Republic of Yemen

Ministry of Higher Education & Scientific Research

Council of Academic Accreditation & Quality

Assurance of Higher Education (CAQA)

21 September University for medical and Applied Science

Faculty of Engineering and Computer

Department of Biomedical Engineering

Program of Biomedical Engineering

Course Specification of

Biomedical Devices Maintenance1

Course Code. (07.02.727)

2024

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

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

I. General Information:

1.	Course Title:	Biomedical Devices Maintenance 1				
2.	Course Code:	07.02.727				
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:	4^{th} Level / 1^{st} Semester				
5.	Pre –Requisite (if any):	07.02.713, 07.02.716 & 07.02.720				
6.	Co –Requisite (if any):					
7.	Program (s) in which the Course is Offered:	Bachelor of Biomedical Engineering				
8.	Language of Teaching the Course:	English/Arabic				
9.	Location of Teaching the Course:	Faculty of Medical Technology				
10.	Prepared by:	Dr. Mushtaq Alazazi				
11	Date and Number of Approval by Council:	09/2024				

II. Course Description:

This course is designed to provide basic knowledge and training for students -enter and/or advance in the occupations associated with medical equipment maintenance and repair. A biomedical equipment technician must possess the skills necessary to repair and replace parts on medical equipment, test and calibrate equipment, perform and record preventative maintenance, procure and track inventory, and facilitate training sessions on the equipment. This course is intended to be basics for the medical equipment technicians to carry out basic maintenance tasks. As the majority of equipment problems are either simple or user-related it is the aim that the better care

and regular maintenance enabled by this class will have a significant positive effect on the delivery of healthcare facilities.

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	Recognize principles and concepts of maintain medical devices technologies, theoretical and practical basics for enabling students operate and maintain medical instrumentation	I	A1	Explain the appropriate models, theories, mathematical foundations, and techniques related to biomedical engineering technology context.
a2	understand biomedical device maintenance principles, including preventive and corrective techniques, and their importance in solving equipment issues in healthcare while ensuring compliance with safety standards.	I	A2	Clarify the biomedical devices maintenance principles and how these are important for solving biomedical devices and equipment's problems in health environment.
a3	Contribute to innovative solutions that improve healthcare and quality of life. This can range from developing easier-to-maintain devices to extending the lifespan of existing equipment, ultimately leading to better patient care and resource management.		A4	Understand an examples of a biomedical engineering technology concept and methods related to maintenance, measurement techniques, programming, creative engineering solutions, analytical skills, applied to healthcare quality and problems of medical devices issues.
	B. Intellectual Skills:			
b1	Integrate engineering principles, life science knowledge, and data analysis with cutting-edge	P	B1	Use the basic science, mathematical theories, engineering principles to

	technology positions them as vital members of the healthcare team, ensuring the continued reliability of medical devices and ultimately, fostering positive patient outcomes.			analyze the problems of devices and/or processes relevant to biomedical engineering fields.
b2	Innovate solutions, and integrate their knowledge base empowers them to tackle complex challenges in the biomedical engineering field. This ultimately translates to improved equipment reliability, enhanced patient care, and a more efficient healthcare system.	P	B2	Analyze the impacts of problems related to the Biomedical equipments and its solution principles in a creative manner by using a systematic and analytical thinking methods.
	C. Professional and Practical Skills:			
c1	Utilize advanced tools, software, and automation empowers them to solve complex problems efficiently, ensuring the continued reliability of medical devices and contributing to improved patient care outcomes.	P	C2	Evaluate an engineering technique, modern analytical tools and required computer programs to analyzing and solve the problems of medical devices.
c2	Conduct well-designed experiments, analyze data effectively, and communicate results clearly paves the way for innovative solutions that improve equipment reliability and efficiency, ultimately leading to better patient care.	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	Function effectively in different work environments as an individual, and as a member or leader in multi-disciplinary teams.	M/A	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	Recognize principles and concepts of maintain medical devices technologies, theoretical and practical basics for enabling students operate and maintain medical instrumentation	▪ Lectures ▪ Tutorials ▪ Discussion ▪ Presentation ▪ Self-learning ▪ Case Study (CBL)	▪ Written Exams ▪ Final practical exam ▪ Assignments
a2	understand biomedical device maintenance principles, including preventive and corrective techniques, and their importance in solving equipment issues in healthcare while ensuring compliance with safety standards.	▪ Lectures ▪ Tutorials ▪ Discussion ▪ Presentation ▪ Self-learning ▪ Case Study (CBL)	▪ Written Exams ▪ Final practical exam ▪ Assignments
a 4	Contribute to innovative solutions that improve healthcare and quality of life. This can range from developing easier to-maintain devices to extending the lifespan of existing equipment, ultimately leading to better patient care and resource management.	▪ Lectures ▪ Tutorials ▪ Discussion ▪ Presentation ▪ Self-learning ▪ Case Study (CBL)	▪ Written Exams ▪ Final practical exam ▪ Assignments
	(B) Alignment of Course Intended Learning Outcomes (Intellectual Skills) to Teaching Strategies and Assessment Methods:		
	Course Intended Learning	**Teaching Strategies**	**Assessment Strategies**

	Outcomes		
b1	innovate solutions, and integrate their knowledge base empowers them to tackle complex challenges in the biomedical engineering field. This ultimately translates to improved equipment reliability, enhanced patient care, and a more efficient healthcare system.	▪ Lectures ▪ Tutorials ▪ Discussion ▪ Case studies (CBL) ▪ Self-Learning ▪ Problem Based Learning (PBL)	▪ Written Exams ▪ Final practical exam ▪ Assignments
b2	Innovate solutions, and integrate their knowledge base empowers them to tackle complex challenges in the biomedical engineering field. This ultimately translates to improved equipment reliability, enhanced patient care, and a more efficient healthcare system.	▪ Lectures ▪ Tutorials ▪ Discussion ▪ Case studies (CBL) ▪ Self-Learning ▪ Problem Based Learning (PBL)	▪ Written Exams ▪ Final practical exam ▪ Assignments
	(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**
c2	Utilize advanced tools, software, and automation empowers them to solve complex problems efficiently, ensuring the continued reliability of medical devices and contributing to improved patient care outcomes.	▪ Tutorials ▪ Training ▪ Case studies (CBL) ▪ Lab work ▪ Problem Solving Learning (PSL) ▪ Problem Based Learning (PBL)	▪ Written Exams ▪ Final practical exam ▪ Assignments

c3	Conduct well-designed experiments, analyze data effectively, and communicate results clearly paves the way for innovative solutions that improve equipment reliability and efficiency, ultimately leading to better patient care.	▪ Tutorials ▪ Training ▪ Case studies (CBL) ▪ Lab work ▪ Problem Solving Learning (PSL) ▪ Problem Based Learning (PBL)	▪ Written Exams ▪ Final practical exam ▪ Assignments
	(D) Alignment of Course Intended Learning Outcomes (Transferable Skills) to Teaching Strategies and Assessment Methods:		
	Course Intended Learning Outcomes	**Teaching Strategies**	**Assessment Strategies**
d1	Function effectively in different work environments as an individual, and as a member or leader in multi-disciplinary teams.	▪ Discussion ▪ Case studies (CBL) ▪ Self-Learning ▪ Presentation	▪ Assignments

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1	**Introduction**	– Introduction to the course. – Course outlines. – The purpose of this course – Theory and practice of maintenance – Project description.	1	2	a1, a2, a4 b1, b2, c2, c3
2	**Provision for**	- The equipment management	2	4	a1, a2,

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
	Maintenance	cycle - Inputs for equipment management - Recommended resources - Types of Medical Equipment Maintenance - Types and approaches to Maintenance of Medical Equipment. - Levels of Maintenance - Planned Maintenance of Medical Equipment – Installation of equipment			a4 b1, b2, c2, c3
3	**Principles of Troubleshooting**	- Reading drawings and diagrams (Block diagram, circuit diagram, and wiring diagram) - Disassembly and re-assembly of equipment. - Equipment failures and causes. - Nature of faults, fault location procedure, and fault-finding aids (service and maintenance manuals and instruction manuals). - Principle of troubleshooting - Logical Approach to Troubleshooting - Circuit-Board Troubleshooting – Transducers troubleshooting	2	4	a1, a2, a4 b1, b2, c2, c3
4	**Medical Laboratory devices: Maintenance and Calibration**	- Introduction - Microscopes -–Clinical Centrifuges, - Spectrophotometer, - Clinical chemistry analyzers - Blood cell counter	2	4	a1, a2, a4 b1, b2, c2, c3

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
		–			
5	Medication Delivery Systems and Aspirators Devices: Maintenance and calibration	- Infusion pumps, - Syringe pumps, - Aspirators, - Suction machine.	1	2	a1, a2, a4 b1, b2, c2, c3
6	Mid-Term Theoretical Exam	– All Previous Topics	1	2	a1, a3, b1, b2, b3, c2, c3
7	Sterilizing Equipment: Maintenance and Calibration	- Steam sterilizers, - Autoclave, – Hot air ovens.	1	2	a1, a2, a4 b1, b2, c2, c3
8	Infant Care Equipment: Maintenance and Calibration	- Infant incubators, – Infant warmers.	1	2	a1, a2, a4 b1, b2, c2, c3
9	Patient Monitoring Systems: Maintenance and Calibration	- Non-invasive blood pressure & vital signs monitors, - Pulse oximeter, – Bedside monitors.	1	4	a1, a2, a4 b1, b2, c2, c3
10	Diagnostic Equipment: Maintenance and calibration	- Electrocardiograph ECG, - Electroencephalograph EEG, - Electromyograph EMG	1	2	a1, a2, a4 b1, b2, c2, c3

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
		- Defibrillators, – Heart lung machine.			
11	Dental unit	- Introduction to Dental unit maintenance - Key component overview - Dilay maintenance protocols – Maintenance and troubleshooting of Dental chair	1	2	a1, a2, a4 b1, b2, c2, c3
12	Project Presentation	– Student's Presentation	1	2	a1, a2, a4 b1, b2, c2, c3, d1
13	Final Theoretical Exam	– All Topics	1	2	a1, a2, a4 b1, b2, c2, c3
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	These will cover similar material to the lectures.	7	14	a1, a2, a4 b1, b2, c2, c3, d1
2	Mid-Term Practical Exam	1	2	a1, a2, a4 b1, b2, c2, c3

No.	Tasks/ Experiments	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
3	These will cover similar material to the lectures.	6	12	a1, a2, a4 b1, b2, c2, c3, d1
4	Final Practical Exam	1	2	a1, a2, a4 b1, b2, c2, c3
Number of Weeks /and Units Per Semester		15	30	

C. Tutorial Aspect (if any):

VII. Assignments:

No.	Assignments	Week Due	Mark	Aligned CILOs (symbols)
1	Assignment 1: Several Assignments on all topics learnt in the lectures.	w2-w15	5	a1, a2, a4 b1, b2, c2, c3
2	Assignment 2: Several Assignments on all experiments learnt in the practical aspect.	w2-w15	5	a1, a2, a4 b1, b2, c2, c3
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	Weekly	10	10%	a1, a2, a4 b1, b2, c2, c3
2	Quizzes 1 & 2	Weeks 4,10	5	5%	a1, a2, a4 b1, b2, c2, c3

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
3	Mid-Term Theoretical Exam	Week 8	20	20%	a1, a2, a4 b1, b2, c2, c3
4	Mid-Term Practical Exam	Week 8	10	10%	a1, a2, a4 b1, b2, c2, c3
5	Final Practical Exam including Project Presentation & Evaluation	Week 15	15	15%	a1, a2, a4 b1, b2, c2, c3
6	Final Theoretical Exam	Week 16	40	40%	a1, a2, a4 b1, b2, c2, c3
Total			100%	100%	-

IX. Learning Resources:

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

1- John G. Webster, Amit J. Nimunkar, 2020, "Medical Instrumentation: Application and Design", 5th Ed., USA, John Wiley & Sons Ltd.

2- R. Keith Mobley, Lindley R. Higgins, Darrin J. Wikoff, 2008 "Maintenance Engineering Handbook", 7th Ed., USA, McGraw-Hill Companies, Inc.

2- Essential References:

1. Ernesto Iadanza, 2020, "Clinical Engineering Handbook", 2nd Ed., USA, Elsevier Academic Press.
2. Justin Cooper, Alex Dahinten, 2013, "Medical Equipment Troubleshooting Flowchart Handbook", 6th Ed., USA, Engineering World Health.
3. Crown Agents, 2010, "Medical Equipment Maintenance Manual", India, Ministry of Health and Family Welfare.

3- Electronic Materials and Web Sites etc.:

Websites:

1- www.frankshospitalworkshop.com is a private and noncommercial website which can be used for self-study. It is a collection of documents, experiences, best-practice

procedures and teaching and learning materials about biomedical technology.
http://www.frankshospitalworkshop.com/

2- DOTmed.com is the world's leading public trading platform for buying and selling medical equipment, parts and services. Many of the original features on DOTmed.com were free, and still are today.
https://www.dotmed.com

Journals:

1- One of the world's largest fully open access journal publishers.

https://www.hindawi.com/journals/jhe/

2- BMC is part of Springer Nature, giving us greater opportunities to help authors

everywhere make more connections with research communities across the world.

https://biomedical-engineering-online.biomedcentral.com/

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:

- Website: Franks Hospital Workshop

http://www.frankshospitalworkshop.com

Other Web Sources:

Health Facilities Management, a publication of the American Hospital Association, is

the most trusted and credible publication in its field.

https://www.hfmmagazine.com/articles/1493-medical-equipment-maintenance/

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

Biomedical Devices Maintenance 1

Course Code. (07.02.727)

I. Information about Faculty Member Responsible for the Course:							
Name of Faculty Member:	**Dr. Awadh Al-Kubati**	**Office Hours**					
Location & Telephone No.:	**21 September University of Medical and Applied Science 770807295**						
E-mail:	**dawadh@21umas.edu.ye**	SAT	SUN	MON	TUE	WED	THU

2024/2025

II. Course Identification and General Information:

11.	Course Title:	Biomedical Devices Maintenance 1				
12.	Course Code:	07.02.727				
13.	Credit Hours:	Credit Hours	Theory Contact Hours		Practical Contact Hours	
			Lecture	Tutorial /Seminar	Lab	Clinical
		3	2	--	2	--
14.	Level/ Semester at which this Course is offered:	4th Level / 1st Semester				
15.	Pre –Requisite (if any):	07.02.713, 07.02.716 & 07.02.720				
16.	Co –Requisite (if any):					
17.	Program (s) in which the Course is Offered:	Bachelor of Biomedical Engineering				
18.	Language of Teaching the Course:	English/Arabic				
19.	Location of Teaching the Course:	Faculty of Medical Technology				
20.	Prepared by:	Dr. Mushtaq Alazazi				
11	Date and Number of Approval by Council:	09/2024				

III. Course Description:

This course is designed to provide basic knowledge and training for students -enter and/or advance in the occupations associated with medical equipment maintenance and repair. A biomedical equipment technician must possess the skills necessary to repair and replace parts on medical equipment, test and calibrate equipment, perform and record preventative maintenance, procure and track inventory, and facilitate training sessions on the equipment. This course is intended to be basics for the medical equipment technicians to carry out basic maintenance tasks. As the majority of equipment problems are either simple or user-related it is the aim that the better care and regular maintenance enabled by this class will have a significant positive

effect on the delivery of healthcare facilities.

IV. Course Intended Learning Outcomes (CILOs) :

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

	A. Knowledge and Understanding:
a1	Recognize principles and concepts of maintain medical devices technologies, theoretical and practical basics for enabling students operate and maintain medical instrumentation
a2	understand biomedical device maintenance principles, including preventive and corrective techniques, and their importance in solving equipment issues in healthcare while ensuring compliance with safety standards.
a3	Contribute to innovative solutions that improve healthcare and quality of life. This can range from developing easier-to-maintain devices to extending the lifespan of existing equipment, ultimately leading to better patient care and resource management.
	B. Intellectual Skills:
b1	Integrate engineering principles, life science knowledge, and data analysis with cutting-edge technology positions them as vital members of the healthcare team, ensuring the continued reliability of medical devices and ultimately, fostering positive patient outcomes.
b2	Innovate solutions, and integrate their knowledge base empowers them to tackle complex challenges in the biomedical engineering field. This ultimately translates to improved equipment reliability, enhanced patient care, and a more efficient healthcare system.
	C. Professional and Practical Skills:
c1	Utilize advanced tools, software, and automation empowers them to solve complex problems efficiently, ensuring the continued reliability of medical devices and contributing to improved patient care outcomes.
c2	Conduct well-designed experiments, analyze data effectively, and communicate results clearly paves the way for innovative solutions that improve equipment reliability and efficiency, ultimately leading to better

	patient care.
	D. Transferable Skills:
d1	Function effectively in different work environments as an individual, and as a member or leader in multi-disciplinary teams.

	A. Knowledge and Understanding:

V. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
1	**Introduction**	– Introduction to the course. – Course outlines. – The purpose of this course – Theory and practice of maintenance – Project description.	1	2
2	**Provision for Maintenance**	- The equipment management cycle - Inputs for equipment management - Recommended resources - Types of Medical Equipment Maintenance - Types and approaches to Maintenance of Medical Equipment. - Levels of Maintenance - Planned Maintenance of Medical Equipment – Installation of equipment	2	4
3	**Principles of Troubleshooting**	- Reading drawings and diagrams (Block diagram, circuit diagram, and wiring diagram) - Disassembly and re-assembly of equipment.	2	4

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
		- Equipment failures and causes. - Nature of faults, fault location procedure, and fault-finding aids (service and maintenance manuals and instruction manuals). - Principle of troubleshooting - Logical Approach to Troubleshooting - Circuit-Board Troubleshooting – Transducers troubleshooting		
4	Medical Laboratory devices: Maintenance and Calibration	- Introduction - Microscopes -–Clinical Centrifuges, - Spectrophotometer, - Clinical chemistry analyzers - Blood cell counter –	2	4
5	Medication Delivery Systems and Aspirators Devices: Maintenance and calibration	- Infusion pumps, - Syringe pumps, - Aspirators, - Suction machine. –	1	2
6	Mid-Term Theoretical Exam	– All Previous Topics	1	2
7	Sterilizing Equipment: Maintenance and Calibration	- Steam sterilizers, - Autoclave, – Hot air ovens.	1	2
8	Infant Care Equipment: Maintenance and Calibration	- Infant incubators, – Infant warmers.	1	2
9	Patient	- Non-invasive blood pressure & vital	1	4

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
	Monitoring Systems: Maintenance and Calibration	signs monitors, - Pulse oximeter, – Bedside monitors.		
10	Diagnostic Equipment: Maintenance and calibration	- Electrocardiograph ECG, - Electroencephalograph EEG, - Electromyograph EMG - Defibrillators, – Heart lung machine.	1	2
11	Dental unit	- Introduction to Dental unit maintenance - Key component overview - Dilay maintenance protocols – Maintenance and troubleshooting of Dental chair	1	2
12	Project Presentation	– Student's Presentation	1	2
13	Final Theoretical Exam	– All Topics	1	2
Number of Weeks /and Units Per Semester			16	32

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
1	Introduction	– Introduction to the course. – Course outlines. – The purpose of this course – Theory and practice of	1	2

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
		maintenance – Project description.		
2	**Provision for Maintenance**	- The equipment management cycle - Inputs for equipment management - Recommended resources - Types of Medical Equipment Maintenance - Types and approaches to Maintenance of Medical Equipment. - Levels of Maintenance - Planned Maintenance of Medical Equipment – Installation of equipment	2	4
3	**Principles of Troubleshooting**	- Reading drawings and diagrams (Block diagram, circuit diagram, and wiring diagram) - Disassembly and re-assembly of equipment. - Equipment failures and causes. - Nature of faults, fault location procedure, and fault-finding aids (service and maintenance manuals and instruction manuals). - Principle of troubleshooting - Logical Approach to Troubleshooting - Circuit-Board Troubleshooting – Transducers troubleshooting	2	4
4	**Medical Laboratory devices: Maintenance and Calibration**	- Introduction - Microscopes -–Clinical Centrifuges, - Spectrophotometer, - Clinical chemistry analyzers - Blood cell counter –	2	4

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
5	**Medication Delivery Systems and Aspirators Devices: Maintenance and calibration**	- Infusion pumps, - Syringe pumps, - Aspirators, - Suction machine.	1	2
6	**Mid-Term Theoretical Exam**	– All Previous Topics	1	2
7	**Sterilizing Equipment: Maintenance and Calibration**	- Steam sterilizers, - Autoclave, – Hot air ovens.	1	2
8	**Infant Care Equipment: Maintenance and Calibration**	- Infant incubators, – Infant warmers.	1	2
9	**Patient Monitoring Systems: Maintenance and Calibration**	- Non-invasive blood pressure & vital signs monitors, - Pulse oximeter, – Bedside monitors.	1	4
10	**Diagnostic Equipment: Maintenance and calibration**	- Electrocardiograph ECG, - Electroencephalograph EEG, - Electromyograph EMG - Defibrillators, – Heart lung machine.	1	2
11	**Dental unit**	- Introduction to Dental unit maintenance - Key component overview	1	2

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
		- Dilay maintenance protocols – Maintenance and troubleshooting of Dental chair		
12	Project Presentation	– Student's Presentation	1	2
13	Final Theoretical Exam	– All Topics	1	2
Number of Weeks /and Units Per Semester			16	32

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
1	Introduction	– Introduction to the course. – Course outlines. – The purpose of this course – Theory and practice of maintenance – Project description.	1	2
2	Provision for Maintenance	- The equipment management cycle - Inputs for equipment management - Recommended resources - Types of Medical Equipment Maintenance - Types and approaches to Maintenance of Medical Equipment. - Levels of Maintenance - Planned Maintenance of Medical Equipment – Installation of equipment	2	4
3	Principles of Troubleshooting	- Reading drawings and diagrams (Block diagram, circuit diagram,	2	4

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
		and wiring diagram) - Disassembly and re-assembly of equipment. - Equipment failures and causes. - Nature of faults, fault location procedure, and fault-finding aids (service and maintenance manuals and instruction manuals). - Principle of troubleshooting - Logical Approach to Troubleshooting - Circuit-Board Troubleshooting – Transducers troubleshooting		
4	Medical Laboratory devices: Maintenance and Calibration	- Introduction - Microscopes -–Clinical Centrifuges, - Spectrophotometer, - Clinical chemistry analyzers - Blood cell counter –	2	4
5	Medication Delivery Systems and Aspirators Devices: Maintenance and calibration	- Infusion pumps, - Syringe pumps, - Aspirators, - Suction machine.	1	2
6	Mid-Term Theoretical Exam	– All Previous Topics	1	2
7	Sterilizing Equipment: Maintenance and Calibration	- Steam sterilizers, - Autoclave, – Hot air ovens.	1	2
8	Infant Care Equipment: Maintenance and	- Infant incubators, – Infant warmers.	1	2

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
	Calibration			
9	Patient Monitoring Systems: Maintenance and Calibration	- Non-invasive blood pressure & vital signs monitors, - Pulse oximeter, – Bedside monitors.	1	4
10	Diagnostic Equipment: Maintenance and calibration	- Electrocardiograph ECG, - Electroencephalograph EEG, - Electromyograph EMG - Defibrillators, – Heart lung machine.	1	2
11	Dental unit	- Introduction to Dental unit maintenance - Key component overview - Dilay maintenance protocols – Maintenance and troubleshooting of Dental chair	1	2
12	Project Presentation	– Student's Presentation	1	2
13	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

No.	Tasks/ Experiments	Number of Weeks	Contact Hours
1	These will cover similar material to the lectures.	7	14
2	**Mid-Term Practical Exam**	1	2
3	These will cover similar material to the lectures.	6	12
4	**Final Practical Exam**	1	2
Number of Weeks /and Units Per Semester		**15**	**30**

C. **Tutorial Aspect:**

VI. Teaching Strategies of the Course:

- Lectures
- Tutorials
- Discussion
- Presentation
- Self-learning
- Case Study (CBL)

VII. Assessment Methods of the Course:

- Written exam (mid and final terms and quizzes),
- Final practical exam
- Assignments (Homework, Team work, oral presentation and project)

VII. Assignments:

No.	Assignments	Week Due	Mark	Aligned CILOs (symbols)
1	Assignment 1: Several Assignments on all topics learnt in the lectures.	w2-w15	5	a1, a2, a4 b1, b2, c2, c3
2	Assignment 2: Several Assignments on all experiments learnt in the practical aspect.	w2-w15	5	a1, a2, a4 b1, b2, c2, c3
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	Weekly	10	10%	a1, a2, a4 b1, b2, c2, c3
2	Quizzes 1 & 2	Weeks 4,10	5	5%	a1, a2, a4 b1, b2, c2, c3
3	Mid-Term Theoretical Exam	Week 8	20	20%	a1, a2, a4 b1, b2, c2, c3
4	Mid-Term Practical Exam	Week 8	10	10%	a1, a2, a4 b1, b2, c2, c3
5	Final Practical Exam including Project Presentation & Evaluation	Week 15	15	15%	a1, a2, a4 b1, b2, c2, c3
6	Final Theoretical Exam	Week 16	40	40%	a1, a2, a4 b1, b2, c2, c3
Total			100%	100%	-

X. Learning Resources:

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

1. John G. Webster, Amit J. Nimunkar, 2020, “Medical Instrumentation: Application

and Design", 5th Ed., USA, John Wiley & Sons Ltd.

2. R. Keith Mobley, Lindley R. Higgins, Darrin J. Wikoff, 2008 "Maintenance Engineering Handbook", 7th Ed., USA, McGraw-Hill Companies, Inc.

2- Essential References:

1. Ernesto Iadanza, 2020, "Clinical Engineering Handbook", 2nd Ed., USA, Elsevier Academic Press.

2. Justin Cooper, Alex Dahinten, 2013, "Medical Equipment Troubleshooting Flowchart Handbook", 6th Ed., USA, Engineering World Health.

3. Crown Agents, 2010, "Medical Equipment Maintenance Manual", India, Ministry of Health and Family Welfare.

3- Electronic Materials and Web Sites etc.:

Websites:

1- **1-** www.frankshospitalworkshop.com is a private and noncommercial website which can be used for self-study. It is a collection of documents, experiences, best-practice

2- procedures and teaching and learning materials about biomedical technology.

3- http://www.frankshospitalworkshop.com/

4- 2- DOTmed.com is the world's leading public trading platform for buying and selling

5- medical equipment, parts and services. Many of the original features on DOTmed.com

6- were free, and still are today.

7- https://www.dotmed.com

8-

9- Journals:

10- 1- One of the world's largest fully open access journal publishers.

11- https://www.hindawi.com/journals/jhe/

12- 2- BMC is part of Springer Nature, giving us greater opportunities to help authors

13- everywhere make more connections with research communities across the world.

14- https://biomedical-engineering-online.biomedcentral.com/

15- **3-** IEEE Transactions on Biomedical Engineering: Peer reviewed academic journal in the field of Biomedical Engineering. http://www.ieeexplore.ieee.org/xpl

16- 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:

17-- Website: Franks Hospital Workshop
18-http://www.frankshospitalworkshop.com
19-Other Web Sources:
20-Health Facilities Management, a publication of the American Hospital Association, is
21-the most trusted and credible publication in its field.
22-https://www.hfmmagazine.com/articles/1493-medical-equipment-maintenance/
23-

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

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.