TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering & Technology

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

UNIVERSITY EXAMINATION FOR BACHELOR OF SCIENCE IN CIVIL ENGINEERING
[Institutional Based Programmes]

ECE 2514: THEORY OF STRUCTURES VII

END OF SEMESTER EXAMINATION
SERIES: AUGUST 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** any other **TWO** questions
Maximum marks for each part of a question are as shown
This paper consists of **FOUR** printed pages

Question One (Compulsory)

a) State **FIVE** assumptions made in plastic analysis of structures. **(5 marks)**

b) From first principles, derive an expression for the shape factor for a rectangular section. **(6 marks)**

c) Determine the "shape factor" of the T-beam shown in figure Q1(c). Determine the maximum uniformly distributed load that the cantilever can carry if yielding is permitted over the tower was to a depth of 25mm. Yield stress of the material of the cantilever is 2225MN/m^2 **(19 marks)**

Question Two

a) A circular plate of diameter 120mm and thickness 10mm is constructed from steel with E = 208GN/m^2 and ν = 0.3. The plate is subjected to a uniform pressure of 5MN/m^2 on one side only. If the plate is clamped at the edges, determine:

(i) Maximum deflection

(ii) Radial stress – its position and magnitude

What percentage change in the results will be obtained if the edge conditions are changed such that the plate can be assumed to be freely supported? **(7 marks)**

b) A circular disc 150mm diameter and 12mm thickness is clamped around the periphery and built into a piston of diameter 60mm at the centre. Assuming that the piston remains rigid, determine the maximum deflection of the disc where the piston carries a load of 5KN. The material of the disc E = 208GN/m^2 and ν = 0.3 **(13 marks)**

Question Three

a) A square slab with built-in edges is isotropically reinforced with top and bottom steel. Determine the intensity "ω" of the uniformly distributed load that will cause collapse of the slab. Use yield line method of analysis **(8 marks)**

b) A rectangular slab whose length and width is 10m and 5m respectively is isotropically reinforced with top and bottom reinforcement such that the yield moment of resistance is "m" per metre width of slab, both for positive and for negative bending about any axis. The slab is simply supported along three edges and fully fixed along the fourth edge. By considering a reasonable yield line pattern such as shown in figure 3 (b) determine the intensity "ω" of the uniformly distributed load that will cause collapse. **(12 marks)**

Question Four

a) Design a rectangular slab 7.5m by 5m simply supported on all edges. The imposed load is 6KN/m^2. The load factors are 1.5 and 2.2 for dead and imposed loads respectively. The ultimate moment in the longer dimension is half of that for the shorter side. Use the yield-line method.

$$\sigma_s = 240N/mm^2$$

$$\sigma_c = 20N/mm^2$$

Take:

Finishes = 1KN/m^2
Unit weight of concrete = 24KN/m^3 **(20 marks)**

Question Five

a) State the following limit theorems of plastic collapse:
(i) Upper limit
(ii) Lower limit **(4 marks)**

b) From first principles derive an expression for the bending moment in a rectangular section when the stress distribution is partly plastic and partly elastic **(7 marks)**

c) Figure Q5(c) shows a loaded beam and its cross-section.
(i) Determine the plastic moment of resistance of the beam section if the yield stress of the material is 250N/mm^2 both in tension and in compression.
(ii) If the load "w" can be applied at any position within the span, determine the maximum value of "w" that will cause collapse.

(iii) If the load "w" is removed just after the formation of the collapse plastic hinges, sketch the shapes of the bending moment and shear force diagrams after the removal of the load.

(9 marks)