Republic of Yemen

Ministry of Education & Higher Research

Council of Academic Accreditation & Quality

Assurance of Higher Education (CAQA)

21 septamber University for Medical and Applied Science

Faculty of Engineering and Computer

Department of Biomedical Engineering

Program of Biomedical Engineering

Course Specification of

Optical & Laboratory Medical Equipment's

Course Code. (07.02.713)

2024

T4: This Template is Developed and Approved by CAQA-Yemen, 2023

Prepared by:	Reviewed by:	Head of the Department:	Quality Unit:	Dean:
Dr. Awadh Alkubati	Dr. -----	Dr. Awadh Al-Kubati	Dr. Mohammed Al-shamahi	Dr. Abdulrahman Obaid

I. General Information:

1.	Course Title:	Optical & Laboratory Medical Equipment's				
2.	Course Code:	07.02.713				
3.	Credit Hours:	Credit Hours	Theory Contact Hours		Practical Contact Hours	
			Lecture	Tutorial /Seminar	Lab	Clinical
		3	2	--	2	--
4.	Level/ Semester at which this Course is offered:	2nd Level / 2nd Semester				
5.	Pre –Requisite (if any):	Biomedical Measurements and Instrumentations				
6.	Co –Requisite (if any):	None				
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 Medical Technology				
10.	Prepared by:	Dr. Awadh Alkubati				
11.	Date and Number of Approval by Council:					

II. Course Description:

This course aims to equip students with a comprehensive understanding of medical laboratory devices and their applications in biomedical engineering. It covers fundamental topics such as the principles of operation, calibration, and performance analysis of diagnostic instruments, including spectrophotometers, colorimeters, CBC analyzers, and centrifuges. The course emphasizes practical skills in designing maintenance protocols, troubleshooting equipment, and integrating devices into biomedical systems, thereby enhancing the student's ability to solve real-world

problems in medical diagnostics and patient care.

III. Course Intended Learning Outcomes (CILOs) : Upon successful completion of the course, students will be able to:			Referenced PILOs	
	A. Knowledge and Understanding:	**I, P or M/A**		
a1	Understand and explain the principles of medical laboratory devices	I	A1	Explain the appropriate models, theories, mathematical foundations, and techniques related to biomedical engineering technology context.
a2	Identify and describe key components of diagnostic instruments	I		
	B. Intellectual Skills:			
b1	Analyze the performance and calibration of medical laboratory devices	I	B1	Use the basic science, mathematical theories, engineering principles to analyze the problems of devices and/or processes relevant to biomedical engineering fields.
b2	Evaluate the integration of laboratory devices into biomedical systems	I	B2	Analyze the impacts of problems related to the Biomedical equipment and its solution principles in a creative manner by using systematic and analytical thinking methods.
	C. Professional and Practical kills:			
c1	Design and implement maintenance protocols for laboratory devices	P	C1	Relate integrally knowledge of life science, biomedical engineering technology practice concepts, principles of engineering and techniques evaluation to solve problems

				relevant to biomedical engineering.
c2	Conduct systematic troubleshooting of laboratory equipment	P	C3	Develop an engineering approach, engineering equipment, instruments to maintenance and conduct experiments, and present results in the biomedical engineering practice.
	D. Transferable Skills:			
d1	Develop technical documentation and reporting skills	P	D3	Exhibit strong IT skills and communicate clearly, both verbally and in written technical reports.
d2	Collaborate on interdisciplinary projects involving biomedical technologies	P	D1	Function effectively as an individual, team member, or leader in activities relevant to biomedical engineering, and collaborating to achieve a shared objective.
I= Introduced, P=Practiced or M/A= Mastered/Advanced				

	(A) Alignment of Course Intended Learning Outcomes (Knowledge and Understanding) to Teaching Strategies and Assessment Methods:		
	Course Intended Learning Outcomes	**Teaching Strategies**	**Assessment Strategies**
a1	Understand and Explain the Principles of Medical Laboratory Devices	▪ Lectures ▪ Videos ▪ Class Discussions ▪ Lab Demonstrations ▪ Interactive Exercises	▪ Quizzes and Tests ▪ Mid-term Exam ▪ Final Written Exam ▪ Practical Mid-term Exam ▪ Final Practical Exam
a2	Identify and Describe Key Components of Diagnostic Instruments		
	(B) Alignment of Course Intended Learning Outcomes (Intellectual Skills) to Teaching Strategies and Assessment Methods:		
	Course Intended Learning Outcomes	**Teaching Strategies**	**Assessment Strategies**

b1	Analyze the Performance and Calibration of Medical Laboratory Devices	▪ Lectures ▪ Interactive Exercises ▪ Case Studies ▪ Practical Labs ▪ Group Work ▪ Project-Based Learning ▪ Workshops	▪ Quizzes and Tests ▪ Mid-term Theoretical Exam ▪ Final Theoretical Exam ▪ Mid-term Practical Exam ▪ Final Practical Exam ▪Assignment (Project Presentation and Project Report)
b2	Evaluate the Integration of Laboratory Devices into Biomedical Systems		
	(C) Alignment of Course Intended Learning Outcomes (Professional and Practical Skills) to Teaching Strategies and Assessment Methods:		
	Course Intended Learning Outcomes	**Teaching Strategies**	**Assessment Strategies**
c1	Design and Implement Maintenance Protocols for Laboratory Devices	▪ Lectures ▪ Role-Playing ▪ Workshops ▪ Practical Labs with Lab Sessions ▪ Demonstrations ▪ Group Activities	▪ Mid-term Practical Exam ▪ Final Practical Exam ▪ Assignment (Maintenance Protocol Report and Role-Play Evaluation).
c2	Conduct Systematic Troubleshooting of Laboratory Equipment		
	(D) Alignment of Course Intended Learning Outcomes (Transferable Skills) to Teaching Strategies and Assessment Methods:		
	Course Intended Learning Outcomes	**Teaching Strategies**	**Assessment Strategies**
d1	Develop Technical Documentation and Reporting Skills	▪ Workshops ▪ Examples ▪ Group Projects ▪ Presentations	▪ Assignment (Technical Report and Project)
d2	Collaborate on Interdisciplinary Projects Involving Biomedical Technologies		

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours	Relevant Learning Outcomes
1	**Introduction to Medical Laboratory Devices**	– Definition of medical laboratory devices – Importance in diagnostics and patient care – General classification of devices – Medical lab technology – Units of medical laboratory	1	2	a1, a2
2	**Medical Laboratory Devices**	– Tests in diagnostic lab – Blood and it's components – Purpose of medical laboratory instrumentation – Basic of instrumental analysis – Selecting analytical instruments – Medical laboratory department devices and equipments	1	2	a1, a2, b1
3	**Spectrophotometer Devices**	– Introduction to spectrophotometer. – Types of spectrophotometers. – Operating principles of spectrophotometer. – Components of spectrophotometer and device Diagrams.	1	2	a1, a2, b1
4	**Colorimetry and Colorimeter Devices**	– Introduction to colorimetry. – Transmittance and Absorptance lows – Operating principles of colorimeter. – Components of colorimeter Devices and Diagram.	2	4	a1, a2, b1
5-6	**Complete Blood Count (CBC)**	– Blood cell Counter Overview – Blood Cell Counter Methods	2	4	a1, a2, b1, b2

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours	Relevant Learning Outcomes
	Analyzers	– Types of tests performed (e.g., hemoglobin, hematocrit, white blood cell count) – Components of CBC analyzers – Hemocytometer – Automatic Blood Cell Counter – Flow Cytometer			
7	**Mid-Term Exam**	– In all previous Topics	1	2	a1, a2, b1, b2
8	**Centrifuges**	– How centrifuges work – Principles of centrifugal force – Types of centrifuges – Procedures for operating a centrifuge – Basic components of centrifuges – Use and care of centrifuges	1	1	a1, a2, b1, b2
9-10	**Bio-Chemistry Analyzer**	– Introduction to bio-chemistry analyzer, – Medical background – Operating principles of bio-chemistry analyzer – Design, block diagram of bio-Chemistry analyzer – Measurement Principles of CHEMISTRY ANALYZER – Photometry Analyzer and Photometric Measurements – Kinetic or Enzymatic Measurements – Components of Automatic bio-chemistry analyzer Devices	2	4	a1, a2, b1, b2
11	**Blood Gas Analyzer**	– Blood gas parameters – Blood gas analyzers components – Types of blood gas analyzers (e.g., for oxygen, carbon dioxide) – Principles of operation	2	4	a1, a2, b1, b2

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours	Relevant Learning Outcomes
		– Steps for performing blood gas tests			
12-14	Project Showcase	– Students project presentations	2	4	d1, d2
15	Final Practical Exam	– All practical topics			a2, b1, b2, c1, c2
16	Final Theoretical Exam	– All theoretical topics	1	2	a1, a2, b1, b2
Number of Weeks /and Units Per Semester			16	32	

B. Practical Aspect (Lab/Clinical) (if any):

No.	Tasks/ Experiments	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1	**Calibration of Medical Devices:** Calibrate different types of medical devices such as spectrophotometers, colorimeters, and blood gas analyzers.	1	2	b1, c1
2	**Performance Testing of a Spectrophotometer:** Conduct tests to measure the performance of a spectrophotometer, including wavelength accuracy and absorbance measurements.	1	2	b1
3	**Colorimeter Analysis:** Use a colorimeter to perform colorimetric analysis on various solutions and compare results with theoretical expectations.	1	2	a2
4	**Blood Cell Counting with a Hemocytometer:** Count blood cells manually using a hemocytometer and compare results with those from an automated blood cell counter.	1	2	a2, b1

No.	Tasks/ Experiments	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
5	**Operation and Maintenance of a Centrifuge:** Use a centrifuge to separate blood components and perform maintenance tasks, including cleaning and rotor inspection.	1	2	c1, c2
6	**Setup and Operation of a Bio-Chemistry Analyzer:** Configure and run tests on a bio-chemistry analyzer, analyze results for photometric and enzymatic measurements.	1	2	b1
7	**Mid-term Practical Exam**	1	2	a2, b1, c1, c2
8	**Blood Gas Analysis:** Perform blood gas analysis using a blood gas analyzer, including calibration and result interpretation.	1	2	b1
9	**Troubleshooting Common Equipment Issues:** Identify and troubleshoot common issues with medical laboratory equipment, such as inaccurate readings or operational failures.	1	2	b2, c2
10	**Designing and Implementing Maintenance Protocols:** Create and implement a maintenance protocol for various laboratory devices, including routine checks and preventive maintenance.	1	2	c1
11	**Technical Documentation and Reporting:** Prepare detailed technical reports and documentation based on lab experiments and device testing.	1	2	d1
12	**Integration of Laboratory Devices into Biomedical Systems:** Work on integrating various laboratory devices into a simulated biomedical system, focusing on data flow and device interoperability.	1	2	b2, a2
13	**Interdisciplinary Project Collaboration:** Collaborate on an interdisciplinary project that	1	2	d2

No.	Tasks/ Experiments	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
	involves designing and implementing a solution incorporating multiple laboratory devices.			
15	**Final Practical Exam**	1	2	a2, b1, b2, c1, c2
Number of Weeks /and Units Per Semester		**14**	**28**	

C. Tutorial Aspect (if any):

No.	Tutorial	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1	None			
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
Number of Weeks /and Units Per Semester				

VII. Assignments:

No.	Assignments	Week Due	Mark	Aligned CILOs (symbols)
1	**Assignment 1:** Comprehensive Analysis and Calibration of Medical Laboratory Devices.	6	2.5	b1, c1, c2, d1
2	**Assignment 2: Integrated Biomedical System Design and Simulation**	13,14	7.5	b2, c1, d2
Total			10	

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	Assignments 1&2 Including Case Study	13, 14	10	10%	b1, b2, c1, c2, d1, d2
2	Mid-Term Theoretical Exam	7	10	10%	a1, a2, b1
3	Mid-Term Practical Exam	7	10	10%	a2, b1, c1, c2
4	Final Practical Exam	15	20	20%	a2, b1, b2, c1, c2
5	Final Theoretical Exam	16	50	70%	a1, a2, b1, b2
Total			100	100 %	

IX. Learning Resources:

1- Required Textbook(s) (maximum two):

1. John Webster, 2010, "Medical Instrumentation: Application and Design," 4th Edition, Wiley, USA.
2. R. S. Khandpur, 2014, "Biomedical Instrumentation: Technology and Applications," McGraw-Hill, USA.

2- Essential References:

1. Joseph Bronzino, 2006, "The Biomedical Engineering Handbook," CRC Press, USA.

2. Myer Kutz, 2009, "Standard Handbook of Biomedical Engineering & Design," McGraw-Hill, USA.
3- Electronic Materials and Web Sites etc.:
Websites: o Biomedical Instrumentation websites, educational videos, and online journals available through the university library portal. o Online databases such as PubMed, IEEE Xplore for up-to-date research articles. **Other Learning Materials:** o Lab manuals, safety protocols, and equipment datasheets provided during the practical sessions.

X. Course Policies: (Based on the Uniform Students' By law (2007)

1	**Class Attendance:** Class Attendance is mandatory. A student is considered absent and shall be banned from taking the final exam if his/her absence exceeds 25% of total classes.
2	**Tardiness:** A student will be considered late if he/she is not in class after 10 minutes of the start time of class.
3	**Exam Attendance/Punctuality:** No student shall be allowed to the exam hall after 30 minutes of the start time, and shall not leave the hall before half of the exam time has passed.
4	**Assignments & Projects:** Assignments and projects must be submitted on time. Students who delay their assignments or projects shall lose the mark allocated for the same.
5	**Cheating:** Cheating is an act of fraud that results in the cancelation of the student's exam or assignment. If it takes place in a final exam, the penalties stipulated for in the Uniform Students' Bylaw (2007) shall apply.
6	**Forgery and Impersonation:** Forgery/Impersonation is an act of fraud that results in the cancelation of the student's exam, assignment or project. If it takes place in a final exam, the penalties stipulated for in the Uniform Students' Bylaw (2007) shall apply.
7	**Other policies:** The University official regulations in force will be strictly observed and students shall comply with all rules and regulations of the examination set by the Department, Faculty and University Administration.

Faculty of Medical Technology

Department of Biomedical Engineering

Program of Biomedical Engineering

Course Plan (Syllabus) of

Optical & Laboratory Medical Equipment's

Course Code. 07.02.713

I. Information about Faculty Member Responsible for the Course:								
Name of Faculty Member:		Office Hours						
Location& Telephone No.:	-—							
E-mail:	–@--.–	SAT	SUN	MON	TUE	WED	THU	

2024/2025

II. Course Identification and General Information:

12.	Course Title:	Optical & Laboratory Medical Equipment's				
13.	Course Code:	07.02.713				
14.	Credit Hours:	Credit Hours	Theory Contact Hours		Practical Contact Hours	
			Lecture	Tutorial /Seminar	Lab	Clinical
		3	2	--	2	--
15.	Level/ Semester at which this Course is offered:	2nd Level / 2nd Semester				
16.	Pre –Requisite (if any):	Biomedical Measurements and Instrumentations				
17.	Co –Requisite (if any):	None				
18.	Program (s) in which the Course is Offered:	Bachelor of Biomedical Engineering				
19.	Language of Teaching the Course:	English				
20.	Location of Teaching the Course:	Faculty of Medical Technology				
21.	Prepared by:	Dr. Awadh Alkubati				
22.	Date and Number of Approval by Council:					

23.	Course Title:	Optical & Laboratory Medical Equipment's				
24.	Course Code:	07.02.713				
25.	Credit Hours:	Credit Hours	Theory Contact Hours		Practical Contact Hours	
			Lecture	Tutorial /Seminar	Lab	Clinical
		3	2	--	2	--

26.	**Level/ Semester at which this Course is offered:**	2nd Level / 2nd Semester
27.	**Pre –Requisite (if any):**	Biomedical Measurements and Instrumentations
28.	**Co –Requisite (if any):**	None
29.	**Program (s) in which the Course is Offered:**	Bachelor of Biomedical Engineering
30.	**Language of Teaching the Course:**	English
31.	**Location of Teaching the Course:**	Faculty of Medical Technology
32.	**Prepared by:**	Dr. Awadh Alkubati
33.	**Date and Number of Approval by Council:**	

III. Course Description:

This course aims to equip students with a comprehensive understanding of medical laboratory devices and their applications in biomedical engineering. It covers fundamental topics such as the principles of operation, calibration, and performance analysis of diagnostic instruments, including spectrophotometers, colorimeters, CBC analyzers, and centrifuges. The course emphasizes practical skills in designing maintenance protocols, troubleshooting equipment, and integrating devices into biomedical systems, thereby enhancing the student's ability to solve real-world problems in medical diagnostics and patient care.

IV. Course Intended Learning Outcomes (CILOs) :

Upon successful completion of the Course, student will be able to:

	A. Knowl

		edgeandUnderstanding:
a1	Understand and explain the principles of medical laboratory devices	
a2	Identify and describe key components of diagnostic instruments	
		B. Intellectu

		a. Skills:
b1	Analyze the performance and calibration of medical laboratory devices	
b2	Evaluate the integration of laboratory devices into biomedical systems	
		c. Professional and Practic

		alkills:
c1	Design and implement maintenance protocols for laboratory devices	
c2	Conduct systematic troubleshooting of laboratory equipment	
		D. Transferable Skills:
d1	**Develop technical documentation and reporting skills**	
d	Collaborate on interdisciplinary projects involving biomedical technologies	

2	

I= Introduced, P=Practiced or M/A= Mastered/Advanced

V. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours	Relevant Learning Outcomes
1	**Introduction to Medical Laboratory Devices**	– Definition of medical laboratory devices – Importance in diagnostics and patient care – General classification of devices – Medical lab technology – Units of medical laboratory	1	2	a1, a2
2	**Medical Laboratory Devices**	– Tests in diagnostic lab – Blood and it's components – Purpose of medical laboratory instrumentation – Basic of instrumental analysis – Selecting analytical instruments – Medical laboratory department devices and equipments	1	2	a1, a2, b1
3	**Spectrophotometer Devices**	– Introduction to spectrophotometer. – Types of spectrophotometers. – Operating principles of spectrophotometer. – Components of spectrophotometer and device Diagrams.	1	2	a1, a2, b1
4	**Colorimetry and Colorimeter Devices**	– Introduction to colorimetry. – Transmittance and Absorptance lows – Operating principles of colorimeter. – Components of colorimeter Devices and Diagram.	2	4	a1, a2, b1

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours	Relevant Learning Outcomes
5-6	**Complete Blood Count (CBC) Analyzers**	– Blood cell Counter Overview – Blood Cell Counter Methods – Types of tests performed (e.g., hemoglobin, hematocrit, white blood cell count) – Components of CBC analyzers – Hemocytometer – Automatic Blood Cell Counter – Flow Cytometer	2	4	a1, a2, b1, b2
7	**Mid-Term Exam**	– In all previous Topics	1	2	a1, a2, b1, b2
8	**Centrifuges**	– How centrifuges work – Principles of centrifugal force – Types of centrifuges – Procedures for operating a centrifuge – Basic components of centrifuges – Use and care of centrifuges	1	1	a1, a2, b1, b2
9-10	**Bio-Chemistry Analyzer**	– Introduction to bio-chemistry analyzer, – Medical background – Operating principles of bio-chemistry analyzer – Design, block diagram of bio-Chemistry analyzer – Measurement Principles of CHEMISTRY ANALYZER – Photometry Analyzer and Photometric Measurements – Kinetic or Enzymatic Measurements – Components of Automatic bio-chemistry analyzer Devices	2	4	a1, a2, b1, b2
11	**Blood Gas Analyzer**	– Blood gas parameters – Blood gas analyzers components – Types of blood gas analyzers (e.g., for oxygen, carbon	2	4	a1, a2, b1, b2

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours	Relevant Learning Outcomes
		dioxide) – Principles of operation – Steps for performing blood gas tests			
12-14	Project Showcase	– Students project presentations	2	4	d1, d2
15	Final Practical Exam	– All practical topics			a2, b1, b2, c1, c2
16	Final Theoretical Exam	– All theoretical topics	1	2	a1, a2, b1, b2
Number of Weeks /and Units Per Semester			16	32	

B. Case Studies and Practical Aspect:

No.	Tasks/ Experiments	Number of Weeks	Contact Hours
1	**Calibration of Medical Devices:** Calibrate different types of medical devices such as spectrophotometers, colorimeters, and blood gas analyzers.	1	2
2	**Performance Testing of a Spectrophotometer:** Conduct tests to measure the performance of a spectrophotometer, including wavelength accuracy and absorbance measurements.	1	2
3	**Colorimeter Analysis:** Use a colorimeter to perform colorimetric analysis on various solutions and compare results with theoretical expectations.	1	2
4	**Blood Cell Counting with a Hemocytometer:** Count blood cells manually using a hemocytometer and compare results with those from an automated blood cell counter.	1	2

No.	Tasks/ Experiments	Number of Weeks	Contact Hours
5	**Operation and Maintenance of a Centrifuge:** Use a centrifuge to separate blood components and perform maintenance tasks, including cleaning and rotor inspection.	1	2
6	**Setup and Operation of a Bio-Chemistry Analyzer:** Configure and run tests on a bio-chemistry analyzer, analyze results for photometric and enzymatic measurements.	1	2
7	**Mid-term Practical Exam**	1	2
8	**Blood Gas Analysis:** Perform blood gas analysis using a blood gas analyzer, including calibration and result interpretation.	1	2
9	**Troubleshooting Common Equipment Issues:** Identify and troubleshoot common issues with medical laboratory equipment, such as inaccurate readings or operational failures.	1	2
10	**Designing and Implementing Maintenance Protocols:** Create and implement a maintenance protocol for various laboratory devices, including routine checks and preventive maintenance.	1	2
11	**Technical Documentation and Reporting:** Prepare detailed technical reports and documentation based on lab experiments and device testing.	1	2
12	**Integration of Laboratory Devices into Biomedical Systems:** Work on integrating various laboratory devices into a simulated biomedical system, focusing on data flow and device interoperability.	1	2
13	**Interdisciplinary Project Collaboration:** Collaborate on an interdisciplinary project that involves designing and implementing a solution incorporating multiple laboratory devices.	1	2

No.	Tasks/ Experiments	Number of Weeks	Contact Hours
15	**Final Practical Exam**	1	2
Number of Weeks /and Units Per Semester		**14**	**28**

No.	Tasks/ Experiments	Number of Weeks	Contact Hours
1	**Calibration of Medical Devices:** Calibrate different types of medical devices such as spectrophotometers, colorimeters, and blood gas analyzers.	1	2
2	**Performance Testing of a Spectrophotometer:** Conduct tests to measure the performance of a spectrophotometer, including wavelength accuracy and absorbance measurements.	1	2
3	**Colorimeter Analysis:** Use a colorimeter to perform colorimetric analysis on various solutions and compare results with theoretical expectations.	1	2
4	**Blood Cell Counting with a Hemocytometer:** Count blood cells manually using a hemocytometer and compare results with those from an automated blood cell counter.	1	2
5	**Operation and Maintenance of a Centrifuge:** Use a centrifuge to separate blood components and perform maintenance tasks, including cleaning and rotor inspection.	1	2
6	**Setup and Operation of a Bio-Chemistry Analyzer:** Configure and run tests on a bio-chemistry analyzer, analyze results for photometric and enzymatic measurements.	1	2
7	**Mid-term Practical Exam**	1	2
8	**Blood Gas Analysis:** Perform blood gas analysis using a blood gas analyzer, including calibration and result interpretation.	1	2

No.	Tasks/ Experiments	Number of Weeks	Contact Hours
9	**Troubleshooting Common Equipment Issues:** Identify and troubleshoot common issues with medical laboratory equipment, such as inaccurate readings or operational failures.	1	2
10	**Designing and Implementing Maintenance Protocols:** Create and implement a maintenance protocol for various laboratory devices, including routine checks and preventive maintenance.	1	2
11	**Technical Documentation and Reporting:** Prepare detailed technical reports and documentation based on lab experiments and device testing.	1	2
12	**Integration of Laboratory Devices into Biomedical Systems:** Work on integrating various laboratory devices into a simulated biomedical system, focusing on data flow and device interoperability.	1	2
13	**Interdisciplinary Project Collaboration:** Collaborate on an interdisciplinary project that involves designing and implementing a solution incorporating multiple laboratory devices.	1	2
15	**Final Practical Exam**	1	2
Number of Weeks /and Units Per Semester		**14**	**28**

C. Tutorial Aspect:

No.	Tutorial	Number of Weeks	Contact Hours
1	None		
2			
3			
4			

	No.	Tutorial		Number of Weeks	Contact Hours
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
Number of Weeks /and Units Per Semester					

VIII. Assignments:

No.	Assignments	Week Due	Mark
1	**Assignment 1: Comprehensive Analysis** and Calibration of Medical Laboratory Devices.	6	2.5
2	**Assignment 2: Integrated Biomedical System Design and Simulation**	13,14	7.5
Total			10

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

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1	**Assignments 1&2 Including Case Study**	13, 14	10	10%	b1, b2, c1, c2, d1, d2

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
2	Mid-Term Theoretical Exam	7	10	10%	a1, a2, b1
3	Mid-Term Practical Exam	7	10	10%	a2, b1, c1, c2
4	Final Practical Exam	15	20	20%	a2, b1, b2, c1, c2
5	Final Theoretical Exam	16	50	70%	a1, a2, b1, b2
Total			100	100 %	

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1	Assignments 1&2 Including Case Study	13, 14	10	10%	b1, b2, c1, c2, d1, d2
2	Mid-Term Theoretical Exam	7	10	10%	a1, a2, b1
3	Mid-Term Practical Exam	7	10	10%	a2, b1, c1, c2
4	Final Practical Exam	15	20	20%	a2, b1, b2, c1, c2
5	Final Theoretical Exam	16	50	70%	a1, a2, b1, b2
Total			100	100 %	

X. Learning Resources:

1- Required Textbook(s) (maximum two):

1. John Webster, 2010, "Medical Instrumentation: Application and Design," 4th Edition, Wiley, USA.
2. R. S. Khandpur, 2014, "Biomedical Instrumentation: Technology and Applications," McGraw-Hill, USA.

2- Essential References:

1. Joseph Bronzino, 2006, "The Biomedical Engineering Handbook," CRC Press, USA.
2. Myer Kutz, 2009, "Standard Handbook of Biomedical Engineering & Design," McGraw-Hill, USA.

3- Electronic Materials and Web Sites etc.:

Websites:

1- Biomedical Instrumentation websites, educational videos, and online journals available through the university library portal.
2- Online databases such as PubMed, IEEE Xplore for up-to-date research articles.

Other Learning Materials:

1. Lab manuals, safety protocols, and equipment datasheets provided during the practical sessions.

XI. Course Policies: (Based on the Uniform Students' Bylaw (2007)

1	**Class Attendance:** Class Attendance is mandatory. A student is considered absent and shall be banned from taking the final exam if his/her absence exceeds 25% of total classes.
2	**Tardiness:** A student will be considered late if he/she is not in class after 10 minutes of the start time of class.
3	**Exam Attendance/Punctuality:** No student shall be allowed to the exam hall after 30 minutes of the start time, and shall not leave the hall before half of the exam time has passed.
4	**Assignments & Projects:** Assignments and projects must be submitted on time. Students who delay their assignments or projects shall lose the mark allocated for the same.
5	**Cheating:** Cheating is an act of fraud that results in the cancelation of the student's exam or assignment. If it takes place in a final exam, the penalties stipulated for in the Uniform Students' Bylaw (2007) shall apply.
6	**Forgery and Impersonation:** Forgery/Impersonation is an act of fraud that results in the cancelation of the student's exam, assignment or project. If it takes place in a final exam, the penalties stipulated for in the Uniform Students' Bylaw (2007) shall apply.
7	**Other policies:** The University official regulations in force will be strictly observed and students shall comply with all rules and regulations of the examination set by the Department, Faculty and University Administration.

Assignments

Assignment 1: Comprehensive Analysis and Calibration of Medical Laboratory Devices

Objective:

To gain hands-on experience with the principles, calibration, and performance analysis of various medical laboratory devices covered in the course.

Tasks:

1. **Device Selection and Overview:**
   - Select three different types of medical laboratory devices covered in the course (e.g., spectrophotometer, colorimeter, and CBC analyzer).
   - Provide a brief overview of each device, including its purpose, components, and operating principles.
2. **Calibration Procedures:**
   - For each selected device, perform the following:
     - **Spectrophotometer:** Calibrate the wavelength accuracy and absorbance measurements.
     - **Colorimeter:** Calibrate for color accuracy and transmittance.
     - **CBC Analyzer:** Perform calibration for blood cell counts and ensure accurate hemoglobin measurements.
3. **Performance Testing:**
   - Conduct performance tests for each calibrated device.
   - Document the results, compare them with standard values or manufacturer specifications, and analyze any discrepancies.
4. **Maintenance and Troubleshooting:**
   - Develop a maintenance protocol for each device, including routine checks and common troubleshooting steps.
   - Simulate a malfunction scenario for each device and apply systematic troubleshooting methods to resolve the issues.
5. **Reporting:**
   - Prepare a comprehensive report including:
     - Device overviews
     - Calibration procedures and results
     - Performance test results and analysis
     - Maintenance protocols and troubleshooting steps
6. **Presentation:**
   - Present your findings to the class, including practical demonstrations if possible.

Expected Outcomes:

- **Hands-On Calibration:** Understand and apply calibration procedures for various devices.
- **Performance Evaluation:** Analyze and document the performance of medical laboratory devices.
- **Maintenance Skills:** Develop and implement maintenance protocols and troubleshoot issues.

Relevant Learning Outcomes:

- **a1:** Understand and Explain the Principles of Medical Laboratory Devices
- **a2:** Identify and Describe Key Components of Diagnostic Instruments

- **b1:** Analyze the Performance and Calibration of Medical Laboratory Devices
- **c1:** Design and Implement Maintenance Protocols for Laboratory Devices
- **c2:** Conduct Systematic Troubleshooting of Laboratory Equipment
- **d1:** Develop Technical Documentation and Reporting Skills

Assignment 2: Integrated Biomedical System Design and Simulation

Objective:

To design an integrated biomedical system incorporating various medical laboratory devices and simulate its operation to assess integration and functionality.

Tasks:

1. **System Design:**
   - Design a conceptual biomedical system that integrates at least four different types of medical laboratory devices discussed in the course (e.g., spectrophotometer, colorimeter, CBC analyzer, centrifuge).
   - Create a detailed block diagram or flowchart illustrating how these devices interact within the system, including data flow and operational sequences.
2. **Integration Analysis:**
   - Analyze the technical requirements for integrating these devices. Consider aspects such as data communication, device compatibility, and workflow integration.
   - Identify potential challenges and propose solutions for seamless integration.
3. **Simulation and Evaluation:**
   - Use simulation software (if available) or theoretical analysis to simulate the operation of the integrated system.
   - Evaluate the performance and efficiency of the system, including how the integration of devices improves diagnostic processes and patient care.
4. **Technical Documentation:**
   - Prepare a detailed report that includes:
     - System design and integration analysis
     - Simulation results and evaluation
     - Recommendations for improving system performance
5. **Team Collaboration:**
   - Work in teams to foster collaboration skills and integrate diverse perspectives into the project.
6. **Presentation:**
   - Present the integrated system design and simulation results to the class, highlighting key aspects of the integration and its benefits.

Expected Outcomes:

- **System Design Skills:** Design and simulate an integrated biomedical system.
- **Integration Analysis:** Assess and propose solutions for device integration and functionality.
- **Technical Documentation:** Develop and present comprehensive documentation of the system.

Relevant Learning Outcomes:

- **a1:** Understand and Explain the Principles of Medical Laboratory Devices
- **a2:** Identify and Describe Key Components of Diagnostic Instruments
- **b2:** Evaluate the Integration of Laboratory Devices into Biomedical Systems
- **c1:** Design and Implement Maintenance Protocols for Laboratory Devices

- **d2:** Collaborate on Interdisciplinary Projects Involving Biomedical Technologies