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 Maintenance 2

Course Code. (07.02.731)

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 2				
2.	Course Code:	07.02.731				
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 / 2^{nd} Semester				
5.	Pre –Requisite (if any):	07.02.727				
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.
a4	Contribute to innovative solutions that improve healthcare and quality of life. This can range from developing easierto-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 technology positions them as vital members of the healthcare team, ensuring the continued reliability of medical devices and ultimately, fostering positive patient outcomes.	P	B1	Use the basic science, mathematical theories, engineering principles to 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:			
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.	P	C2	Evaluate an engineering technique, modern analytical tools and required computer programs to analyzing and solve the problems of medical devices.
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.	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-	▪ ▪ Lectures ▪ Tutorials ▪ Discussion ▪ Presentation ▪ Self-learning ▪ Case Study (CBL)	▪ ▪ Written Exams ▪ Final practical exam ▪ Assignments

	maintain devices to extending the lifespan of existing equipment, ultimately leading to better patient care and resource management.		
	(B) Alignment of Course Intended Learning Outcomes (Intellectual Skills) to Teaching Strategies and Assessment Methods:		
	Course Intended Learning Outcomes	**Teaching Strategies**	**Assessment Strategies**
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	**Ventilator Machine maintenance and troubleshooting**	- Routine Inspection and testing - Cleaning and sterilization - Calibration - Gas supply and oxygen concentration - Battery and power supply - Alarm system testing – Software update and upgrades	1	2	a1, a2, a4 b1, b2, c2, c3
2	**Anesthesia Machine maintenance and troubleshooting**	- Routine Inspection and Testing - Cleaning and sterilization - Calibration - Ventilation system maintenance - Gas supply and pipeline maintenance – Electrical safety checks	1	2	a1, a2,a4, b1, b2, c2, c3
3	**Electrosurgical unit maintenance and troubleshooting**	- Routine Inspection and testing - Electrical safety checks - Calibration - Replacement of consumable parts – Troubleshooting and repair	1	2	a1, a2, a4, b1, b2, c2, c3
4	**Hemodialysis Machine maintenance and troubleshooting**	- Routine cleaning and disinfection - Water quality management - Calibration and testing - Machine function checks - Preventive maintenance - Troubleshooting and repair –	1	2	a1, a2, a4 ,b1, b2, , c2, c3

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
5	**Endoscopy Maintenance and calibration**	- Cleaning and disinfection - Endoscopy inspection - Leak testing - Preventive maintenance - Troubleshooting common issues - Repair and replacement guidelines –	1	2	a1, a2, a4, b1, b2, c2, c3
6	**Ultrasound machines maintenance and troubleshooting**	- Transducer care - Quality assurance and calibration - Troubleshooting common issues - Peripheral equipment maintenance - Probe maintenance and repair – Power and connectivity checks	1	2	a1, a2, a4, b1, b2, c2, c3
7	**Mid-Term Theoretical Exam**	– All Previous Topics	1	2	a1, a2, a4, b1, b2, c2, c3
8	**X ray machines Maintenance and troubleshooting**	- Regular inspections - Calibration - Quality control - Radiation safety - Electrical safety	2	4	a1, a2, a4, b1, b2, c2, c3

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
		- Troubleshooting common issues			
9	**Digital X ray machines Maintenance and troubleshooting**	- Detector maintenance - Software updates - Image processing calibration - Storage and archiving - Network connectivity – Troubleshooting common issues	1	2	a1, a2, a4, b1, b2, c2, c3
10	**CT Scan maintenance**	- Regular inspection - Calibration - Image quality problems - Scanner malfunction - Mechanical Failures - Electrical failures – Software errors	1	2	a1, a2, a4, b1, b2, c2, c3
11	**MRI maintenance**	- Regular inspection - Cryogen management - Safety checks - Room environment control - RF shielding - Gradient coil maintenance - RF coil maintenance - Image quality problems – Software errors	1	2	a1, a2, a4, b1, b2, c2, c3

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
12	Nuclear medicine machines maintenance	- Gamma Camera - Single photon emission tomography (SPECT) - Positron emission tomography (PET) - PET/CT - Linear accelerator (LINAC) – Cobalt 60	1	2	a1, a2, a4, b1, b2, c2, c3
13	Ophthalmic devices maintenance and calibration	- Ophthalmoscope - Slit lamp - Tonometer - Autorefractometer - Lensometer - Retinoscope - Optical coherence tomography – Corneal topography	1	2	a1, a2, a4, b1, b2, c2, c3
14	Project Presentation	– Student's Presentation	1	2	a1, a2, a4, b1, b2, c2, c3, d1
15	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, d1
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, d1
Number of Weeks /and Units Per Semester		**15**	**30**	

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

No.	Assignments	Week Due	Mark	Aligned CILOs (symbols)
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
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:

- *Written in the following order:* Author, Year of publication, Title, Edition, Place of publication, Publisher.

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 2

Course Code. (07.02.731)

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 2				
12.	Course Code:	07.02.731				
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 / 2nd Semester				
15.	Pre –Requisite (if any):	07.02.727				
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.
a4	Contribute to innovative solutions that improve healthcare and quality of life. This can range from developing easierto-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:

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.
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.
	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	**Ventilator Machine maintenance and troubleshooting**	- Routine Inspection and testing - Cleaning and sterilization - Calibration - Gas supply and oxygen concentration - Battery and power supply - Alarm system testing – Software update and upgrades	1	2
2	**Anesthesia Machine maintenance and troubleshooting**	- Routine Inspection and Testing - Cleaning and sterilization - Calibration - Ventilation system maintenance - Gas supply and pipeline maintenance – Electrical safety checks	1	2

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
3	**Electrosurgical unit maintenance and troubleshooting**	- Routine Inspection and testing - Electrical safety checks - Calibration - Replacement of consumable parts – Troubleshooting and repair	1	2
4	**Hemodialysis Machine maintenance and troubleshooting**	- Routine cleaning and disinfection - Water quality management - Calibration and testing - Machine function checks - Preventive maintenance - Troubleshooting and repair –	1	2
5	**Endoscopy Maintenance and calibration**	- Cleaning and disinfection - Endoscopy inspection - Leak testing - Preventive maintenance - Troubleshooting common issues - Repair and replacement guidelines –	1	2
6	**Ultrasound machines maintenance and troubleshooting**	- Transducer care - Quality assurance and calibration - Troubleshooting common issues - Peripheral equipment maintenance - Probe maintenance and repair – Power and connectivity checks	1	2
7	**Mid-Term Theoretical Exam**	– All Previous Topics	1	2
8	**X ray machines Maintenance and troubleshooting**	- Regular inspections - Calibration	2	4

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
		- Quality control - Radiation safety - Electrical safety - Troubleshooting common issues		
9	**Digital X ray machines Maintenance and troubleshooting**	- Detector maintenance - Software updates - Image processing calibration - Storage and archiving - Network connectivity – Troubleshooting common issues	1	2
10	**CT Scan maintenance**	- Regular inspection - Calibration - Image quality problems - Scanner malfunction - Mechanical Failures - Electrical failures – Software errors	1	2
11	**MRI maintenance**	- Regular inspection - Cryogen management - Safety checks - Room environment control - RF shielding - Gradient coil maintenance - RF coil maintenance - Image quality problems	1	2

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
		– Software errors		
12	**Nuclear medicine machines maintenance**	- Gamma Camera - Single photon emission tomography (SPECT) - Positron emission tomography (PET) - PET/CT - Linear accelerator (LINAC) – Cobalt 60	1	2
13	**Ophthalmic devices maintenance and calibration**	- Ophthalmoscope - Slit lamp - Tonometer - Autorefractometer - Lensometer - Retinoscope - Optical coherence tomography – Corneal topography	1	2
14	**Project Presentation**	– Student's Presentation	1	2
15	**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

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
1	**Ventilator Machine maintenance and troubleshooting**	- Routine Inspection and testing - Cleaning and sterilization - Calibration - Gas supply and oxygen concentration - Battery and power supply - Alarm system testing – Software update and upgrades	1	2
2	**Anesthesia Machine maintenance and troubleshooting**	- Routine Inspection and Testing - Cleaning and sterilization - Calibration - Ventilation system maintenance - Gas supply and pipeline maintenance – Electrical safety checks	1	2
3	**Electrosurgical unit maintenance and troubleshooting**	- Routine Inspection and testing - Electrical safety checks - Calibration - Replacement of consumable parts – Troubleshooting and repair	1	2
4	**Hemodialysis Machine maintenance and troubleshooting**	- Routine cleaning and disinfection - Water quality management - Calibration and testing - Machine function checks - Preventive maintenance - Troubleshooting and repair –	1	2
5	**Endoscopy Maintenance and calibration**	- Cleaning and disinfection - Endoscopy inspection - Leak testing - Preventive maintenance - Troubleshooting common issues - Repair and replacement guidelines	1	2

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
		–		
6	**Ultrasound machines maintenance and troubleshooting**	- Transducer care - Quality assurance and calibration - Troubleshooting common issues - Peripheral equipment maintenance - Probe maintenance and repair – Power and connectivity checks	1	2
7	**Mid-Term Theoretical Exam**	– All Previous Topics	1	2
8	**X ray machines Maintenance and troubleshooting**	- Regular inspections - Calibration - Quality control - Radiation safety - Electrical safety - Troubleshooting common issues	2	4
9	**Digital X ray machines Maintenance and troubleshooting**	- Detector maintenance - Software updates - Image processing calibration - Storage and archiving - Network connectivity – Troubleshooting common issues	1	2
10	**CT Scan maintenance**	- Regular inspection - Calibration - Image quality problems	1	2

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
		- Scanner malfunction - Mechanical Failures - Electrical failures – Software errors		
11	**MRI maintenance**	- Regular inspection - Cryogen management - Safety checks - Room environment control - RF shielding - Gradient coil maintenance - RF coil maintenance - Image quality problems – Software errors	1	2
12	**Nuclear medicine machines maintenance**	- Gamma Camera - Single photon emission tomography (SPECT) - Positron emission tomography (PET) - PET/CT - Linear accelerator (LINAC) – Cobalt 60	1	2
13	**Ophthalmic devices maintenance and calibration**	- Ophthalmoscope - Slit lamp - Tonometer	1	2

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
		- Autorefractometer - Lensometer - Retinoscope - Optical coherence tomography – Corneal topography		
14	Project Presentation	– Student's Presentation	1	2
15	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	Ventilator Machine maintenance and troubleshooting	- Routine Inspection and testing - Cleaning and sterilization - Calibration - Gas supply and oxygen concentration - Battery and power supply - Alarm system testing – Software update and upgrades	1	2
2	Anesthesia Machine maintenance and troubleshooting	- Routine Inspection and Testing - Cleaning and sterilization - Calibration - Ventilation system maintenance - Gas supply and pipeline maintenance – Electrical safety checks	1	2
3	Electrosurgical unit maintenance	- Routine Inspection and testing - Electrical safety checks	1	2

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
	and troubleshooting	- Calibration - Replacement of consumable parts – Troubleshooting and repair		
4	Hemodialysis Machine maintenance and troubleshooting	- Routine cleaning and disinfection - Water quality management - Calibration and testing - Machine function checks - Preventive maintenance - Troubleshooting and repair –	1	2
5	Endoscopy Maintenance and calibration	- Cleaning and disinfection - Endoscopy inspection - Leak testing - Preventive maintenance - Troubleshooting common issues - Repair and replacement guidelines –	1	2
6	Ultrasound machines maintenance and troubleshooting	- Transducer care - Quality assurance and calibration - Troubleshooting common issues - Peripheral equipment maintenance - Probe maintenance and repair – Power and connectivity checks	1	2
7	Mid-Term Theoretical Exam	– All Previous Topics	1	2
8	X ray machines Maintenance and troubleshooting	- Regular inspections - Calibration - Quality control	2	4

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
		- Radiation safety - Electrical safety - Troubleshooting common issues		
9	**Digital X ray machines Maintenance and troubleshooting**	- Detector maintenance - Software updates - Image processing calibration - Storage and archiving - Network connectivity – Troubleshooting common issues	1	2
10	**CT Scan maintenance**	- Regular inspection - Calibration - Image quality problems - Scanner malfunction - Mechanical Failures - Electrical failures – Software errors	1	2
11	**MRI maintenance**	- Regular inspection - Cryogen management - Safety checks - Room environment control - RF shielding - Gradient coil maintenance - RF coil maintenance - Image quality problems – Software errors	1	2

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
12	**Nuclear medicine machines maintenance**	- Gamma Camera - Single photon emission tomography (SPECT) - Positron emission tomography (PET) - PET/CT - Linear accelerator (LINAC) – Cobalt 60	1	2
13	**Ophthalmic devices maintenance and calibration**	- Ophthalmoscope - Slit lamp - Tonometer - Autorefractometer - Lensometer - Retinoscope - Optical coherence tomography – Corneal topography	1	2
14	**Project Presentation**	– Student's Presentation	1	2
15	**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	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**

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**

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**

VI. 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),

VII. Assessment Methods of the Course:

- Written tests (mid and final terms and quizzes),
- Short reports,
- Lab\Project report
- Practical lab performance assessment,
- Coursework activities assessment,
- Presentations.

VIII. Assignments:

No.	Assignments	Week Due	Mark	Aligned CLOs (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

No.	Assignments	Week Due	Mark	Aligned CLOs (symbols)
				, 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:

- *Written in the following order:* Author, Year of publication, Title, Edition, Place of publication, Publisher.

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.

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

1-

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/

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.