



**TECHNICAL UNIVERSITY OF MOMBASA**

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FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT BUILDING AND CIVIL ENGINEERING

**UNIVERSITY EXAMINATION FOR:**

BSC IN CIVIL ENGINEERING

ECE 2510: HARBOUR ENGINEERING

END OF SEMESTER EXAMINATION

**SERIES: APRIL 2016**

**TIME: 2 HOURS**

**DATE: 11 May 2016**

**Instructions to Candidates**

You should have the following for this examination

*-Answer Booklet, Drawing Instruments, Scientific calculator, examination pass and student ID*

This paper consists of five questions. Attempt question ONE (Compulsory) and any other TWO questions.

**QUESTION ONE –COMPULSORY- (30 MARKS)**

A vertical breakwater constructed of concrete caisson filled with sand measures 11.0 M wide by 16.0 M high. It is constructed on a rubble mound base of thickness 4.5 m

Using the design information given below:-

- a) Calculate the wave pressure and uplift on the breakwater using Hiroi's formula  
**(10 Marks)**
- b) Determine the stability of the breakwater against:-
  - i. Sliding
  - ii. Overturning **(12 Marks)**

Design information:-

- Design wave height 5.2 M
- Design wave length 38.0 M
- Depth of water at breakwater 14.5 M
- Specific weight of water 10.0 KN/M<sup>3</sup>
- Unit weight of caisson 17.0 KN/M<sup>3</sup>
- Coefficient of friction 0.6

- c) i) State the assumptions in Nagais formula for the determination of wave pressure on vertical break waters
- ii) Sketch the pressure diagram assumed for Sainflou's simplified formula for wave pressures on vertical break waters **(8 Marks)**

**QUESTION TWO (20 MARKS)**

- a) State the factors that influence the following:- **(8 Marks)**
  - i. Channel width
  - ii. Water depth in a harbor
- b) Using a suitable sketch illustrate the components of width of a two way Channel **(6 Marks)**
- c) Sketch a small artificial harbor to show its layout and minimum dimensions **(6 Marks)**

**QUESTION THREE (20 MARKS)**

- a) State any six factors that affect the choice between solid and open berth construction **(3 Marks)**

- b) Describe the following solid berth structures using suitable sketches: - **(12 Marks)**  
i. Block wall Quay  
ii. Simple sheet pile wall Quay
- c) Define a jetty and use suitable sketch to illustrate its use with dolphins **(5 Marks)**

**QUESTION FOUR** **(20 MARKS)**

- a) Sketch and label the following harbor structures:- **(15 Marks)**  
i. Rubble sloping Breakwater  
ii. Caisson type upright Breakwater  
iii. Concrete block type upright Breakwater
- b) State any of the following:- **(5 Marks)**  
i. Four types of dredgers  
ii. Factors that determine the selection of dredger for any job

**QUESTION FIVE** **(20 MARKS)**

- a) Describe the zones of marine deterioration with respect to a sheet pile berth Structure using a suitable sketch **(6 Marks)**
- b) Define the following terms of ship characteristics:- **(6 Marks)**  
i. Displacement tonnage  
ii. Dead weight tonnage
- c) Define the important wave heights that should be recorded for design Purposes **(8 Marks)**