



## Course Information

<b>Course Code</b>	5627023
<b>Course Section</b>	1
<b>Course Title</b>	COASTAL & HARBOUR STRUCTURES DESIGN 2
<b>Course Credit</b>	3
<b>Course ECTS</b>	8.0
<b>Course Catalog Description</b>	Flow around and forces on cylindrical structures in steady currents, regular and random waves. Phase-averaged and phase-resolved flow features around cylinders. Diffraction effect and forces on large bodies. Basic principles of scour around marine structures: pipelines, slender and large piles. Time scale of scour and backfilling. Scour protection, field measurements of scour. Scour at edge structures, breakwaters, seawalls. Introduction and physics of liquefaction, biot equations and their solutions. Wave induced residual and momentary liquefaction around marine structures. Floatation of buried pipelines, sinking of pipelines and marine objects.
<b>Prerequisites</b>	No prerequisites
<b>Schedule</b>	Thursday , 13:40 - 16:30, K5LBCHL

## Instructor Information

<b>Name/Title</b>	Assist.Prof.Dr CÜNEYT BAYKAL
<b>Office Address</b>	Middle East Technical University, Dept. of Civil Engineering, Ocean Engineering Research Centre, K5 Building, Room 106, Dumlupinar Blv. 06800
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<b>Office Phone</b>	
<b>Office Hours</b>	Tuesday, 10:40-12:30; Thursday, 10:40-12:30

## Course Assistants

<b>Name/Title</b>	Araş.Gör. HASAN GÖKHAN GÜLER
<b>Office Address</b>	
<b>Email</b>	<a href="mailto:goguler@metu.edu.tr">goguler@metu.edu.tr</a>
<b>Office Hours</b>	

## Course Objectives

By the end of this course, the students will:

- comprehend hydrodynamics and morphodynamics around cylindrical structures such as piles and pipelines in marine environment.
- know the principle design considerations of cylindrical structures in coastal and offshore engineering.

## Course Learning Outcomes

By the end of this course, the students will be able to:

- Describe the flow features around the marine structures in case of steady currents and waves,
- Compute resulting hydrodynamic forces and design cylindrical marine structures against various combinations of the flow conditions of steady current and waves,
- Explain the underlying mechanisms of morphodynamic processes such as scour and backfilling around marines structures linking to the hydrodynamic flow features,
- Assess the engineering problems of scour around marine structures: floatation of buried pipelines, sinking of pipelines and marine objects,
- Function successfully as part of a 2-4 member team to study above given engineering design problems.

## Instructional Methods



Formal lectures, assignments, invited seminars, tutorials (individual/group), laboratories/computer applications, assigned seminars, questioning.

## Tentative Weekly Outline

Week	Topic	Relevant Reading	Assignments
1	Flow around and forces on cylinders in steady current.		
2	Flow around and forces on cylinders in oscillatory flows.		
3	Vortex shedding regimes and Streaming. Forces on a cylinder in regular waves.		
4	Forces on a cylinder in irregular waves. Breaking wave impacts on cylindrical structures.		
5	Diffraction effect. Forces on large bodies.		Homework 1
6	Basic principles of scour. Scour below pipelines.		
7	Scour below pipelines. Scour around piles - slender & large.		
8	Scour around piles - slender & large. Time scale of scour and backfilling.		
9	Scour around a group of slender piles, Scour protection, field measurements of scour.		Homework 2
10	Scour at edge structures, breakwaters, seawalls. Ship propeller scour.		
11	Introduction and physics of liquefaction, biot equations and their solutions.		
12	Liquefaction around marine structures - residual and momentary liquefaction.		
13	Momentary liquefaction. Floatation/sinking of buried pipelines.		
14	Floatation/sinking of buried pipelines. Liquefaction under standing waves. Vessel motions under installation of structures and motions of moored ships.		Homework 3

## Course Textbook(s)

Lecture Notes, CE 7023 'Coastal & Harbour Structures Design 2' by Cüneyt Baykal (will be distributed throughout the semester.)

## Course Material(s) and Reading(s)

### Material(s)

B. Mutlu Sumer & Jørgen Fredsøe. Hydrodynamics around Cylindrical Structures. Advanced Series on Ocean Engineering: Volume 26. World Scientific. 2006

B. Mutlu Sumer & Jørgen Fredsøe. The Mechanics of Scour in the Marine Environment. Advanced Series on Ocean Engineering: Volume 17. World Scientific. 2002

### Reading(s)

A.M.Yanmaz. Köprü Hidroliği. METU Press. Ankara, 2002.



B Mutlu Sumer. Liquefaction around Marine Structures. World Scientific. 2014.

## Supplementary Readings / Resources / E-Resources

### Readings

R. Whitehouse. Scour at Marine Structures: A Manual for Practical Applications. Thomas Telford Publishing. 1998.

Arthur T. Ippen. Estuary and Coastline Hydrodynamics. McGraw-Hill. 1966.

Melville, B.W., ve Coleman, S.E. Bridge Scour. Water Resources Publications, LLC, Colorado, ABD, 2000.

## Assessment of Student Learning

Assessment	Dates or deadlines
<b>Assignments:</b> The homework assignments will be designed to help you learn specific skills covered in class. Late work will be accepted with penalty, besides in excused (instructor approved) circumstances.	See weekly outline.
<b>Midterm exam:</b> In class exam will be carried out in two parts as closed-book and open-book. You may only use your calculators in the closed-book part. They cannot be shared during the exam. In the open-book part, you may use your books, lecture notes, calculators and your portable personal computers. More detailed instructions regarding format and content of the exam will be given later in the semester.	Exam date will be determined close to mid-semester.
<b>Term Project:</b> Each group/student will be assigned a specific problem of 2-dimensional flow around an object. Using any available computational fluid dynamics (CFD) tool, flow characteristics around the object will be determined (discussing the flow regime, location of separation, shedding frequency, and shedding regime in comparison with the theory), maximum resultant force (in-line and lift forces) and variation of these forces applied on the object will be found in comparison with the forces that can be computed using the formulas given in the lecture notes and finally the flow around the object will be visualized drawing streamlines and vorticities. The project will be presented first orally and then in written form at the end of the semester.	End of semester.
<b>Final exam:</b> In class exam will be carried out in two parts as closed-book and open-book. You may only use your calculators in the closed-book part. They cannot be shared during the exam. In the open-book part, you may use your books, lecture notes, calculators and your portable personal computers. More detailed instructions regarding format and content of the exam will be given later in the semester.	End of semester.

## Course Grading

Deliverable	Grade Points
Assignments	30
Midterm Examination	20
Term Project	20
Final Examination	30
<b>Total</b>	<b>100</b>

## Course Policies

### Class Attendance

You should attend all classes on a regular basis so that you can benefit from the course at maximum level. Attendance will be taken in each



class. If you are not able to attend the class due to some important reasons, then inform me certainly before the class via e-mail. Do not forget to compensate for notes, assignments, or tasks. If you are ill, report it to me officially.

#### *Class Participation*

Active participation in class is strongly encouraged and you should keep in mind that the definition of participation includes relevant contributions to class discussion, and participation in-class activities.

#### *Late Submission of Assignments*

Late assignments cannot be accepted without penalty. 10% per week late will be docked from late assignment submissions. Extensions without penalty will only be provided in the medical circumstances in case a medical note is provided within one week of the absence. Medical notes will not be accepted after the course has concluded.

#### *Make up for Exams and Assignments*

If a student misses the midterm or final exam due to an unanticipated and serious medical emergency or due to a death in the immediate family, then that student will be required to take a makeup exam administered by the Department at the officially announced day and time. It is the student's responsibility to contact the instructor.

## Information for Students with Disabilities

To obtain disability related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the ODTÜ Disability Support Office as soon as possible. If you need any accommodation for this course because of your disabling condition, please contact me. For detailed information, please visit the website of Disability Support Office: <http://engelsiz.metu.edu.tr/>

## Academic Honesty

The METU Honour Code is as follows: *"Every member of METU community adopts the following honour code as one of the core principles of academic life and strives to develop an academic environment where continuous adherence to this code is promoted. The members of the METU community are reliable, responsible and honourable people who embrace only the success and recognition they deserve, and act with integrity in their use, evaluation and presentation of facts, data and documents."*