3, b1,b2, c1, c2

University of Sana'a
Faculty of Engineering
Department: Biomedical Engineering
Title of the Program: Biomedical Engineering



	<p>equipment,</p> <ul style="list-style-type: none"> - Components of blood cell counter equipment - Operation of blood cell counter equipment 			
6	<ul style="list-style-type: none"> - Detection of errors, troubleshooting, repair, and maintenance of blood cell counter equipment 	1	2	a1, a2, a3, b1,b2, c1, c2
7	<ul style="list-style-type: none"> - Midterm Practical Exam 	1	2	a1, a2, a3, b1,b2, c1, c2
8	<ul style="list-style-type: none"> - Types of blood gas analyzer equipment - Components of blood gas analyzer equipment - Operation of blood gas analyzer equipment 	1	2	a1, a2, a3, b1,b2, c1, c2
9	<ul style="list-style-type: none"> - Detection of errors, troubleshooting, repair, and maintenance of blood gas analyzer equipment 	1	2	a1, a2, a3, b1,b2, c1, c2
10	<ul style="list-style-type: none"> - Types of biochemistry analyzer equipment - Components of biochemistry analyzer equipment - Operation of biochemistry analyzer equipment 	1	2	a1, a2, a3, b1,b2, c1, c2
11	<ul style="list-style-type: none"> - Operation of biochemistry analyzer equipment 	1	2	a1, a2, a3, b1,b2, c1, c2
12	<ul style="list-style-type: none"> - Detection of errors, troubleshooting, 	1	2	a1, a2, a3, b1,b2, c1, c2

University of Sana'a
Faculty of Engineering
Department: Biomedical Engineering
Title of the Program: Biomedical Engineering



	repair, and maintenance of biochemistry analyzer equipment			
13	- Practical Project	1	2	a1, a2, a3, b1,b2, c1, c2, d1
14	- Practical Project (Continue)	1	2	a1, a2, a3, b1,b2, c1, c2, d1
15	- Final Practical Exam	1	2	a1, a2, a3, b1,b2, c1, c2
Number of Weeks /and Units Per Semester			15	30

V. Teaching Strategies of the Course:

- Interactive lectures & examples,
- Tutorials,
- Videos demonstrations,
- Presentation/seminar,
- Interactive class discussions,
- Case studies,
- Laboratory/Practical experiments based session,
- Computer laboratory-based sessions,
- Workshops practices,
- Directed self- study,
- Problem based learning,
- Team work (cooperative learning),
- Field visits/training,
- Mini/major project.

VI. Assessment Methods of the Course:

- Written tests (mid and final terms and quizzes),
- Short reports,



VI. Assessment Methods of the Course:

- Lab\Project report
- Practical lab performance assessment,
- Coursework activities assessment,
- Presentations.

VII. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1				
2				
3				
4				
5				
Total				

VIII. Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1	Quiz 1	6	5	3.33%	a1, a2, a3, b2,c1, c2
2	Midterm Practical Exam	7	20	13.33%	a1, a2, a3, b2,c1, c2
3	Midterm Theoretical Exam	8	10	6.67%	a1, a2, a3, b2,c1, c2
4	Report, Presentation, and Project	10, 11	20	13.33%	a1, a2, a3, b2,c1, c2, d1

University of Sana'a
Faculty of Engineering
Department: Biomedical Engineering
Title of the Program: Biomedical Engineering



5	Quiz 2	12	5	3.33%	a1, a2, a3, b2,c1, c2
6	Final Practical Exam	15	30	20%	a1, a2, a3, b2,c1, c2
7	Final Theoretical Exam	16	60	40%	a1, a2, a3, b2,c1, c2
Total			150	100%	

IX. Learning Resources:	
<ul style="list-style-type: none"> Written in the following order: (Author - Year of publication – Title – Edition – Place of publication – Publisher). 	
1- Required Textbook(s) (maximum two).	
	1- R S Khandpur, 2006, Handbook of Analytical Instruments , Second Edition, McGraw Hill Education. 2- Ed. Joseph D. Bronzino, 2016, The Biomedical Engineering Handbook , Fourth Edition, CRC Press LLC. 3- Roger Narayan, 2019, Wiley Encyclopedia of Biomedical Engineering , Elsevier.
2- Essential References.	
	1- James Moore, George Zouridakis, 2004, Biomedical Technology and Devices Handbook , CRC Press LLC. 2- Metin Akay, 2006, Wiley Encyclopedia of Biomedical Engineering , John Wiley & Sons, In. 3- John G. Webster, 2006, Encyclopedia Of Medical Devices and Instrumentation , Second Edition, John Wiley & Sons.
3- Electronic Materials and Web Sites etc.	
	Websites: 1- Medical Devices & Sensors Journal, Wiley. Peer reviewed academic journal in the field of Medical Devices. http://onlinelibrary.wiley.com/journal/2573802x 2- Journal of Medical Devices. Peer reviewed academic journal in the field of Medical

University of Sana'a
Faculty of Engineering
Department: Biomedical Engineering
Title of the Program: Biomedical Engineering



	<p>Devices.</p> <p>http://medigitalcollection.asme.org/</p> <p>Journals:</p> <p>3- IEEE Transactions on Biomedical Engineering: Peer reviewed academic journal in the field of Biomedical Engineering.</p> <p>http://www.ieeexplore.ieee.org/xpl</p> <p>4- Journal of Medical Devices. Peer reviewed academic journal in the field of Medical Devices</p> <p>https://publons.com/journal/19039/journal-of-medical-devices</p> <p>Other Web Sources:</p> <p>5- Website: Franks Hospital Workshop</p> <p>http://www.frankshospitalworkshop.com</p>
--	---

X. Course Policies:	
1	<p>Class Attendance:</p> <p>A student should attend not less than 75 % of total hours of the subject; otherwise he/she will not be able to take the exam and will be considered as exam failure. If the student is absent due to illness, he/she should bring a proof statement from university Clinic. If the absent is more than 25% of a course total contact hours, student will be required to retake the entire course again.</p>
2	<p>Tardy:</p> <p>For late in attending the class, the student will be initially notified. If he repeated lateness in attending class, he/she will be considered as absent.</p>
3	<p>Exam Attendance/Punctuality:</p> <p>A student should attend the exam on time. He/she is permitted to attend an exam half one hour from exam beginning, after that he/she will not be permitted to take the exam and he/she will be considered as absent in exam</p>
4	<p>Assignments & Projects:</p>

University of Sana'a
Faculty of Engineering
Department: Biomedical Engineering
Title of the Program: Biomedical Engineering



	In general one assignment is given to the students after each chapter; the student has to submit all the assignments for checking on time, mostly one week after given the assignment.
5	<p>Cheating:</p> <p>For cheating in exam, a student will be considered as fail. In case the cheating is repeated three times during his/her study the student will be disengaged from the Faculty.</p>
6	<p>Plagiarism:</p> <p>Plagiarism is the attending of a student the exam of a course instead of another student. If the examination committee proofed a plagiarism of a student, he/she will be disengaged from the Faculty. The final disengagement of the student from the Faculty should be confirmed from the Student Council Affair of the university or according to the university roles.</p>
7	<p>Other policies:</p> <ul style="list-style-type: none"> - Mobile phones are not allowed to use during a class lecture. It must be closed; otherwise the student will be asked to leave the lecture room. - Mobile phones are not allowed in class during the examination. - Lecture notes and assignments might be given directly to students using soft or hard copy.



Template for Course Plan (Syllabus)

Biomedical Equipment 1- BE263

I. Course Identification and General Information:					
1	Course Title:	Biomedical Equipment 1			
2	Course Code & Number:	BE263			
3	Credit Hours:	Credit Hours	Theory Hours		Lab. Hours
			Lecture	Exercise	
3		3	2	--	2
4	Study Level/ Semester at which this Course is offered:	3 rd Level / 2 nd Semester			
5	Pre –Requisite (if any):	Biomedical Sensors and Measurements (BE224), Biochemistry (BE202)			
6	Co –Requisite (if any):	Bioelectronics (BE227)			
7	Program (s) in which the Course is Offered:	Bachelor of Biomedical Engineering			
8	Language of Teaching the Course:	English			
9	Location of Teaching the Course:	Faculty of Engineering			
10	Prepared by:	Dr. Mohammed Al-olofi			
11	Reviewed by:	Dr. Waleed Al-Talbi			
12	Date of Approval:				

II. Course Description:

The course aims to provide basic concepts, operating principles, and block diagrams of several medical laboratory equipment. The students would be learned the skills for analyze, repair, maintenance, and troubleshooting as well as using maintenance, test, and calibration tools. The course includes: An introduction to analytical instruments and bio-analysis devices, design of instrumental analysis,

University of Sana'a
Faculty of Engineering
Department: Biomedical Engineering
Title of the Program: Biomedical Engineering



spectrophotometer, colorimeter, flame photometer, blood cell counter, blood gas analyzer, and bio-chemistry analyzer. The course focuses on practical activities related to operating, calibrations, troubleshooting, and maintenance of medical laboratory equipment.

III. Course Intended Learning Outcomes (CILOs): (مخرجات تعلم المقرر)

A. Knowledge and Understanding: Upon successful completion of the course, students will be able to:

a1	Explain the basic concepts and principles for the analytical instruments and bio-analysis devices.
a2	Identify the operation principles, and design of analytical instruments and bio-analysis devices.
a3	Describe the clinical applications of medical analytical instruments and bio-analysis devices, their operational theories and their clinical environments.

B. Intellectual Skills: Upon successful completion of the course, students will be able to:

b1	Design the analytical instruments and bio-analysis medical devices used in medical laboratory with considerate environmental conditions, health and safety, manufacturability and sustainability.
b2	Categorize the analytical instruments and bio-analysis devices according to their specifications and features.

C. Professional and Practical Skills: Upon successful completion of the course, students will be able to:

c1	Use mathematical, simulation models, and IT software packages to analytical instruments effectively.
c2	Construct, operate and maintain the analytical instruments and bio-analysis devices by using rules and regulations of industrial safety.

D. Transferable Skills: Upon successful completion of the course, students will be able to:

d1	Function effectively in different work environments as an individual, and as a member or
----	--



III. Course Intended Learning Outcomes (CILOs): (مخرجات تعلم المقرر)	
	leader in multi-disciplinary teams.

IV. Course Contents:				
A. Theoretical Aspect:				
No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
1	Introduction to analytical instruments and bio-analysis devices.	<ul style="list-style-type: none"> • Introduction of analysis instruments, • Medical background on the blood, • Blood purpose, • Blood components, • Types of blood test. 	1	2
2	Design of instrumental analysis.	<ul style="list-style-type: none"> • Basic design of instrumental analysis. • Selecting the analytical instruments. • Introduction to the medical laboratory department. 	1	2
3	Spectrophotometer	<ul style="list-style-type: none"> • Introduction to spectrophotometer. • Types of spectrophotometer. • Operating principles of spectrophotometer. 	1	2
4	Spectrophotometer (Continue)	<ul style="list-style-type: none"> • Design, block diagram, and components of spectrophotometer. • Maintenance and troubleshooting of spectrophotometer. 	1	2
5	Colorimeter	<ul style="list-style-type: none"> • Introduction to colorimeter. • Operating principles of colorimeter. • Design, block diagram, and components of colorimeter. • Maintenance and troubleshooting of colorimeter. 	1	2
6	Flame photometer	<ul style="list-style-type: none"> • Introduction to flame photometer. • Operating principles of flame 	1	2

University of Sana'a
 Faculty of Engineering
 Department: Biomedical Engineering
 Title of the Program: Biomedical Engineering



IV. Course Contents:				
A. Theoretical Aspect:				
No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
		photometer. • Design, block diagram, and components of flame photometer. • Maintenance and troubleshooting of flame photometer.		
7	Blood Cell Counter	• Introduction to blood cell counter instrument. • Types of blood cell counter. • Operating principles of blood cell counter.	1	2
8	Mid-Term Theoretical Exam	- All Previous Topics	1	2
9	The Blood Cell Counter (Continue)	• Design, block diagram, and components of blood cell counter. • Maintenance and troubleshooting of blood cell counter.	1	2
10	Blood Gas Analyser	• Introduction to blood gas analyzer, • Medical background, • Operating principles of blood gas analyzer.	1	2
11	Blood Gas Analyser (Continue)	• Design, block diagram, and components of blood gas analyzer, • Maintenance and troubleshooting of blood gas analyzer.	1	2
12	Report & Presentation	• 3 to 4 students make a report and presentation about one analytical instrument.	1	2
13	Report & Presentation (Continue)	• 3 to 4 students make a report and presentation about one analytical instrument.	1	2
14	Bio-Chemistry Analyzer	• Introduction to bio-chemistry analyzer,	1	2



IV. Course Contents:				
A. Theoretical Aspect:				
No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
		<ul style="list-style-type: none"> • Medical background. • Operating principles of bio-chemistry analyzer, 		
15	Bio-Chemistry Analyzer (Continue)	<ul style="list-style-type: none"> • Design, block diagram, and components of bio-chemistry analyzer, • Maintenance and troubleshooting of bio-chemistry analyzer. 	1	2
16	Final Theoretical Exam	- All Topics	1	2
Number of Weeks /and Units Per Semester			16	32

B. Case Studies and Practical Aspect:			
No.	Tasks/ Experiments	Number of Weeks	Contact Hours
1	- Review on the laboratory department in hospital	1	2
2	<ul style="list-style-type: none"> - Types of spectrophotometer equipment - Components of spectrophotometer equipment - Operation of spectrophotometer equipment 	1	2
3	- Detection of errors, troubleshooting, repair, and maintenance of spectrophotometer equipment	1	2
4	<ul style="list-style-type: none"> - Components of colorimeter equipment - Operation of colorimeter equipment - Detection of errors, troubleshooting, repair, and 	1	2

University of Sana'a
Faculty of Engineering
Department: Biomedical Engineering
Title of the Program: Biomedical Engineering



B. Case Studies and Practical Aspect:			
No.	Tasks/ Experiments	Number of Weeks	Contact Hours
	maintenance of colorimeter equipment		
5	- Types of blood cell counter equipment, - Components of blood cell counter equipment - Operation of blood cell counter equipment	1	2
6	- Detection of errors, troubleshooting, repair, and maintenance of blood cell counter equipment	1	2
7	- Midterm Practical Exam	1	2
8	- Types of blood gas analyzer equipment - Components of blood gas analyzer equipment - Operation of blood gas analyzer equipment	1	2
9	- Detection of errors, troubleshooting, repair, and maintenance of blood gas analyzer equipment	1	2
10	- Types of biochemistry analyzer equipment - Components of biochemistry analyzer equipment - Operation of biochemistry analyzer equipment	1	2
11	- Operation of biochemistry analyzer equipment	1	2
12	- Detection of errors, troubleshooting, repair, and maintenance of biochemistry analyzer equipment	1	2
13	- Practical Project	1	2
14	- Practical Project (Continue)	1	2
15	- Final Practical Exam	1	2



B. Case Studies and Practical Aspect:			
No.	Tasks/ Experiments	Number of Weeks	Contact Hours
Number of Weeks /and Units Per Semester		15	30

V. Teaching Strategies of the Course:
<ul style="list-style-type: none"> • Interactive lectures & examples, • Tutorials, • Videos demonstrations, • Presentation/seminar, • Interactive class discussions, • Case studies, • Laboratory/Practical experiments based session, • Computer laboratory-based sessions, • Workshops practices, • Directed self- study, • Problem based learning, • Team work (cooperative learning), • Field visits/training, • Mini/major project.

VI. Assessment Methods of the Course:
<ul style="list-style-type: none"> • Written tests (mid and final terms and quizzes), • Short reports, • Lab\Project report • Practical lab performance assessment,



VI. Assessment Methods of the Course:

- Coursework activities assessment,
- Presentations.

VII. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1				
2				
3				
4				
5				
Total				

VIII. Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment
1	Quiz 1	6	5	3.33%
2	Midterm Practical Exam	7	20	13.33%
3	Midterm Theoretical Exam	8	10	6.67%
4	Report, Presentation, and Project	10, 11	20	13.33%
5	Quiz 2	12	5	3.33%
6	Final Practical Exam	15	30	20%
7	Final Theoretical Exam	16	60	40%



VIII. Schedule of Assessment Tasks for Students During the Semester:				
No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment
Total			150	100%

IX. Learning Resources:
<ul style="list-style-type: none"> Written in the following order:
<ul style="list-style-type: none"> Written in the following order: (Author - Year of publication – Title – Edition – Place of publication – Publisher).
1- Required Textbook(s) (maximum two):
<ol style="list-style-type: none"> 1- R S Khandpur, 2006, Handbook of Analytical Instruments, Second Edition, McGraw Hill Education. 2- Ed. Joseph D. Bronzino, 2016, The Biomedical Engineering Handbook, Fourth Edition, CRC Press LLC. 3- Roger Narayan, 2019, Wiley Encyclopedia of Biomedical Engineering, Elsevier.
2- Essential References:
<ol style="list-style-type: none"> 1- James Moore, George Zouridakis, 2004, Biomedical Technology and Devices Handbook, CRC Press LLC. 2- Metin Akay, 2006, Wiley Encyclopedia of Biomedical Engineering, John Wiley & Sons, In. 3- John G. Webster, 2006, Encyclopedia Of Medical Devices and Instrumentation, Second Edition, John Wiley & Sons.
3- Electronic Materials and Web Sites etc.:
<p>Websites:</p> <ol style="list-style-type: none"> 1- Medical Devices & Sensors Journal, Wiley. Peer reviewed academic journal in the field of Medical Devices. http://onlinelibrary.wiley.com/journal/2573802x 2- Journal of Medical Devices. Peer reviewed academic journal in the field of Medical Devices. http://medigitalcollection.asme.org/ <p>Journals:</p>



IX. Learning Resources:

3- IEEE Transactions on Biomedical Engineering: Peer reviewed academic journal in the field of Biomedical Engineering.

<http://www.ieeexplore.ieee.org/xpl>

4- Journal of Medical Devices. Peer reviewed academic journal in the field of Medical Devices

<https://publons.com/journal/19039/journal-of-medical-devices>

Other Web Sources:

5- Website: Franks Hospital Workshop

<http://www.frankshospitalworkshop.com>

X. Course Policies:

1	<p>Class Attendance:</p> <p>A student should attend not less than 75 % of total hours of the subject; otherwise he/she will not be able to take the exam and will be considered as exam failure. If the student is absent due to illness, he/she should bring a proof statement from university Clinic. If the absent is more than 25% of a course total contact hours, student will be required to retake the entire course again.</p>
2	<p>Tardy:</p> <p>For late in attending the class, the student will be initially notified. If he repeated lateness in attending class, he/she will be considered as absent.</p>
3	<p>Exam Attendance/Punctuality:</p> <p>A student should attend the exam on time. He/she is permitted to attend an exam half one hour from exam beginning, after that he/she will not be permitted to take the exam and he/she will be considered as absent in exam</p>
4	<p>Assignments & Projects:</p> <p>In general one assignment is given to the students after each chapter; the student has to submit all the assignments for checking on time, mostly one week after given the assignment.</p>

University of Sana'a
Faculty of Engineering
Department: Biomedical Engineering
Title of the Program: Biomedical Engineering



5	<p>Cheating:</p> <p>For cheating in exam, a student will be considered as fail. In case the cheating is repeated three times during his/her study the student will be disengaged from the Faculty.</p>
6	<p>Plagiarism:</p> <p>Plagiarism is the attending of a student the exam of a course instead of another student. If the examination committee proofed a plagiarism of a student, he/she will be disengaged from the Faculty. The final disengagement of the student from the Faculty should be confirmed from the Student Council Affair of the university or according to the university roles.</p>
7	<p>Other policies:</p> <ul style="list-style-type: none"> - Mobile phones are not allowed to use during a class lecture. It must be closed; otherwise the student will be asked to leave the lecture room. - Mobile phones are not allowed in class during the examination. - Lecture notes and assignments might be given directly to students using soft or hard copy.