



## 63-Course Specification of Reinforced Concrete 4

I. Course Identification and General Information:					
1	Course Title:	<i>Reinforced Concrete 4</i>			
2	Course Code & Number:	CE 409			
3	Credit hours:	C.H			Credit Hours
		Th.	Tu.	Pr.	Tr.
		1	2		
4	Study level/ semester at which this course is offered:	4th year level / 1st semester			
5	Pre –requisite (if any):	1. Reinforced Concrete 2 (CE 209) 2. Structural Analysis 2 CE 208)			
6	Co –requisite (if any):	Non			
8	Program (s) in which the course is offered:	Civil Engineering			
9	Language of teaching the course:	English+ Arabic			
10	Location of teaching the course:	Class room			
11	Prepared By:	Prof. Dr. Ahmed Hasan Alwathaf			
12	Date of Approval				

II. Course Description:
<p>This course provides students with an understanding of the behavior of reinforced concrete tanks under hydrostatic pressure and other loads, and the ability to design and proportion elements of the tanks considering the design criteria such as strength, stability, serviceability, and economy. Different types of tanks are covered in the course, such as: Rectangular Tanks, Circular Tanks, Elevated Tanks, and Ground and Under Ground Tanks. Design procedures are based on the Allowable Stress Design Method for Structural Concrete provided by ECOP and ACI Code. Theoretical analysis and Aided Tables and Charts are presented for structural members based on Theory of Elasticity. The mechanics underlying the code design equations are explained as well as their application to practical design problems.</p>

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<b>III. Course Intended learning outcomes (CILOs) of the course</b>		<b>Reference d PILOs</b>
<b>a.1</b>	Describe the governing relationships of structural systems of tanks and their components under different types of effects.	<b>A1</b>
<b>a.2</b>	Describe design procedures of reinforced concrete tanks starting from the first step of proposing the initial dimensions of the system to the last step of calculating reinforcements and preparing design detailing.	<b>A3</b>
<b>a.3</b>	Show the role of the structural professional engineer in safety and serviceability of tanks, and traditional practices of structural engineering.	<b>A4</b>
<b>b.1</b>	Demonstrate competence in structural design of tanks through applying particular elaborated operations including selection of efficient structural system, calculation of imposed loads, structural analyzing, determination of critical sections, and calculation of appropriate cross sections and reinforcements.	<b>B1</b>
<b>b.2</b>	Choose appropriate structural modeling and analysis methods and also Aided Tables and Charts for different types of tanks.	<b>B2</b>
<b>b.3</b>	Demonstrate proficiency in the evaluation and integration of information and processes in tanks design work including proposing and analyzing different alternatives, identifying interaction between different elements, evaluating and comparing different structural systems, address broad contextual constraints.	<b>B3</b>
<b>b.4</b>	Consider the economic and effect of environment on designing of reinforced concrete tanks.	<b>B4</b>
<b>c.1</b>	Conduct full design calculations for a real reinforced concrete tank based on the Code of practice provisions in which all the components are proportioned to fulfill structural requirements.	<b>C2</b>
<b>c.2</b>	Apply a systematic approach to reach the desired solution to a problem including problem definition, concept, planning, design, and development.	<b>C3</b>
<b>d.1</b>	Prepare clear design reports and design detailing for the reinforced concrete designs.	<b>D1</b>

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<b>(A) Alignment Course Intended Learning Outcomes of Knowledge and Understanding to Teaching Strategies and Assessment Strategies:</b>		
<b>Course Intended Learning Outcomes</b>	<b>Teaching strategies</b>	<b>Assessment Strategies</b>
<b>a1.</b> Describe the governing relationships of structural systems of tanks and their components under different types of effects.	Lecture Tutorial- Problem solving Directed self-study	Written exam Written assignment
<b>a2.</b> Describe design procedures of reinforced concrete tanks starting from the first step of proposing the initial dimensions of the system to the last step of calculating reinforcements and preparing design detailing.	Lecture Tutorial- Problem solving Directed self-study Course project	Written exam Written assignment Project evaluation
<b>a3.</b> Show the role of the structural professional engineer in safety and serviceability of tanks, and traditional practices of structural engineering.	Lecture Tutorial- Problem solving Directed self-study Course project	Written exam Written assignment Project evaluation

<b>(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:</b>		
<b>Course Intended Learning Outcomes</b>	<b>Teaching strategies</b>	<b>Assessment Strategies</b>
<b>b1.</b> Demonstrate competence in structural design of tanks through applying particular elaborated operations including selection of efficient structural system, calculation of imposed loads, structural analyzing, determination of critical sections, and calculation of appropriate cross sections and reinforcements.	Lecture Tutorial- Problem solving Directed self-study Course project	Written exam Written assignment Project evaluation
<b>b2.</b> Choose appropriate structural modeling and analysis methods and also Aided Tables and Charts for different types of tanks.	Lecture Tutorial- Problem solving Directed self-study Course project	Written exam Written assignment Project evaluation

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<b>b3.</b> Demonstrate proficiency in the evaluation and integration of information and processes in tanks design work including proposing and analyzing different alternatives, identifying interaction between different elements, evaluating and comparing different structural systems, address broad contextual constraints.	Lecture Tutorial- Problem solving Directed self-study Course project	Written exam Written assignment Project evaluation
<b>b4.</b> Consider the economic and effect of environment on designing of reinforced concrete tanks.	Lecture Tutorial- Problem solving Directed self-study Course project	Written exam Written assignment Project evaluation

**(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
<b>c1.</b> Conduct full design calculations for a real reinforced concrete tank based on the Code of practice provisions in which all the components are proportioned to fulfill structural requirements.	Lecture Tutorial- Problem solving Directed self-study Course project	Written exam Written assignment Project evaluation
<b>c2.</b> Apply a systematic approach to reach the desired solution to a problem including problem definition, concept, planning, design, and development.	Lecture Tutorial- Problem solving Directed self-study Course project	Written exam Written assignment Project evaluation

**(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:**

Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
<b>d1.</b> Prepare clear design reports and design detailing for the reinforced concrete designs.	Lecture Tutorial- Problem solving Directed self-study	Written exam Written assignment Project evaluation

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	Course project	
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IV. Course Content:					
A – Theoretical Aspect:					
Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	contact hours
1	Introduction to RC tanks	a1, a2, a3, b1, b2, b3,b4	Production of Water Tight Concrete, Design Requirements, Design Methods, Allowable Stresses for Concrete and Steel.	1	1
2	Joints of Tanks	a1, a2, a3, b1, b2, b3,b4	Wall/Floor Joints, Expansion and Contraction Joints	1	1
3	Design of Sections	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1	Axial Tension/Effect of shrinkage, Simple Bending, Eccentric Tension or Compression.	1	1
4	Design of Rectangular Tanks	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1	Deep Tanks Shallow Tanks Medium Tanks Wall/Floor Interaction	4	4
5	Water Tank Design Project	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1	Efficient structural layout, loads and boundaries, structural modeling and analysis, members proportioning, detailing and design report.	1	1
6	Design of Circular Tanks	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1	Theory of Reissner and Lewy Simplified Method Portland Cement Association Tables.	3	3
7	Elevated Tanks	a1, a2, a3 ,b1, b2,	Analysis of elevated tanks components and tower,	1	1

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IV. Course Content:					
A – Theoretical Aspect:					
Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	contact hours
		b3,b4, c1, c2,d1	stability check (overturning and sliding)		
8	Design of Ground Tanks	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1	Tanks on soft weak soils, Tanks on rigid foundations, Tanks on compressible soils, Theory of beams on elastic foundation.	1	1
9	Design of Underground Tanks	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1	Soil and surcharge lateral pressure, Case of loadings study, stability check (uplift)	1	1
Number of Weeks /and Units Per Semester				14	14

B - Tutorial Aspect:				
Order	Tasks/ Experiments	Number of Weeks	contact hours	Learning Outcomes
1	Design method and review for the ECOP Code provisions.	1	2	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1
2	Design of Sections	1	2	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1
3	Design of Rectangular Tanks-deep	1	2	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1
4	Design of Rectangular Tanks-shallow	1	2	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1
5	Design of Rectangular Tanks-medium	1	2	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1
6	Design of Rectangular Tanks-Wall/Floor Interaction	2	4	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1

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### B - Tutorial Aspect:

Order	Tasks/ Experiments	Number of Weeks	contact hours	Learning Outcomes
7	Discussion on structural design of course project	1	2	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1
8	Design of Circular Tanks	1	2	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1
9	Design of Elevated Tanks	1	2	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1
10	Design of Ground Tanks	1	2	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1
11	Design of Under Ground Tanks	2	4	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1
12	Evaluation of course project	1	2	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1
Number of Weeks /and Units Per Semester		14	28	

### V. Teaching strategies of the course:

Lecture  
Tutorial- Problem solving  
Directed self-study  
Course project

### VI. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1	Assignment 1 (design of rectangular tank 1)	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1	4	0.5
2	Assignment 2 (design of rectangular tank 2)	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1	7	0.5
3	Assignment 3 (design of circular tank)	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1	10	1
4	Assignment 4 (design of ground tank)	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1	13	1

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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	4,7,10,13	3	3%	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1
2	Quizzes	Two times randomly	2	2%	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1
3	Mid-term exam	8	20	20%	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1
4	Course Project	15	5	5%	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1
5	Final-exam	16	70	70%	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1
<b>Total</b>			<b>100</b>	<b>100%</b>	

VIII. Learning Resources:	
<ul style="list-style-type: none"> <li>Written in the following order: (Author - Year of publication – Title – Edition – Place of publication – Publisher).</li> </ul>	
<b>1- Required Textbook(s) (maximum two ).</b>	
	1. M. Hillal (1988). Theory and Design of Reinforced Concrete Tanks, Mrcou & Co., Cairo. Egypt.
<b>2- Essential References.</b>	
	1. Egyptian Code Committee, Egyptian Code of Practice, 1999, Cairo, Egypt. 2. ACI 318-11 (2011). Building Code Requirement for Structural Concrete, American Concrete Institute, ACI, USA. 3. ASCE/SEI 7-10 (2010). Minimum Design Loads for Buildings and Other Structures, American Society of Civil Engineers, ASCE, USA.
<b>3- Electronic Materials and Web Sites etc.</b>	
	- Non

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<b>IX. Course Policies:</b>	
<b>1</b>	<b>Class Attendance:</b> The students should have more than 75 % of attendance according to rules and regulations of the faculty.
<b>2</b>	<b>Tardy:</b> The students should respect the timing of attending the lectures. They should attend within 10 minutes from starting of the lecture.
<b>3</b>	<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.
<b>4</b>	<b>Assignments &amp; Projects:</b> The assignment is given to the students after each chapter, the student has to submit all the assignments for checking on time.
<b>5</b>	<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 <b>enquiries</b> .
<b>6</b>	<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.
<b>7</b>	<b>Other policies:</b> <ul style="list-style-type: none"> <li>All the teaching materials should be kept out 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>

## **Course Plan (Syllabus) of Reinforced Concrete 4**

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I. Information about Faculty Member Responsible for the Course:						
Name of Faculty Member	Prof. Dr. Ahmed Hasan Alwathaf		Office Hours			
Location & Telephone No.			SAT	SUN	MO N	TU E
E-mail						

II. Course Identification and General Information:					
1-	Course Title:	Reinforced Concrete 4			
2-	Course Number & Code:	CE 409			
3-	Credit hours:	C.H			Credit Hours
		Th.	Tu.	Pr.	Tr.
		1	2		
4-	Study level/year at which this course is offered:	4th year level / 1st semester			
5-	Pre –requisite (if any):	1. Reinforced Concrete 2 (CE 209) 2. Structural Analysis 2 CE 208)			
6-	Co –requisite (if any):	Non			
7-	Program (s) in which the course is offered	Civil Engineering			
8-	Language of teaching the course:	English+ Arabic			
9-	System of Study:	Regular			
10-	Mode of delivery:	Lecture + Tutorial			
11-	Location of teaching the course:	Class room			

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### III. Course Description:

This course provides students with an understanding of the behavior of reinforced concrete tanks under hydrostatic pressure and other loads, and the ability to design and proportion elements of the tanks considering the design criteria such as strength, stability, serviceability, and economy. Different types of tanks are covered in the course, such as: Rectangular Tanks, Circular Tanks, Elevated Tanks, and Ground and Under Ground Tanks. Design procedures are based on the Allowable Stress Design Method for Structural Concrete provided by ECOP and ACI Code. Theoretical analysis and Aided Tables and Charts are presented for structural members based on Theory of Elasticity. The mechanics underlying the code design equations are explained as well as their application to practical design problems.

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

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

- a.1** Describe the governing relationships of structural systems of tanks and their components under different types of effects.
- a.2** Describe design procedures of reinforced concrete tanks starting from the first step of proposing the initial dimensions of the system to the last step of calculating reinforcements and preparing design detailing.
- a.3** Show the role of the structural professional engineer in safety and serviceability of tanks, and traditional practices of structural engineering.
- b.1** Demonstrate competence in structural design of tanks through applying particular elaborated operations including selection of efficient structural system, calculation of imposed loads, structural analyzing, determination of critical sections, and calculation of appropriate cross sections and reinforcements.
- b.2** Choose appropriate structural modeling and analysis methods and also Aided Tables and Charts for different types of tanks.
- b.3** Demonstrate proficiency in the evaluation and integration of information and processes in tanks design work including proposing and analyzing different alternatives, identifying interaction between different elements, evaluating and comparing different structural systems, address broad contextual constraints.
- b.4** Consider the economic and effect of environment on designing of reinforced concrete tanks.
- c.1** Conduct full design calculations for a real reinforced concrete tank based on the Code of practice provisions in which all the components are proportioned to fulfill structural requirements.

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- c.2** Apply a systematic approach to reach the desired solution to a problem including problem definition, concept, planning, design, and development.
- d.1** Prepare clear design reports and design detailing for the reinforced concrete designs.

## V. Course Content:

- Distribution of Semester Weekly Plan Of course Topics/Items and Activities.

### A – Theoretical Aspect:

Order	Topics List	Sub Topics List	Week Due	Contact Hours
1	Introduction to RC tanks	Production of Water Tight Concrete, Design Requirements, Design Methods, Allowable Stresses for Concrete and Steel.	1	1
2	Joints of Tanks	Wall/Floor Joints, Expansion and Contraction Joints	2	1
3	Design of Sections	Axial Tension/Effect of shrinkage, Simple Bending, Eccentric Tension or Compression.	3	1
4	Design of Rectangular Tanks	Deep Tanks Shallow Tanks Medium Tanks Wall/Floor Interaction	4,5,6,7	4
5	Midterm exam		8	1
6	Water Tank Design Project	Efficient structural layout, loads and boundaries, structural modeling and analysis, members proportioning, detailing and design report.	9	1
7	Design of Circular Tanks	Theory of Reissner and Lewy Simplified Method Portland Cement Association Tables.	10,11,12	3

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8	Elevated Tanks	Analysis of elevated tanks components and tower, stability check (overturning and sliding)	13	1
9	Design of Ground Tanks	Tanks on soft weak soils, Tanks on rigid foundations, Tanks on compressible soils, Theory of beams on elastic foundation.	14	1
10	Design of Underground Tanks	Soil and surcharge lateral pressure, Case of loadings study, stability check (uplift)	15	1
11	Final exam		16	1
<b>Number of Weeks /and Units Per Semester</b>			<b>16</b>	<b>16</b>

<b>B – Tutorial Aspect:</b>			
Order	Topics List	Week Due	Contact Hours
1	Design method and review for the ECOP Code provisions.	1	2
2	Design of Sections	2	2
3	Design of Rectangular Tanks-deep	3	2
4	Design of Rectangular Tanks-shallow	4	2
5	Design of Rectangular Tanks-medium	5	2
6	Design of Rectangular Tanks- Wall/Floor Interaction	6,7	4
7	Discussion on structural design of course project	8	2
8	Design of Circular Tanks	9	2
9	Design of Elevated Tanks	10	2
10	Design of Ground Tanks	11	2
11	Design of Under Ground Tanks	12,13	4
12	Evaluation of course project	14	2

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Number of Weeks /and Units Per Semester	14	28
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## VI. Teaching strategies of the course:

Lecture  
Tutorial- Problem solving  
Directed self-study  
Course project

## VII. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1	Assignment 1 (design of rectangular tank 1)	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1	4	0.5
2	Assignment 2 (design of rectangular tank 2)	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1	7	0.5
3	Assignment 3 (design of circular tank)	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1	10	1
4	Assignment 4 (design of ground tank)	a1, a2, a3 ,b1, b2, b3,b4, c1, c2,d1	13	1

## 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	4,7,10,13	3	3%
2	Quizzes	Two times randomly	2	2%
3	Mid-term exam	8	20	20%
4	Course Project	15	5	5%
5	Final-exam	16	70	70%
	<b>Total</b>	<b>100</b>	<b>100%</b>	

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## IX. Learning Resources:

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

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

2. M. Hillal (1988). Theory and Design of Reinforced Concrete Tanks, Mrcou & Co., Cairo. Egypt.

### 2- Essential References.

4. Egyptian Code Committee, Egyptian Code of Practice, 1999, Cairo, Egypt.
5. ACI 318-11 (2011). Building Code Requirement for Structural Concrete, American Concrete Institute, ACI, USA.
6. ASCE/SEI 7-10 (2010). Minimum Design Loads for Buildings and Other Structures, American Society of Civil Engineers, ASCE, USA.

### 3- Electronic Materials and Web Sites etc.

- Non

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## X. Course Policies:

Unless otherwise stated, the normal course administration policies and rules of the Faculty of ----- apply. For the policy, see: -----

1	<b>Class Attendance:</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 within 10 minutes 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 the 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 enquiries.
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 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>

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