



THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

((A Constituent College of JKUAT)

(A Centre of Excellence)

Faculty of Engineering & Technology

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

UNIVERSITY EXAMINATION FOR DEGREE IN BACHELOR OF SCIENCE IN
CIVIL ENGINEERING

ECE 2502: STRUCTURAL DESIGN III

END OF SEMESTER EXAMINATION

SERIES: AUGUST 2012

TIME: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

- Answer Booklet
- Design Codes, Tables and Charts

This paper consists of **FIVE** questions.

Answer question **ONE (COMPULSORY)** and any other **TWO** questions

Maximum marks for each part of a question are as shown

This paper consists of **THREE** printed pages

Question One (Compulsory - 30 Marks)

- a) With the aid of labeled sketches illustrate the parts of a bridge structure and state the main functions of each part. **(13 marks)**
- b) Figure Q1 (b) below shows the plan and elevations of a reinforced concrete pier. The loads indicated are design loads at the ultimate limit state. Design the required reinforcement for the bridge pier at the ultimate limit state if the characteristic strength of reinforcement and concrete are 425N/mm^2 and 40N/mm^2 respectively.

Assume that the articulation of the deck is such that:

- i) Side sway is prevented

ii) Side sway can occur

Comment on your results.

(17 marks)

Figure Q1 (b)

Question Two (20 marks)

Figure Q2 below shows a cantilever retaining wall backfilled with granular material having a unit weight of 19KN/m^3 and an internal angle of friction of 30° . The soil bearing pressure of the soil is 120KN/m^2 , the coefficient of friction is 0.4 and the unit weight of reinforced concrete is 24KN/m^3 .

- a) Determine the factors of safety against sliding and overturning.
- b) Calculate the ground bearing pressures
- c) Design the wall reinforcement taking $f_{cu} = 35\text{N/mm}^2$ and $f_y = 460\text{N/mm}^2$ and cover to reinforcement is 35mm. Show arrangement of reinforcement in the wall. **(20 marks)**

Figure Q 2

Question Three (20 marks)

- a) Outline the main aspects that should be considered in the design of timber members subjected to bending. **(5 marks)**
- b) A timber beam whose overall span is 3150mm supports a total uniformly distributed load of 10KN including its self-weight. Select a suitable section for the beam using timber of strength class SC3. The bearing length of the beam is 150mm. The ends of the beam are held in position and the compressive edge held in line. **(15 marks)**

Question Four (20 marks)

A reinforced concrete floor subjected to an imposed load of 3.5KN/m^2 has a n overall span of 4650mm and is supported on 150mm thick walls. Design the floor for mild exposure conditions using concrete grade 35 and steel grade 460. **(20 marks)**

Question Five (20 marks)

- a) Outline the main factors that justify the periodic inspection and maintenance of bridges. Identify the **THREE** main types of inspection carried on bridges and state the activities involved in each. Outline the activities carried out in the maintenance of bridge bearing and expansion joints. **(8 marks)**
- b) Figure 5 shows the plan and elevation of a flour-pile cap. The characteristic strength of the reinforcement and concrete are 425N/mm^2 and 30N/mm^2 respectively. The design loads at the ultimate limit is 5200KN. Using the bending theory, design the reinforcement to satisfy bending and shear. **(12 marks)**

Column or pier