(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY SUPPLEMENTARY EXAMINATIONS 2021/2022 ACADEMIC YEAR

FOURTH YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF SCIENCE IN CIVIL AND STRUCTURAL ENGINEERING

COURSE CODE: CSE 414

COURSE TITLE: STRUCTURAL CONCRETE DESIGN

DATE: 06 OCTOBER 2022 **TIME:** 12:00-02:00 PM

INSTRUCTIONS:

1. This paper contains FOUR questions
2. **Attempt ANY THREE questions in this booklet.**
3. Marks for each question are indicated in the parenthesis.
4. Eurcode BS EN 1992 is permitted for this exam (without any written information within)

Examination duration is **2 Hours**

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 5 Printed Pages. Please Turn Over.

Question 1 **(20 marks)**

A simply supported beam (450x200) Height; h=450mm and breadth, b=200mm spans over a clear span of 4 m. The applied load produces a maximum bending moment (M_{max})=175kN.m and the Maximum shear force (V_{max})=125kN. Given f_{ck}=40N/mm^2, and f_{yk}=500N/mm^2

a) Design the required reinforcement for the beam to resist the applied forces **(10 marks)**

b) Check for shear and propose the link spacing **(6marks)**

c) Sketch the beam reinforcement **(4 marks)**

Question 2 **(20 marks)**

i. Design the reinforcement for a simply supported slab 200mm thick spanning in two directions. The effective span is (l_x) 4.5m and (l_y) 5m. The slab supports a live load of 10kN/m^2. The characteristic strength of concrete is f_{ck}=40N/mm^2, and steel f_{yk}=500N/mm^2 **(12 marks)**

ii. Check for deflection of the slab **(8marks)**

Question 3 **(20 marks)**

A square foundation pad footing is required to resist an axial load of 1000kN dead load and 300kN live load, imposed from a square column (400x400mm). The safe bearing pressure on the soil is 150kN/m^2 and the characteristic strength of concrete is f_{cK}=35N/mm^2, and steel f_{yK}=500N/mm^2. Assume a footing weight of 120kN.

a. Determine the footing size **(2 marks)**

b. Determine the area of steel required to resist bending **(12marks)**

c. Check for punching shear as well as single shear **(6 marks)**

Question 4 (20 marks)

T-section beam in Fig. Q3 is required to resist an ultimate moment of 200kNm. f_{yk}=500N/mm^2 and f_{ck}=35N/mm^2 . Calculate the area of reinforcement required. Use first principles from the stress block to balance the forces.

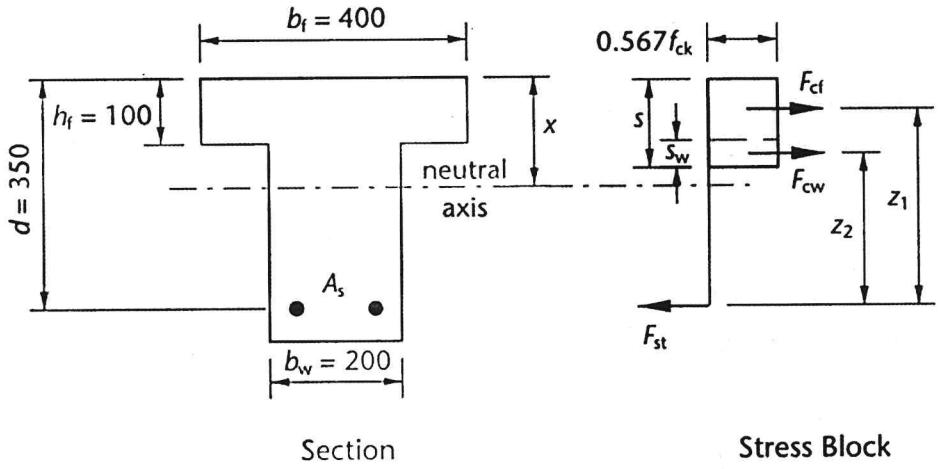

Fig. Q3.

A) Determine the moment resistance of the concrete flange (4mks)
B) Determine the depth of the neutral axis (10mks)
C) Determine the area of steel A_s (6mks)

-- end --

DESIGN AIDE

Cross sectional area of number of bars (mm²) - FOR BEAMS

	Number of Bars											
Bar Size (mm)	1	2	3	4	5	6	7	8	9	10	11	12
12	113	226	339	452	565	679	792	905	1018	1131	1244	1357
16	201	402	603	804	1005	1206	1407	1608	1810	2011	2212	2413
20	314	628	942	1257	1571	1885	2199	2513	2827	3142	3456	3770
25	491	982	1473	1963	2454	2945	3436	3927	4418	4909	5400	5890

Cross sectional area of bars per metre (mm²/m) - FOR SLABS

	Bar Spacing (mm)											
Bar Size (mm)	**50**	**75**	**100**	125	**150**	175	**200**	**225**	**250**	**275**	**300**	**400**
6	565	377	283	226	188	162	141	126	113	103	94	71
8	1005	670	503	402	335	287	251	223	201	183	168	126
10	1571	1047	785	628	524	449	393	349	314	286	262	196
12	2262	1508	1131	905	754	646	565	503	452	411	377	283
16	4021	2681	2011	1608	1340	1149	1005	894	804	731	670	503

Link reinforcement in beams, $\frac{A_{sw}}{s}$ (mm²/mm) - TWO (2) legs - FOR SHEAR IN BEAMS

	Spacing of Links (mm)											
Bar Size (mm)	**50**	**75**	**100**	**125**	**150**	**175**	**200**	**225**	**250**	**275**	**300**	**400**
6	1.13	0.75	0.57	0.45	0.38	0.32	0.28	0.25	0.23	0.21	0.19	0.14
8	2.01	1.34	1.01	0.80	0.67	0.57	0.50	0.45	0.40	0.37	0.34	0.25
10	3.14	2.09	1.57	1.26	1.05	0.90	0.79	0.70	0.63	0.57	0.52	0.39

Bending moment coefficients for a two-way spanning rectangular slab supported by beams

Type of panel and moments considered	short span coefficients for values of l_y/l_x					**long span coefficients for all values of l_y/l_x**
	1.0	**1.25**	**1.5**	**1.75**	**2.0**	
Interior panels						
Negative moment at continuous edge	0.031	0.044	0.053	0.059	0.063	**0.032**
Positive moment at midspan	0.24	0.034	0.04	0.044	0.048	**0.024**
One short edge discontinuous						
Negative moment at continuous edge	0.039	0.05	0.058	0.063	0.067	**0.037**
Positive moment at midspan	0.029	0.038	0.043	0.047	0.05	**0.028**
One long edge discontinuous						
Negative moment at continuous edge	0.039	0.059	0.073	0.083	0.089	**0.037**
Positive moment at midspan	0.03	0.045	0.055	0.062	0.067	**0.028**
Two adjacent edges discontinuous						
Negative moment at continuous edge	0.047	0.066	0.078	0.087	0.093	**0.045**
Positive moment at midspan	0.036	0.049	0.059	0.065	0.07	**0.034**