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

Course Specification of Management Systems and Healthcare Delivery

Course Code (BE375)

I. Course Identification and General Information:

1	**Course Title:**	Management Systems and Healthcare Delivery				
2	**Course Code & Number:**	BE375				
3	**Credit hours:**	C.H				TOTAL
		Th.	Seminar	Pr	Tr.	
		2	--	--	2	3
4	**Study level/ semester at which this course is offered:**	4^{th} Level / 2^{nd} Semester				
5	**Pre –requisite (if any):**	Clinical Engineering (BE366)				
6	**Co –requisite (if any):**	None				
7	**Program (s) in which the course is offered:**	Biomedical Engineering Program				
8	**Language of teaching the course:**	English				
9	**Location of Teaching the Course:**	Faculty of Engineering				
10	**Prepared by:**	Dr. Mohammed Al-olofi				
11	**Reviewed by:**	Dr. Waleed Al-Talbi				
12	**Date of Approval:**					

II. Course Description:

The Management Systems and Healthcare Delivery course aims to give the student knowledge of the basic concepts of the total quality management and project cycle management in hospital, the medical gases networks, the methods applied to measure, test, evaluate and design the medical gases network. The course includes the Project Cycle Management (PCM), Total Quality Management

(TQM), 5S principle, Kaizen principle, continuous quality improvement, introduction of medical gases network, design of medical gases network, medical gases and its applications, medical gas pipe line system, components of medical gases network, medical gases plants, testing of medical gases networks.

III. Course Intended learning outcomes (CILOs) of the course (maximum 8CILOs)		**Referenced PILOs** (Only write code number of referenced Program Intended learning outcomes)
Knowledge and Understanding: Upon successful completion of the undergraduate Biomedical Engineering Program, the graduates will be able to:		
a1	Describe the basic concepts, and principles of the total quality management and project cycle management methods in healthcare sector.	A1 Describe and explain the underlying mathematical methods and theories; life scientific-principles; and engineering core concepts related to the Biomedical Engineering context.
a2	Explain the design and development of medical gas networks in hospitals.	A2 Clarify the design principles and techniques and the engineering materials characteristics and how these are relevant to the developments and technologies in a biomedical systems context.
a3	Recognize ethical and professional responsibilities in biomedical engineering situations and make informed judgments, considering the impact of biomedical engineering solutions in global, economic, environmental, and societal contexts.	A3 Recognize and explain the need for a high level of management, professional and ethical behavior, responsibility, quality assurance systems, codes of practice, standards, health and safety requirements, and environmental impacts in biomedical systems.
B. Cognitive/ Intellectual Skills: Upon successful completion of the undergraduate Biomedical		

Engineering Program, the graduates will be able to:		
b1	Design, test and establish the medical gas networks and their components with considerate environmental conditions, health and safety, manufacturability and sustainability.	B3 Design the biomedical systems or processes within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.
b2	Categorize the medical gas systems based on their specifications and characteristics.	B5 Distinguish the main characteristics of biomedical systems, apply diagnostic skills and technical knowledge and perform failure analysis to these systems.
C. Professional and Practical Skills: Upon successful completion of the undergraduate Biomedical Engineering Program, the graduates will be able to:		
c1	Apply mathematical, simulation models, and IT software packages to medical gas networks effectively.	C2 Use a wide range of analytical tools, techniques, IT, modern engineering tools, software packages and develop required computer programs to solve, modeling and analyzing Biomedical Engineering problems.
c2	Install, operate, troubleshooting, and maintenance the medical gas networks by using rules and regulations of medical safety.	C4 Use rules and regulations of industrial safety as well as safe and diagnose systems at work, evaluate performance and observe the appropriate steps to manage risks concerning biomedical systems.
D. Transferable Skills: Upon successful completion of the undergraduate Biomedical Engineering Program, the graduates will be able to:		
d1	Function effectively in different work environments as an individual, and as a member or leader in multi-disciplinary teams.	D1 Lead and motivate individuals, show capability to work in stressful environments and within constraints, collaborate effectively within multidisciplinary team.

(A) Alignment Course Intended Learning Outcomes of Knowledge and Understanding to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
a1 Describe the basic concepts, and principles of the total quality management and project cycle management methods in healthcare sector.	• Interactive lectures & examples, • Tutorials, • Videos demonstrations, • Presentation/seminar, • Interactive class discussions, • Case studies, • Directed self- study, • Problem based learning, • Team work (cooperative learning), • Field visits/training,	• Written tests (mid and final terms and quizzes), • Short reports, • Coursework activities assessment, • Presentations.
a2 Explain the design and development of medical gas networks in hospitals.	• Interactive lectures & examples, • Tutorials, • Videos demonstrations, • Presentation/seminar, • Interactive class discussions, • Case studies, • Directed self- study, • Problem based learning, • Team work (cooperative learning),	• Written tests (mid and final terms and quizzes), • Short reports, • Coursework activities assessment, • Presentations.

	• Field visits/training,	
a3 Recognize ethical and professional responsibilities in biomedical engineering situations and make informed judgments, considering the impact of biomedical engineering solutions in global, economic, environmental, and societal contexts.	• Interactive lectures & examples, • Tutorials, • Videos demonstrations, • Presentation/seminar, • Interactive class discussions, • Case studies, • Directed self- study, • Problem based learning, • Team work (cooperative learning), • Field visits/training,	• Written tests (mid and final terms and quizzes), • Short reports, • Coursework activities assessment, • Presentations.

(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
b1 Design, test and establish the medical gas networks and their components with considerate environmental conditions, health and safety, manufacturability and sustainability.	• Interactive lectures & examples, • Tutorials, • Videos demonstrations, • Presentation/seminar, • Interactive class discussions, • Case studies, • Directed self- study, • Problem based learning, • Team work (cooperative	• Written tests (mid and final terms and quizzes), • Short reports, • Coursework activities assessment, • Presentations.

	learning), • Field visits/training,	
b2 Categorize the medical gas systems based on their specifications and characteristics.	• Interactive lectures & examples, • Tutorials, • Videos demonstrations, • Presentation/seminar, • Interactive class discussions, • Case studies, • Directed self- study, • Problem based learning, • Team work (cooperative learning), • Field visits/training,	• Written tests (mid and final terms and quizzes), • Short reports, • Coursework activities assessment, • Presentations.

(C) Alignment Course Intended Learning Outcomes of Professional and Practical Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
c1 Apply mathematical, simulation models, and IT software packages to medical gas networks effectively.	• Interactive lectures & examples, • Tutorials, • Videos demonstrations, • Presentation/seminar, • Interactive class discussions, • Case studies, • Directed self- study, • Problem based learning, • Team work (cooperative	• Written tests (mid and final terms and quizzes), • Short reports, • Coursework activities assessment, • Presentations.

	learning), • Field visits/training,	
c2 Install, operate, troubleshooting, and maintenance the medical gas networks by using rules and regulations of medical safety.	• Interactive lectures & examples, • Tutorials, • Videos demonstrations, • Presentation/seminar, • Interactive class discussions, • Case studies, • Directed self- study, • Problem based learning, • Team work (cooperative learning), • Field visits/training,	• Written tests (mid and final terms and quizzes), • Short reports, • Coursework activities assessment, • Presentations.

(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:		
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.	• Interactive lectures & examples, • Tutorials, • Videos demonstrations, • Presentation/seminar, • Interactive class discussions, • Case studies, • Directed self- study, • Problem based learning,	• Written tests (mid and final terms and quizzes), • Short reports, • Coursework activities assessment, • Presentations.

	• Team work (cooperative learning), • Field visits/training,	

IV. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	contact hours
1	**Introduction to Management Systems**	a1, a2, a3	– Introduction to management systems. – Project cycle management (PCM) method. – Total quality management (TQM) framework.	1	2
2	**Total Quality Management (TQM) Framework**	a1, a2, a3	– Introduction of total quality management (TQM) framework. – Model of total quality management (TQM) in public and private sector.	1	2
3	**5S – Principle and Kaizen Principle**	a1, a2, a3, b1,b2	– 5-S principle. – Application of 5-S principle to work environment improvement (WEI). – KAIZEN principle. – Application of KAIZEN to continuous quality improvement (CQI).	1	2
4	**Total Quality Management**	a1, a2, a3, b1,b2	– Improving the hospital,	1	2

	(TQM) Framework for Health Services using Continuous Quality Improvement (CQI) and 5-S Principles		management by the total quality management (TQM). – Quality in hospital services. – A success story on TQM-CQI-5S in hospital.		
5	**Introduction of Medical Gas Networks**	a1, a2, a3	– Introduction to medical gas network. – Medical gas networks applications.	1	2
6	**Medical Gas Networks (1)**	a1, a2, a3, b1,b2, c1, c2	– Type of medical gases. – Type of systems of medical gas networks.	1	2
7	**Medical Gas Networks (2)**	a1, a2, a3, b1,b2, c1, c2	– Precautions of medical gas networks. – Notes of medical gas networks.	1	2
8	**Mid-Term Theoretical Exam**	a1, a2, a3, b1,b2, c1, c2	- All Previous Topics	1	2
9	**Components of Medical Gas Networks**	a1, a2, a3, b1,b2, c1, c2	– Pipes lines. – Pipe valves. – Pressure regulators. – Area control boxes. – Gas outlets. – Pendants. – Filters. – Alarm systems.	1	2
10	**Plants of Medical Gas Networks (1)**	a1, a2, a3, b1,b2, c1, c2	– Oxygen plant (O2manifold). – N2O plant (N2Omanifold). – Medical air plant.	1	2

			– Vacuum plant. – Oxygen production plant.		
11	**Plants of Medical Gas Networks (2)**	a1, a2, a3, b1,b2, c1, c2	– Oxygen production plant.	1	2
12	**Report & Presentation**	a1, a2, a3, b1,b2, c1, c2, d1	– 3 to 4 students make a report and presentation about the TQM and medical gas systems.	1	2
13	**Design of Medical Gas Networks (1)**	a1, a2, a3, b1,b2, c1, c2	– International standards and codes of medical gas networks. – Calculate of number of outlets for different areas in hospital. – Calculate the flow of each medical gas.	1	2
14	**Design of Medical Gas Networks (2)**	a1, a2, a3, b1,b2, c1, c2	– Calculate the actual flow of each area and section in hospital for all medical gases. – Calculate the diameter of pipe lines. – Calculate the size of medical gases plants.	1	2
15	**Testing and Inspection of Medical Gas Networks**	a1, a2, a3, b1,b2, c1, c2	– Testing of medical gas network. – Test of pressure and flow of each outlets. – Tests and checks on the pipeline carcass. – Tests on the pipeline system. – Alarm systems test. – Recommendation of medical gas network.	1	2

16	**Final Theoretical Exam**	a1, a2, a3, b1,b2, c1, c2	- All Topics	1	2
Number of Weeks /and Units Per Semester				**16**	**32**

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V. Teaching Strategies of the Course:

- Interactive lectures & examples,
- Tutorials,
- Videos demonstrations,
- Presentation/seminar,
- Interactive class discussions,
- Case studies,
- Directed self- study,
- Problem based learning,
- Team work (cooperative learning),
- Field visits/training,

VI. Assessment Methods of the Course:

- Written tests (mid and final terms and quizzes),
- Short reports,
- Coursework activities assessment,
- Presentations.

VII. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1	Problems on the Management systems	a1, a2	2	3
2	Problems on the TQM	a1, a2	3	3
3	Problems on the 5-S & KEIZEN	a1, a2, b1, b2, b3	5	3
4	Problems on the medical gas networks	a1, a2, b1, b2, b3	9	3
5	Problems on the medical gas plants	a1, a2, b1, b2, b3, c1, c2	10	6
6	Problems on the design of medical gas networks	a1, a2, b1, b2, b3, c1, c2	13	6
7	Problems on the test of medical gas networks	a1, a2, b1, b2, b3, c1, c2	15	6
Total				30

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**	15	30	20%	a1, a2, b1, b2, b3, c1, c2
2	**Quiz 1**	6	10	3.33%	a1, a2, b1, b2, b3
3	**Midterm Theoretical Exam**	8	20	13.33%	a1, a2, b1, b2, b3
4	**Quiz 2**	11	5	3.33%	a1, a2, b1, b2, b3, c1, c2

5	**Report & Presentation**	12	15	10%	a1, a2, b1, b2, b3, c1, c2, d1
6	**Final Theoretical Exam**	16	70	46.67%	a1, a2, b1, b2, b3, c1, c2
Total			150	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- Handa Yujiro, Strategic, 2008, **Management and Continuous Quality Improvement (CQI) using 5 – S principle**,
2- 1997, **HTM 2022 Medical Gas Pipeline Systems Design, Installation, Validation and Verification**, Health Technical Memorandum 2022

2- Essential References.

1- Tauseef Aized, 2012, **Total Quality Management and Six Sigma**, InTech.
2- Mohinder L. Nayyar, 2000,**Piping Handbook**, sixth edition, McGraw-Hill.

3- Electronic Materials and Web Sites *etc*.

Websites:

1- Medical gas systems.
http://www.chhealthcare.com/blog

Journals:

2- International Journal of productivity and quality management
http://www.inderscience.com/

3- International Medical Journal – Multidisciplinary Journal.
https://www.ijsrm.in/

Other Web Sources:

4- British compressed gases association
http://www.bcga.uk/

X. Course Policies:	
1	**Class Attendance:** A student should attend not less than 75 % of total hours of the subject; otherwise he/she will not be able to take the exam and will be considered as exam failure. If the student is absent due to illness, he/she should bring a proof statement from university Clinic. If the absent is more than 25% of a course total contact hours, student will be required to retake the entire course again.
2	**Tardy:** For late in attending the class, the student will be initially notified. If he repeated lateness in attending class, he/she will be considered as absent.
3	**Exam Attendance/Punctuality:** A student should attend the exam on time. He/she is permitted to attend an exam half one hour from exam beginning, after that he/she will not be permitted to take the exam and he/she will be considered as absent in exam
4	**Assignments & Projects**: In general one assignment is given to the students after each chapter; the student has to submit all the assignments for checking on time, mostly one week after given the assignment.
5	**Cheating**: For cheating in exam, a student will be considered as fail. In case the cheating is repeated three times during his/her study the student will be disengaged from the Faculty.
6	**Plagiarism**: Plagiarism is the attending of a student the exam of a course instead of another student. If the examination committee proofed a plagiarism of a student, he/she will be disengaged from the Faculty. The final disengagement of the student from the Faculty should be confirmed from the Student Council Affair of the university or according to the university roles.
7	**Other policies**:

	- Mobile phones are not allowed to use during a class lecture. It must be closed; **otherwise** the student will be asked to leave the lecture room. - Mobile phones are not allowed in class during the examination. - Lecture notes and assignments might be given directly to students using soft or hard copy.

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

Template for Course Plan (Syllabus)

Management Systems and Healthcare Delivery - BE375

I. Course Identification and General Information:					
1	**Course Title:**	Management Systems and Healthcare Delivery			
2	**Course Code & Number:**	BE375			
3	**Credit Hours:**	**Credit Hours**	**Theory Hours**		**Lab. Hours**
			Lecture	**Exercise**	
		3	2	2	--
4	**Study Level/ Semester at which this Course is offered:**	4th Level / 2nd Semester			
5	**Pre –Requisite (if any):**	Clinical Engineering (BE366)			
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 Engineering			
10	**Prepared by:**	Dr. Mohammed Al-olofi			
11	**Reviewed by:**	Dr. Waleed Al-Talbi			
12	**Date of Approval:**				

II. Course Description:

The Management Systems and Healthcare Delivery course aims to give the student knowledge of the basic concepts of the total quality management and project cycle management in hospital, the medical gases networks, the methods applied to measure, test, evaluate and design the medical gases

network. The course includes the Project Cycle Management (PCM), Total Quality Management (TQM), 5S principle, Kaizen principle, continuous quality improvement, introduction of medical gases network, design of medical gases network, medical gases and its applications, medical gas pipe line system, components of medical gases network, medical gases plants, testing of medical gases networks.

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

A. Knowledge and Understanding: Upon successful completion of the course, students will be able to:	
a1	Describe the basic concepts, and principles of the total quality management and project cycle management methods in healthcare sector.
a2	Explain the design and development of medical gas networks in hospitals.
a3	Recognize ethical and professional responsibilities in biomedical engineering situations and make informed judgments, considering the impact of biomedical engineering solutions in global, economic, environmental, and societal contexts.
B. Intellectual Skills: Upon successful completion of the course, students will be able to:	
b1	Design, test and establish the medical gas networks and their components with considerate environmental conditions, health and safety, manufacturability and sustainability.
b2	Categorize the medical gas systems based on their specifications and characteristics.
C. Professional and Practical Skills: Upon successful completion of the course, students will be able to:	
c1	Apply mathematical, simulation models, and IT software packages to medical gas networks effectively.
c2	Install, operate, troubleshooting, and maintenance the medical gas networks by using rules and regulations of medical safety.
D. Transferable Skills: Upon successful completion of the course, students will be able to:	
d1	Function effectively in different work environments as an individual, and as a member or

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

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
1	**Introduction to Management Systems**	– Introduction to management systems. – Project cycle management (PCM) method. – Total quality management (TQM) framework.	1	2
2	**Total Quality Management (TQM) Framework**	– Introduction of total quality management (TQM) framework. – Model of total quality management (TQM) in public and private sector.	1	2
3	**5S – Principle and Kaizen Principle**	– 5-S principle. – Application of 5-S principle to work environment improvement (WEI). – KAIZEN principle. – Application of KAIZEN to continuous quality improvement (CQI).	1	2
4	**Total Quality Management (TQM) Framework for Health Services using Continuous**	– Improving the hospital, management by the total quality management (TQM). – Quality in hospital services.	1	2

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
	Quality Improvement (CQI) and 5-S Principles	– A success story on TQM-CQI-5S in hospital.		
5	**Introduction of Medical Gas Networks**	– Introduction to medical gas network. – Medical gas networks applications.	1	2
6	**Medical Gas Networks (1)**	– Type of medical gases. – Type of systems of medical gas networks.	1	2
7	**Medical Gas Networks (2)**	– Precautions of medical gas networks. – Notes of medical gas networks.	1	2
8	**Mid-Term Theoretical Exam**	- All Previous Topics	1	2
9	**Components of Medical Gas Networks**	– Pipes lines. – Pipe valves. – Pressure regulators. – Area control boxes. – Gas outlets. – Pendants. – Filters. – Alarm systems.	1	2
10	**Plants of Medical Gas Networks (1)**	– Oxygen plant (O2manifold).	1	2

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
		– N2O plant (N2Omanifold). – Medical air plant. – Vacuum plant. – Oxygen production plant.		
11	**Plants of Medical Gas Networks (2)**	– Oxygen production plant.	1	2
12	**Report & Presentation**	– 3 to 4 students make a report and presentation about the TQM and medical gas systems.	1	2
13	**Design of Medical Gas Networks (1)**	– International standards and codes of medical gas networks. – Calculate of number of outlets for different areas in hospital. – Calculate the flow of each medical gas.	1	2
14	**Design of Medical Gas Networks (2)**	– Calculate the actual flow of each area and section in hospital for all medical gases. – Calculate the diameter of pipe lines. – Calculate the size of medical gases plants.	1	2
15	**Testing and Inspection of Medical Gas Networks**	– Testing of medical gas network. – Test of pressure and flow of each outlets. – Tests and checks on the pipeline	1	2

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
		carcass. – Tests on the pipeline system. – Alarm systems test. – Recommendation of medical gas network.		
16	**Final Theoretical Exam**	- All Topics	1	2
Number of Weeks /and Units Per Semester			**16**	**32**

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V. Teaching Strategies of the Course:

- Interactive lectures & examples,
- Tutorials,
- Videos demonstrations,
- Presentation/seminar,
- Interactive class discussions,
- Case studies,
- Directed self- study,
- Problem based learning,
- Team work (cooperative learning),
- Field visits/training,

VI. Assessment Methods of the Course:

- Written tests (mid and final terms and quizzes),
- Short reports,
- Coursework activities assessment,
- Presentations.

VII. Assignments:

No.	Assignments	Week Due	Mark
1	Problems on the Management systems	2	3
2	Problems on the TQM	3	3
3	Problems on the 5-S & KEIZEN	5	3
4	Problems on the medical gas networks	9	3
5	Problems on the medical gas plants	10	6
6	Problems on the design of medical gas networks	13	6
7	Problems on the test of medical gas networks	15	6
Total			**30**

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

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment
1	**Assignments**	15	30	20%
2	**Quiz 1**	6	10	3.33%

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

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment
3	**Midterm Theoretical Exam**	8	20	13.33%
4	**Quiz 2**	11	5	3.33%
5	**Report & Presentation**	12	15	10%
6	**Final Theoretical Exam**	16	70	46.67%
Total			**150**	**100%**

IX. Learning Resources:

- *Written in the following order:*

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

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3- International Medical Journal – Multidisciplinary Journal.

IX. Learning Resources:

https://www.ijsrm.in/

Other Web Sources:

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