



## Course Specification of Sanitary Engineering-1

I. Course Identification and General Information:					
1	Course Title:	Sanitary Engineering-I			
2	Course Code & Number:	CE 308			
3	Credit hours:	C.H			Credit Hours
		Th.	Tu.	Pr.	Tr.
		2	2		
4	Study level/ semester at which this course is offered:	4 <sup>th</sup> Level/ 2 <sup>nd</sup> semester			
5	Pre –requisite (if any):	Hydraulics, Hydrology,			
6	Co –requisite (if any):				
7	Program (s) in which the course is offered:	Civil engineering			
8	Language of teaching the course:	English+ Arabic			
9	Location of teaching the course:	Classroom+ lab			
10	Prepared By:	Prof. Fadhl Al-Nozaily			
11	Date of Approval				

II. Course Description:
<p>This course deals with basic topics in drinking water quantity, quality, distribution networks and drinking water treatment. It will mainly include the following topics:</p> <p>The course seeks to provide basics information about water situation/scarcity and integrated water resources management (IWRM) in Yemen, the region and the world, quality, quantity, design, operation and maintenance of water distribution networks, water pumping stations, Non-Revenue Water (NRW), water conservation, water treatment processes/ units/ plants.</p>

Prepared by    Head of Department    Quality Assurance Unit    Dean of the Faculty    Academic Development Center & Quality Assurance

Rector of Sana'a University



III. Course Intended learning outcomes (CILOs) of the course		Referenced PILOs
a.1	Describe the role of sanitary Engineer in managing water availability/ scarcity and water resources from IWRM point of view	A2 (A)
a.2	show the characteristics /standard of drinking water quality.	A2 (A)
a.3	Describe the project management of water distribution from the view of IWRM	A4 (A)
b.1	Choose the knowledge of mathematics for estimating water availability and water consumption and population forecasting; Non-Revenue Water (NRW)	B2 (E)
b.2	Consider the drinking water quality and quantity in the region, world and compare with Yemen case	B3 (A)
b.3	Validate the water quality to the WHO/Yemeni standard.	B4 (E)
c.1	Design of water distribution networks, pumping stations, force-mains	C2 (E)
c.2	Apply software such as Excel program and software such as EPANET/ WATERCAD to design water distribution networks	C3 (A)
c.3	Design the water treatment process/unit	C2 (E)
c.4	Use laboratory and field equipment to analyze water quality, record, analyze	C1 (E)
d.1	Communicate effectively within multi-disciplinary teams and act professionally in design and supervision of water projects in order to be able to lead and supervise a group of designers and site technicians.	D1 (I)

(A) Alignment Course Intended Learning Outcomes of Knowledge and Understanding to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
<b>a.1-</b> Describe the role of sanitary Engineer in managing water availability/ scarcity and water resources from IWRM point of view	Lecture Multimedia Presentations	Written assignment Quiz Midterm exam

Prepared by Head of Department    Quality Assurance Unit    Dean of the Faculty    Academic Development Center & Quality Assurance

Rector of Sana'a University



a.2- Show the standard of drinking water quality.		Final exam
a.3- Describe the project Management of water distribution from the view of IWRM.		Student Presentations

<b>(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:</b>		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
<b>b.1-</b> Choose the knowledge of mathematics for estimating water availability and water consumption and population forecasting.	Lecture Multimedia Presentations Tutorial	Participation- Written assignment written exam
<b>b.2-</b> Consider the drinking water quality and quantity in the region, world and compare with Yemen case.	Lecture Lab Case study- Presentations	assignment quiz lab exam
<b>b.3-</b> Validate the water quality to the WHO/Yemeni standard.	Lecture Multimedia Presentations Tutorial	Participation- Written assignment Midterm exam

<b>C Alignment Course Intended Learning Outcomes of Professional and Practical Skills to Teaching Strategies and Assessment Strategies:</b>		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
<b>c.1</b> Design of water distribution networks, pumping stations, force-mains	Lecture Tutorial Case study- Individual/group projects Presentations	Assignment Project Student Presentations Final exam



c.2- Apply software such as Excel program and software such as EPANET to design water distribution networks	Case study- Tutorial Individual/group projects Presentations	Assignment/ Project
c.3- Design the water treatment process/unit	Lecture Tutorial Case study- Individual/group projects Presentations Filed visit	Assignment Student Presentations Final exam
c.4 Use laboratory and field equipment to analyze water quality, record, analyze	Lecture Lab	Report Lab exam

<b>(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:</b>		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
d1. Communicate effectively within multi-disciplinary teams and act professionally in design and supervision of water projects in order to be able to lead and supervise a group of designers and site technicians.	Case study-lab Field visit	Project Student's presentation Assignments from internet

<b>IV. Course Content:</b>					
<b>A – Theoretical Aspect:</b>					
Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	contact hours
1	Ch.1. Water resources situation in Yemen and the world	a.1,	History of water resources; water uses; classification compared to the situation in Yemen	2	4
2	Ch. 2. Characteristics	a.2, b.3	drinking water standard compared to WHO/Yemen standard	2	4

Prepared by Head of Department    Quality Assurance Unit    Dean of the Faculty    Academic Development Center & Quality Assurance

Rector of Sana'a University



	of drinking water				
3	Ch. 3. Water uses and estimating demand	a.2, b.1, b.2	Demand estimation based on the actual and different uses of water from health point of view, defining the poverty line	1	2
4	Ch. 4. Types of Water distribution networks	a.1, a.2, c.1	apply different layout systems with gravity, pressurized or combination of water networks to the actual case at different topography and water resources situation and availability and economic analysis	2	4
5	Ch. 5. Design of water distribution networks	a.1, b.1, b.2, c1, c.2, d1	apply different equations, emphasizing on Manning equation and then design the network using Hardy cross method and later applying the EPANET software to design the water distribution networks	4	8
6	Ch. 6. Non-Revenue Water	a.1, a.2, b.1, b.2, b3, c1, d1	discussing the zoning of network for possible rationing. Discuss different causes of UFW such as technical, legal, administrative reasons.	1	2
7	Ch. 7. Water conservation	a.1, a2, a3, b.1, b.2, b3	apply different types of conservation methods starting from awareness, using different means and appliances.	1	2
8	Ch. 8. Introduction to water treatment	a.1, a2, b.1, b.2, b3, c.2, d1	investigating the pollutants in the water and accordingly select the proper treatment method to remove the pollutant with consideration to chlorination to avoid post pollution in the networks	1	2
<b>Number of Weeks /and Units Per Semester</b>				<b>14</b>	<b>28</b>

Prepared by Head of Department    Quality Assurance Unit    Dean of the Faculty    Academic Development Center & Quality Assurance

Rector of Sana'a University



<b>b - Tutorial Aspect:</b>				
Order	Tasks/ Experiments	Number of Weeks	contact hours	Learning Outcomes
1	Introduction to lab and subject topics; participation	2	4	c1, b3, c4
2	pH, EC, temperature, color, odour, taste, Turbidity Lab test,	2	4	c1, b3, c4
3	Suspended solids, Total Dissolved Solids (TDS), Dissolved Oxygen (DO)	2	4	c1, b3, c4
4	NH4, NO3, PO4,	2	4	c1, b3, c4
5	Total Hardness (TH), Chloride (Cl), Sulfate (SO4),	2	4	c1, b3, c4
6	Mg, Ca, Alk, Residual Chlorine, Fluoride, Iron, Na, K	2	4	c1, b3, c4
7	Total Coliform (TC), Faecal Coliform (FC)	2	4	c1, b3, c4
Number of Weeks /and Units Per Semester		<b>14</b>	<b>28</b>	

<b>V. Teaching strategies of the course:</b>
Lectures Multimedia Presentations Tutorial Lab Field visit Individual/group projects

<b>VI. Assignments:</b>				
No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1	water sector organization and relation to the water management	a.1	1,2	2.5
2	Field visits report and presentation	b.2	3	5
3	design examples of water distribution network; gravity and pressurized	c.1	4,5	2.5

Prepared by Head of Department    Quality Assurance Unit    Dean of the Faculty    Academic Development Center & Quality Assurance

Rector of Sana'a University



4	design example of hardy cross method with loops; open networks	c.1	6,7	2.5
5	Design project of water supply network by excel program	c.2	8,9,10	5
6	Design project of water supply network by EPANET/WATERCAD computer program	c.2	11,12	5
7	Design/ layout of zoning to minimize the NRW	b.1	13,14	2.5

## VII. Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1	Written Assignment	1-14	25	15	a.1, b.1, b.2., c.1, c.2
2	Quizzes.	one time	5	5	b.3
3	Mid-term Exam.	7 <sup>th</sup>	15	10	a2, a3., b.1, b.2, b.3, c.1
4	Final Exam.	13	75	50	a.2, a.3, b.1, b.2, b.3, c.1
5	Project	7,8	15	10	c.1
6	Lab exam		15	10	c.2, c.4
	Sum	14	150	100%	

## VIII. Learning Resources:

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

### 1- Required Textbook(s) (maximum two ).

- 1- IHE-Delft (recently named UNESCO- IHE) (1990-1991). Post graduate Diploma lecture notes on water distribution course by different authors, Delft, The Netherlands
- 2 Clark John W, Viessman Warren and Hammer Mark J (1988) Water supply and Pollution Control Published by Longman, ISBN 10: 0060468211

### 2- Essential References.





	Prof. Fadhl Al-Nozaily; Dr. Mohamed Al-Hamdi; Dr. Mansour Haidera; Dr. Adnan Muharram; Dr. Abdulwali Al-Shargabi; Eng. Musaed Aqlan. Al-Jeel Al-Jadeed publishers, Sana'a.
<b>3- Electronic Materials and Web Sites etc.</b>	
	1- web site of the local Yemen institutions such as: SWSLC: <a href="http://www.swslc-yemen.com.ye">www.swslc-yemen.com.ye</a> 2- web site of the international organizations such as: GIZ: <a href="https://www.giz.de">https://www.giz.de</a> 3- Computer program EPANET from EPA SITE internet: EPANET 2, EPA, United States 4- Environmental Protection Agency; EPA/600/R-00/057 September 2000: <a href="https://cfpub.epa.gov">https://cfpub.epa.gov</a> 5- WATER CAD program for design of water distribution <a href="http://communities.bentley.com/Wiki/view.aspx/Haestad_Methods_Product_Tech_Notes_And_FAQs">http://communities.bentley.com/Wiki/view.aspx/Haestad_Methods_Product_Tech_Notes_And_FAQs</a>

<b>IX. Course Policies:</b>	
1	<b>Class Attendance: min 75%</b> - The students should have more than 75% of attendance according to rules and regulations of the faculty.
2	<b>Tardy:</b> - The students should respect the timing of attending the lectures. They should attend with 1 minute from starting of the lecture.
3	<b>Exam Attendance/Punctuality:</b> - The student should attend the exam on time. The punctuality should be implemented according to rules and regulations of the faculty for midterm exam and final exam.
4	<b>Assignments &amp; Projects:</b> - The assignment is given to the students after each chapter, the student has to submit all assignments for checking on time.
5	<b>Cheating:</b> - If any cheating occurred during the examination, the student is not allowed to continue and he/she has to face the examination committee for enquires.
6	<b>Plagiarism:</b>





	- The student will be terminated from the faculty if one student attends the exam on another behalf according to the policy, rules and regulations of the university.
7	<b>Other policies:</b> <ul style="list-style-type: none"> <li>- All the teaching materials should be kept out of the examination hall.</li> <li>- The mobile phone is not allowed.</li> <li>- There should be a respect between the student and his teacher.</li> </ul>

<b>Reviewed By</b>	<b><u>Vice Dean for Academic Affairs and Post Graduate Studies</u></b> <b><u>Dr. Tarek A. Barakat</u></b> <b><u>Dr. Mohammad Algorafi</u></b>
	<b><u>Deputy Rector for Academic Affairs Dr. Ibrahim AlMutaa</u></b> <b><u>Dr. Ahmed mujahed</u></b> <b><u>Dr. Munaser Alsubri</u></b>



## Template for Course Plan (Syllabus) of Sanitary Engineering -1

I. - Information about Faculty Member Responsible for the Course:							
Name of Faculty Member	Prof. Fadhl Ali Al-Nozaily	Office Hours					
Location& Telephone No.	Office: Sanitary/Hydraulics Building; 777381627	SAT	SUN	MON	TUE	WED	THU
E-mail	drfadhl@yahoo.com	8-10					

II. Course Identification and General Information:						
1-	Course Title:	Sanitary Engineering -I				
2-	Course Number & Code:	CE 308				
3-	Credit hours:	C.H				Credit Hours
		Th.	Tu.	Pr.	Tr.	
		2	2			3
4-	Study level/year at which this course is offered:	4 <sup>th</sup> level / 2 <sup>nd</sup> semester				
5-	Pre –requisite (if any):	Hydraulics, Hydrology,				
6-	Co –requisite (if any):					
7-	Program (s) in which the course is offered	Civil engineering				
8-	Language of teaching the course:	English+ Arabic				
9-	System of Study:	Semesters/ credit hrs				
10-	Mode of delivery:	Lecturing, lab, field visits, tutorial, projects				
11-	Location of teaching the course:	Education building b2, Sanitary Lab				



### III. Course Description:

This course deals with basic topics in drinking water quantity, quality, distribution networks and drinking water treatment. It will mainly include the following topics:

The course seeks to provide basics information about water situation/scarcity and integrated water resources management (IWRM) in Yemen, the region and the world, quality, quantity, design, operation and maintenance of water distribution networks, water pumping stations, Non-Revenue Water (NRW), water conservation, water treatment processes/ units/ plants.

### IV. Intended learning outcomes (ILOs) of the course:

Brief summary of the knowledge or skill the course is intended to develop:

1	Describe the role of sanitary Engineer in managing water availability/ scarcity and water resources from IWRM point of view
2	show the characteristics /standard of drinking water quality.
3	Describe the project management of water distribution from the view of IWRM
4	Choose the knowledge of mathematics for estimating water availability and water consumption and population forecasting; Non-Revenue Water (NRW)
5	Consider the drinking water quality and quantity in the region, world and compare with Yemen case
6	Validate the water quality to the WHO/Yemeni standard.
7	Design of water distribution networks, pumping stations, force-mains
8	Apply software such as Excel program and software such as EPANET/ WATERCAD to design water distribution networks
9	Design the water treatment process/unit
10	Use laboratory and field equipment to analyze water quality, record, analyze
11	communicate effectively within multi-disciplinary teams and act professionally in design and supervision of water projects in order to be able to lead and supervise a group of designers and site technicians.



<b>V.Course Content:</b>				
<ul style="list-style-type: none"> <li>Distribution of Semester Weekly Plan of Course Topics/Items and Activities.</li> </ul>				
<b>A – Theoretical Aspect:</b>				
<b>Order</b>	<b>Topics List</b>	<b>Sub Topics List</b>	<b>Week Due</b>	<b>Contact Hours</b>
1	Ch.1. Water resources situation in Yemen and the world	History of water resources; water uses; classification compared to the situation in Yemen	1,2	4
2	Ch. 2. Characteristics of drinking water	drinking water standard compared to WHO/Yemen standard	3,4	4
3	Ch. 3. Water uses and estimating demand	Demand estimation based on the actual and different uses of water from health point of view, defining the poverty line	5	2
4	Ch. 4. Types of Water distribution networks	apply different layout systems with gravity, pressurized or combination of water networks to the actual case at different topography and water resources situation and availability and economic analysis	6,7	4
5	Midterm Exam		8	2
6	Ch. 5. Design of water distribution networks	apply different equations, emphasizing on Manning equation and then design the network using Hardy cross method and later applying the EPANET software to design the water distribution networks	9,10,11,12	8
7	Ch. 6. Non-Revenue Water	discussing the zoning of network for possible rationing. Discuss different causes of UFW such as	13	2



		technical, legal, administrative reasons.		
8	Ch. 7. Water conservation	apply different types of conservation methods starting from awareness, using different means and appliances.	14	2
9	Ch. 8. Introduction to water treatment	investigating the pollutants in the water and accordingly select the proper treatment method to remove the pollutant with consideration to chlorination to avoid post pollution in the networks	15	2
10	Final Exam		16	2
<b>Number of Weeks /and Units Per Semester</b>			<b>16</b>	<b>32</b>

<b>b - Tutorial Aspect:</b>			
Order	Topics List	Week Due	Contact Hours
1	Introduction to lab and subject topics; participation	1,2	4
2	pH, EC, temperature, color, odor, taste, Turbidity Lab test,	3,4	4
3	Suspended solids, Total Dissolved Solids (TDS), Dissolved Oxygen (DO)	5,6	4
4	NH <sub>4</sub> , NO <sub>3</sub> , PO <sub>4</sub> ,	7,8	4
5	Total Hardness (TH), Chloride (Cl), Sulfate (SO <sub>4</sub> ),	9,10	4
6	Mg, Ca, Alk., Residual Chlorine, Fluoride, Iron, Na, K	11,12	4

Prepared by Head of Department    Quality Assurance Unit    Dean of the Faculty    Academic Development Center & Quality Assurance

Rector of Sana'a University



7	Total Coliform (TC), Fecal Coliform (FC)	13,14	4
<b>Number of Weeks /and Units Per Semester</b>		<b>14</b>	<b>28</b>

<b>VI. Teaching strategies of the course:</b>	
Lectures Multimedia Presentations Tutorial Lab Filed visit Individual/group projects	

<b>VII. Assignments:</b>				
No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1	water sector organization and relation to the water management	a.1.	1,2	2.5
2	Field visits report and presentation	b.2	3	5
3	design examples of water distribution network; gravity and pressurized	c.1	4,5	2.5
4	design example of hardy cross method with loops; open networks	c.1	6,7	2.5
5	Design project of water supply network by excel program	c.2	8,9,10	5
6	Design project of water supply network by EPANET computer program	c.2	11,12	5
7	Design/ layout of zoning to minimize the UFW	b.1	13,14	2.5

Prepared by Head of Department    Quality Assurance Unit    Dean of the Faculty    Academic Development  
Center & Quality Assurance

Rector of Sana'a University



VIII. Schedule of Assessment Tasks for Students During the Semester:				
Assessment	Type of Assessment Tasks	Week Due	Mark	Proportion of Final Assessment
1	Written assignment	1-14	25	15
2	Quizzes.	one time	5	5
3	Mid-term exam.	7 <sup>th</sup>	15	10
4	Final-exam.	13	90	60
5	Project	7,8	15	10
	Sum	14	150	100%

I. Learning Resources:
Written in the following order: (Author – Year of publication – Title – Edition – Place of publication – Publisher).
1- Required Textbook(s) (maximum two ).
1- IHE-Delft (recently named UNESCO- IHE) (1990-1991). Post graduate Diploma lecture notes on water distribution course by different authors, Delft, The Netherlands 2 Clark John W, Viessman Warren and Hammer Mark J (1988) Water supply and Pollution Control Published by Longman, ISBN 10: 0060468211
2- Essential References.
Prof. Fadhl Al-Nozaily; Dr. Mohamed Al-Hamdi; Dr. Mansour Haidera; Dr. Adnan Muharram; Dr. Abdulwali Al-Shargabi; Eng. Musaed Aqlan. Al-Jeel Al-Jadeed publishers, Sana'a.
3- Electronic Materials and Web Sites etc.
1- web site of the local Yemen institutions such as: SWSLC: <a href="http://www.swslc-yemen.com.ye">www.swslc-yemen.com.ye</a> 2-web site of the international organizations such as: GIZ: <a href="https://www.giz.de">https://www.giz.de</a> 3- Computer program EPANET from EPA SITE internet: EPANET 2, EPA, United States Environmental Protection Agency; EPA/600/R-00/057 September 2000: <a href="https://cfpub.epa.gov">https://cfpub.epa.gov</a>





I. Course Policies:	
1	<b>Class Attendance: min 75%</b> - The students should have more than 75% of attendance according to rules and regulations of the faculty.
2	<b>Tardy:</b> - The students should respect the timing of attending the lectures. They should attend with 1 minute from starting of the lecture.
3	<b>Exam Attendance/Punctuality:</b> - The student should attend the exam on time. The punctuality should be implemented according to rules and regulations of the faculty for midterm exam and final exam.
4	<b>Assignments &amp; Projects:</b> - The assignment is given to the students after each chapter, the student has to submit all assignments for checking on time.
5	<b>Cheating:</b> -If any cheating occurred during the examination, the student is not allowed to continue and he/she has to face the examination committee for enquires.
6	<b>Plagiarism:</b> - The student will be terminated from the faculty if one student attends the exam on another behalf according to the policy, rules and regulations of the university.
7	<b>Other policies:</b> - All the teaching materials should be kept out of the examination hall. - The mobile phone is not allowed. - There should be a respect between the student and his teacher.