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 2415: DESIGN II (RC DESIGN)

END OF SEMESTER EXAMINATION
SERIES: APRIL 2015
TIME ALLOWED: 2 HOURS

Instructions to Candidates:
You should have the following for this examination

- *Answer Booklet*
- *Pocket Calculator*

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
Use neat, large and well labeled diagrams where required
This paper consists of **THREE** printed pages

Question One (Compulsory)

Interior
Panel

Figure 1 represents an interior panel of a reinforced concrete floor slab. Concrete cover – 20mm. Concrete f_{cu} = 40N/mm. Factored design load F = 71.3KN/m

Reinforcement

f_y (main bars) – 460N/mm^2

F_{yv} (links) – 250N/mm^2

Table 1 one-way slabs – ultimate bending moments and shear forces (BS 8110; Cl 3.5.2.4)

	End Support	**End Span**	**First Interior Support**	**Interior Spans**	**Interior Support**
Moment	0	0.086FL	-0.086FL	0.063FL	-0.063F
Shear	0.4F	-	0.6F		0.5F

Table 1.2 lever arm and neutral axis depth factor

$K = \frac{m}{f_{cu}bd^2}$	0.05	0.06	0.07	0.08	0.09	1.00	0.104	0.110	0.119	0.156
$\left(z/d\right)$	0.94	0.93	0.91	0.90	0.89	0.87	0.87	0.86	0.84	0.775
$\left(x/d\right)$	0.13	0.16	0.19	0.22	0.25	0.29	0.30	0.32	0.35	0.50

Design reinforcement for the panel for the following limit states:

(i) Ultimate
(ii) Shear
(iii) Deflection
(iv) Cracking

Also design for secondary reinforcement

Table 1.3 Basic span/effective depth ratios (BS 8110: Cl 3.4.6.3)

Support Condition	**Rectangular Sections**
Cantilever	7
Simply supported	20
Continuous	26

Table 1.4 modification factor for tension reinforcement

$m/bd^2 \left(N/mm^2\right)$ Service stress $f_y\left(N/mm^2\right)$	0.50	0.75	1.00	1.50	2.00	3.0	4.0	5.0	6.0
f_y = 460	1.68	1.50	1.38	1.21	1.09	0.95	0.87	0.82	0.70

Question Two

a) Calculate the ultimate axial load of a 250 x 250mm column section having 6 No 12mm diameter bars. **(2 marks)**

b) Design the longitudinal reinforcement for a 500mm x 300mm column section if N = 2300kN, M_x = 300KNm and M_y = 120KNm $f_{cu} = 40N/mm^2$ and $f_y = 460N/mm^2$

Table 2.1 values of β (BS 8110: C1.3.8.4.5)

$N/f_{cu}bh$	0	0.1	0.2	0.3	0.4	0.5	≥ 0.6
β	1.00	0.88	0.77	0.65	0.53	0.42	0.30

Question Three

The design ultimate moment M for a rectangular beam $b = 250mm$ and effective depth (d) = 700mm is 860KN/m. If $f_{cu} = 40N/mm^2$ and $f_y = 460N/mm^2$ working from the first principles, design the reinforcement **(20 marks)**

Question Four

Fig. 4.1 Column footing

Figure 4.1 shows a reinforced concrete footing required to resist characteristic axial loads of 900KN dead and 300KN imposed from a 400mm square column with 16mm dowels. The safe bearing pressure of the soil is 200KN/m^2 characteristic material strength are f_{cu} = 40N/mm^2 and f_y = 460N/mm^2. Design the footing **(20 marks)**

Question Five

Figure 5.1 shows the cross-section of a pre-stressed reinforced concrete beam.

P = 140KN

Figure 5.1

a) Determine the stresses due to the prestressing force

b) If the beam is simply supported at the ends of an 8 metre span and carries a uniformly distributed load of 1.5KN/m, determine the stresses at mid-span. Density of concrete = 24.0KN/m^3

(10 marks)