



## Course Specifications

<b>Course Title:</b>	Soil Stabilization and Site Improvement
<b>Course Code:</b>	CE 444
<b>Program:</b>	B.Sc. in Civil Engineering
<b>Department:</b>	Civil Engineering
<b>College:</b>	Jubail University College
<b>Institution:</b>	Jubail University College

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## A. Course Identification

<b>1. Credit hours:</b>	3
<b>2. Course type</b>	
a.	University <input type="checkbox"/> College <input type="checkbox"/> Department <input checked="" type="checkbox"/> Others <input type="checkbox"/>
b.	Required <input type="checkbox"/> Elective <input checked="" type="checkbox"/>
<b>3. Level/year at which this course is offered:</b>	Level 6, Third Year (Elective) Level 7, Fourth Year (Elective)
<b>4. Pre-requisites for this course (if any):</b>	CE 438 Foundation of Earth structure design
<b>5. Co-requisites for this course (if any):</b>	None

### 6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	✓	100
2	Blended		
3	E-learning		
4	Correspondence		
5	Other		

### 7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
<b>Contact Hours</b>		
1	Lecture	45
2	Laboratory/Studio	
3	Tutorial	
4	Others (specify)	
	<b>Total</b>	<b>45</b>

## B. Course Objectives and Learning Outcomes

<p><b>1. Course Description</b></p> <p><i>CE 444 Soil Stabilization and Site Improvement (3-0-3)</i> <span style="float: right;"><i>Prerequisite: CE 438</i></span></p> <p>General survey of soil types and their behavior and the available techniques for improvement; shallow and deep mechanical modifications; modifications by admixtures and grouting; modifications by inclusions; the use of geosynthetic material in filtration, seepage control, separation, reinforcement and water retention; hydraulic modifications; and treatment of marginal soils. Methods of Analysis for stabilization of soils and rocks.</p>
<p><b>2. Course Main Objective</b></p> <p>The main purpose of this course is to enable the students to analyze soil types and their behavior, apply the available techniques for improvement and modification and extend the analysis, modification and stabilization of rock mass.</p>

### 3. Course Learning Outcomes

CLOs		Aligned PLOs
1	<b>Knowledge and Understanding</b>	
	N/A	
2	<b>Skills :</b>	
2.1	Discuss soil modification techniques and types of Admixture and their Effects on Soil Properties	1
2.2	Evaluate the mechanical compaction its properties and control	1
2.3	Estimate the soil densification by preloading and vertical drains	1
2.4	Analyze hydraulic modifications, slots and wells	1
2.5	Assess filtration, drainage control with geosynthetics	1
2.6	Appraise chemical modification, getting with depth	1
2.7	Estimate soil and rock reinforcement, soil confinement by formwork	1
2.8	Design of dewatering system	2
2.9	Evaluate the mechanical compaction its properties and control	1
3	<b>Values</b>	
	N/A	

### C. Course Content

No	List of Topics	Contact Hours
1	<b>Unit 1:</b> Introduction to Engineering Ground Modification 1.1 The need for Engineered ground improvement 1.2 Classification Ground Modification Techniques 1.3 Suitability, Feasibility and desirability	3
2	<b>Unit 2:</b> Shallow and Deep Mechanical Modifications 2.1 Compaction purpose and Strategies 2.2 Laboratory procedure 2.3 Shallow and deep Compaction 2.4 Dynamic Compaction 2.5 Compaction Quality Control and Assessment	3
3	<b>Unit 3:</b> Modifications by Admixtures 3.1 Types of Admixture and their Effects on Soil Properties 3.2 Admixture in Pavement 3.3 Stabilization of Industrial waste	6
4	<b>Unit 4:</b> Modifications by Grouting 4.1 Introduction to Grouting 4.2 Grout Materials 4.3 Grouting Techniques and Control 4.4 Permeation Grouting of Soil 4.5 Permeation Grouting of Rock Joint and Fissures 4.6 Hydraulic Fracturing of Soils and Rocks	6
5	<b>Unit 5:</b> Modifications by Inclusion 5.1 Evolution of soil reinforcement 5.2 Mechanical models for soil reinforcement 5.3 Flexible Geosynthetic Sheet reinforcement 5.4 Strip, Bar, Mesh, Grid-Reinforced Soil	6
6	<b>Unit 6:</b> Modifications by the use of Geosynthetic Material in Filtration, Seepage control, Separation, Reinforcement and Water Retention 6.1 Introduction to Geosynthetic	

	6.2 Water flow through soils and fabrics 6.3 Porometry 6.4 Filter action 6.5 Drainage 6.6 Screen and Baffles for Control of Sediments Transport and Water	3
7	<b>Unit 7:</b> Hydraulic Modifications 7.1 Traditional Dewatering 7.2 Open Sumps and Ditches 7.3 Gravity Flow Wells 7.4 Vacuum Dewatering Wells 7.5 Fundamentals soil/water Relationship 7.6 Design of Dewatering System	6
8	<b>Unit 8:</b> Treatment of Marginal Soils 8.1 Chemical Stabilization 8.2 Preloading with Vertical drains 8.3 Instrumentation and Performance Monitoring	3
9	<b>Unit 9:</b> Methods of Analysis for Stabilization of Soils 9.1 Properties of Compacted Cohesive soils 9.2 Properties of Compacted Cohesiveless soils 9.3 Shallow surface Compaction Control test 9.4 In situ Evaluation of deep Compaction	6
10	<b>Unit 10:</b> Methods of Analysis for Stabilization of Rocks 10.1 Ground Anchors 10.2 Rock Bolts 10.3 Soil Nailing	3
<b>Total</b>		45

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
<b>1.0</b>	<b>Knowledge and Understanding</b>		
	N/A		
<b>2.0</b>	<b>Skills</b>		
2.1	Discuss soil modification techniques and types of Admixture and their Effects on Soil Properties	Interactive learning Self-directed learning	Quiz 1
2.2	Evaluate the mechanical compaction its properties and control		Quiz I, Assignment I
2.3	Estimate the soil densification by preloading and vertical drains		Quiz I, Assignment I, midterm
2.4	Analyze hydraulic modifications, slots and wells		Quiz I, Assignment I, midterm
2.5	Assess filtration, drainage control with geosynthetics		Quiz I, Assignment I, midterm
2.6	Appraise chemical modification, getting with depth		Quiz II, Assignment II, final
2.7	Estimate soil and rock reinforcement, soil confinement by formwork		Quiz II, Assignment II, final

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
2.8	Design of dewatering system		Quiz II, Assignment II, final
2.9	Evaluate the mechanical compaction its properties and control		Quiz II, Assignment II, final
3.0	<b>Values</b>		
	N/A		

## 2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Quiz 1	4	10%
2	Assignment 1	6	10%
3	Mid-term LT	8	20%
4	Quiz 2	12	10%
5	Assignment 2	14	10%
6	Final Exam LT	17-19	40%

\*Assessment task (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice :**

- Office hours 5 hr/week; students can go in times of office hours for teacher to explain what could not be understood from the lesson.
- Students can communicate with a staff member outside the official working hours by email.
- Students are also encouraged to visit their academic advisors.

## F. Learning Resources and Facilities

### 1. Learning Resources

<b>Required Textbooks</b>	<a href="#">B. Hausmann M.R.</a> (2002). <i>Engineering Principles of Ground Modification</i> , USA: McGraw-Hill International Edition.
<b>Essential References Materials</b>	<a href="#">Moseley M.P.</a> (2007). <i>Ground Improvement</i> , Florida, USA: Blackie Academic and Professional, Boca Taton
<b>Electronic Materials</b>	None
<b>Other Learning Materials</b>	None

### 2. Facilities Required

Item	Resources
<b>Accommodation</b> (Classrooms, laboratories, demonstration rooms/labs, etc.)	Lecture rooms with a capacity of at least 25 students and fitted with multimedia projector and a computer.
<b>Technology Resources</b>	None

Item	Resources
(AV, data show, Smart Board, software, etc.)	
<b>Other Resources</b> (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	None

## G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching and assessment as per QMS-Policy-006 Feedback Survey, QMS-QAP-116 Monitoring Students' Satisfaction	Students	Indirect: Analyzing the results of the following surveys Course Evaluation Survey (CES), Program Evaluation Survey (PES), Student Experience Survey (SES)
Quality of Exam papers and Verifying Standards of Student Achievement as per QMS-Policy-004 Policy for Examinations and Marking, QMS-ACP-102 Procedure for Marking Examinations	Examination Committee	Direct: Peer review of examination papers and review or double check a minimum of three or 10% of answer papers. Verifying the entries in the Activity Mark Sheet.
Achievement of learning outcomes as per QMS-Policy-001 Course Review, QMS-CDP-106, QMS-CDP-112 Curriculum Review	Faculty	Direct: Course Report (Section B-3)
Implementation of the action plans based on previous semester as per QMS-Policy-001 Course Review, QMS-CDP-106 Procedure for Course Review, QMS-CDP-112 Procedure for Curriculum Review	Faculty	Direct and Indirect: Course report (Section G-1, G-2)
Monitoring Teaching and Learning as per QMS-Policy-005 Monitoring of Teaching and Learning	Chairperson/Program Director/Course Director	Indirect: Feedback by Chairperson/Program director/Course director. Program Delivery Record.
Effectiveness of planned Teaching Strategies QMS-Policy-001 Course Review	Faculty	Indirect: Course Report (Section B-4)
Course effectiveness and planning for improvement as per QMS-Policy-001 Course Review, QMS-CDP-106 Procedure for Course Review, QMS-CDP-112 Procedure for Curriculum Review	Faculty	Direct and Indirect: Course report (Section G-3)

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Verifying Standards of Student Achievement and Quality of Exam papers as per QMS-ACP-119 External Assessment Review	Assessment External Reviewer	Direct: Report of assessment external reviewer. Review of sample of ten or 10% of student's assessments and coursework scripts.

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)

**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify))

**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

<b>Council / Committee</b>	Civil Engineering Department Council
<b>Reference No.</b>	REG MIN-CED-10
<b>Date</b>	27-04-2020

### Appendix A Revision Details

Revision no.	DESCRIPTION	Reference MoMs			
		DC		CDC	
		Sem	#	Sem	#
1	Revision of Course Teaching Strategies and action verbs based on the comments of NCAAA reviewer	392	4	392	4
2	Course Specification Template 2018	402			