



TECHNICAL UNIVERSITY OF MOMBASA
**Faculty of Engineering &
Technology**

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

UNIVERSITY EXAMINATION FOR:
BACHELOR OF SCIENCE IN CIVIL ENGINEERING

ECE 2415: STRUCTURAL DESIGN II

END OF SEMESTER EXAMINATION

SERIES: DECEMBER 2013

TIME ALLOWED: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

- *Answer Booklet*

This paper consists of **FIVE** questions. Answer question **ONE (Compulsory)** and any **TWO** questions

Maximum marks for each part of a question are as shown

This paper consists of **TWO** printed pages

Question One (Compulsory)

- a) Discuss the methods used in prestressing concrete **(8 marks)**
- b) A prestressed concrete beam 0.8m wide and 1.2m deep carries a dead load of 24KN/m (excluding self weight) and imposed load of 20KN/m over an effective span of 10m. Determine the minimum

prestressing force and its position from the bottom of the beam if all tensile stresses are to be eliminated and straight tendons used. Sketch the final stress distribution at mid span of the beam.

(12 marks)

Question Two

A 420mm square column carries axial dead load of 1000KN and an imposed load of 250KN. The safe bearing capacity of the soil is 170KN/m². Taking $f_{cu} = 35\text{N/mm}^2$ and $f_y = 460\text{N/mm}^2$ and cover to reinforcement as 40mm, design a suitable isolated pad foundation to resist the applied loads. Show the arrangement of the reinforcement in plan.

(20 marks)

Question Three

A reinforced concrete slab subject to an imposed load of 3.5KN/m² spans between two 150mm thick walls. The slab has an effective span of 4m and a length of 6.0m. Design the floor slab given the following information:

- Cover to reinforcement = 20mm
- $f_{cu} = 35\text{N/mm}^2$
- $f_y = 460\text{N/mm}^2$

Show the arrangement of reinforcement in section only.

(20 marks)

Question Four

- a) State THREE requirements of BS 8110 that should be satisfied for lateral links for reinforced concrete columns. **(3 marks)**
- b) With the aid of labeled sketches, describe the various failure mechanisms of reinforced concrete columns. **(3 marks)**
- c) Discuss the various classifications of reinforced concrete columns **(4 marks)**
- d) A reinforced concrete column carries an ultimate axial force of 2000KN. The steel ratio is 2% of the gross-cross sectional area. If $f_{cu} = 40\text{N/mm}^2$ and $f_y = 460\text{N/mm}^2$, design a suitable column section. Show the arrangement of reinforcement in the section **(10 marks)**

Question Five

- a) Show that the ultimate moment of resistance of a rectangular reinforced concrete beam may be expressed as:

$$M_u = 0.156 f_{cu} b d^2$$

where the symbols have their usual meaning

(6 marks)

- b) A reinforced concrete beam 500mm deep and 300mm wide has an overall span of 4.30m. The beam carries dead load of 4KN/m (excluding self weight) and an imposed load of 8KN/m. Given the following information:

- $f_{cu} = 30\text{N/mm}^2$
- $f_y = 460\text{N/mm}^2$

- Cover to reinforcement = 20mm
- Unit weight of concrete = 24KN/m³

Design a suitable form of reinforcement for the beam

(14 marks)