



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

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

UNIVERSITY EXAMINATION FOR DECREE IN:

**BACHELOR OF SCIENCE IN CIVIL ENGINEERING (BSCE)**

ECE 2514: THEORY OF STRUCTURES VII

**END OF SEMESTER EXAMINATION**

SERIES: APRIL 2015

**TIME ALLOWED: 3 HOURS**

**Instructions to Candidates:**

You should have the following for this examination

- *Answer Booklet*
- *Pocket Calculator*

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

Maximum marks for each part of a question are as shown

Use neat, large and well labeled diagrams where required

This paper consists of **THREE** printed pages

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**Question One (Compulsory)**

- a) The rectangular beam shown in figure Q1(a) is made from a material having a yield stress in compression of  $20\text{N/mm}^2$  and in tension of  $100\text{N/mm}^2$ . If it is to be used to carry a load of  $40\text{KN/m}$  with a load factor of 2.0 on a span of 10m, what must be the value of the dimension d

**(10 marks)**

### Figure Q1 (a)

- b) The working stress in mild steel is  $150\text{N/mm}^2$ . If the yield stress is  $230\text{N/mm}^2$ , calculate the load factor in the case of a joist having a shape factor of 1.15 **(6 marks)**
- c) From first principles, derive the expression used to determine the location of the positive yield line from a supported edge of a slab and the capacity of the collapse load using the method of segmental equilibrium. **(14 marks)**

### Question Two

- a) Find the collapse load factor for the portal frame shown in figure Q2 (a) **(8 marks)**  
4m

- b) One of the spans of a continuous one-way slab has been so reinforced that the ultimate moment capacities at the left end, right end and in the span are  $1400$ ,  $1200$  and  $900\text{kg m/m}$  respectively. The centre to centre distance of support is  $3\text{m}$  and slab is uniformly loaded. Locate the yield line and compute the collapse load **(12 marks)**

### Question Three

- a) Illustrate the yield line patterns in the following slabs:  
(i) Simply supported square slab  
(ii) Rectangular slab with fixed edges  
(iii) Simply supported triangular slab  
(iv) Rectangular slab simply supported **(4 marks)**
- b) State FOUR assumptions in plastic theory and design of structures **(4 marks)**
- c) Determine the shape factor for the I-section shown in figure Q3(c) **(12 marks)**

$$b = 200\text{mm}$$

#### Question Four

a) Briefly explain the following theorems of plastic analysis of structures:

- (i) Kinematic theorem
- (ii) The lower bound theorem
- (iii) Uniqueness theorem

**(9 marks)**

b) Determine the collapse load factor for a propped cantilever beam loaded with a concentrated load  $P$  at its mid length as shown in figure Q4(b) **(11 marks)**

**Figure 4 (b)**

#### Question Five

a) Outline FOUR assumptions of yield line analysis

**(4 marks)**

b) With aid of diagram, discuss THREE elementary mechanisms that can occur in plastic analysis of frames

**(9 marks)**

c) A simply supported beam of 7m span is subjected to a uniformly distributed load of 15kN/m. Calculate the elastic section modulus on plastic theory if the yield stress is  $240\text{N/mm}^2$ . Take the load factor as 1.75 and shape factor as 1.15

**(7 marks)**