JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF ENGINEERING AND TECHNOLOGY

UNIVERSITY EXAMIMATION FOR THE DIPLOMA IN BUILDING AND CIVIL ENGINEERING

3RD YEAR 1ST SEMESTER 2022/2023 ACADEMIC YEAR

SPECIAL EXAMS

CENTRE: MAIN CAMPUS

COURSE CODE: TBC 2311

COURSE TITLE: STRUCTURAL DESIGN I

EXAM VENUE: **STREAM: Dip. BUILD & CIV ENG**

DURATION: 2 HOURS

Instructions

1. **Answer question 1 (Compulsory) and ANY other two questions**
2. **Candidates are advised not to write on question paper**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room.**

QUESTION ONE (COMPLULSORY) (30 MARKS)

i. Explain any four causes of failure of concrete structures. (8 Marks)

ii. Once a reinforced concrete building form and structural arrangement have been finalized, the design problem consists mainly of five steps. Explain each of these steps (5 Marks)

iii. State the five major elements of a reinforced concrete structure and describe the types of loads they transmit. (5 marks)

iv. Explain any three causes of failures of reinforced concrete structures (6 marks)

v. Explain what is meant by compressive strength of concrete and how it is measured. (2 marks)

vi. Describe any two types of walls that are structurally used in buildings. (4 marks)

QUESTION TWO (15 Marks)

i. What is workability of a concrete mix? Describe the two main tests for measuring workability of concrete in the laboratory. (4Marks)

ii. A simply supported reinforced rectangular beam of 7.5 m span carries uni- formly distributed characteristic dead load, which includes an allowance for self-weight of 8 kN/m and characteristic imposed load of 4.5 kN/m. The breadth b=200 mm. Design the beam at mid-span section. Use grade 30 concrete and high yield steel reinforcement, f =460 N/mm2. (9 Marks)

ii. Explain the difference between Braced and unbraced columns. (2 marks)

QUESTION THREE (15 Marks)

i Explain the following limit states in safe design. (3 marks)

a) Ultimate Limit State

b) Serviceability Limit State

ii Using well labeled diagrams, differentiate between one way spanning and two-way spanning slabs. (4 Marks)

iii The effective height of a column depends on four main factors, explain these factors. (4 marks)

iv Using neat sketches, explain any two types of foundations used in buildings. (4 marks)

QUESTION FOUR (15 Marks)

i. Neatly draw a well labeled part elevation of a reinforced concrete building and indicate the following: T-beam section, column section, continuous slab and column base. (6 Marks)

ii. A short braced column is 300mm square and supports 1700 KN at the ultimate limit state. The characteristic material strengths are f_y = 460N/mm^2 and f_{cu} = 30N/mm^2, design and detail the steel for the column. (9 Marks)

QUESTION FIVE (15 Marks)

i. A slab in an office building measuring 4.5m×6m m is simply supported at the edges with no provision to resist torsion at the corners or to hold the corners down. The

slab is assumed initially to be 200 mm thick. The total characteristic dead load including self-weight, screed, finishes, partitions, services etc. is 6.2 kN/m2. The characteristic imposed load is 2.5 kN/m2. Design and details the slab using grade C30 concrete and grade 460 reinforcements (15 marks)

TABLES FOR TBC 2311 – STRUCTURAL ANALYSIS I – TO BS 8110 PART 1

Table 1: Areas of Group of Bars

Diameter of Bar in mm	No. of Bars in mm							
	1	2	3	4	5	6	7	8
6	28	57	83	113	141	170	198	226
8	50	101	151	201	251	302	352	402
10	79	157	236	314	393	471	550	628
12	113	226	339	452	566	679	792	905
16	201	402	603	804	1005	1206	1407	1609
20	314	628	943	1257	1571	1885	2109	2513
25	491	982	1473	1964	2454	2945	3436	3927
32	804	1609	2413	3217	4021	4826	5630	6434

Table 2: Steel areas in slabs, walls, etc.

Total Reinforcement Area (mm/m^2)							
Bar Spacing, mm	Bar Diameter, mm						
	6	8	10	12	16	20	25
50	566	1010	1570	2260	4020	6280	9820
75	378	670	1050	1510	2680	4190	6550
100	283	503	785	1130	2010	3140	4910
125	226	402	628	904	1610	2510	3930
150	189	335	523	753	1340	2090	3270
175	162	288	448	646	1150	1790	2810
200	141	251	392	565	1010	1570	2460
250	113	201	314	452	804	1260	1960
300	94	167	261	376	670	1050	1640
350	81	144	224	323	574	897	1400
400	70	126	196	282	502	785	1230
450	63	112	174	251	447	697	1090
500	57	101	157	226	402	628	982

Table 3: Calculations for the Design Chart

x/d	1 – 0.45x/d	z/d	$M/(bd^2f_{cu})$	$100\left\{\frac{As}{bd}\right\}\left\{\frac{fy}{fcu}\right\}$
0.001	1	0.95	0	0
0.025	0.99	0.95	0.0095	1.055
0.05	0.98	0.95	0.0191	2.111
0.10	0.96	0.95	0.0381	4.221
0.15	0.93	0.93	0.0561	6.332
0.20	0.91	0.91	0.0730	8.442
0.25	0.89	0.89	0.089	10.553
0.30	0.87	0.87	0.1041	12.663
0.35	0.84	0.84	0.1183	14.774
0.40	0.82	0.82	0.1315	16.884
0.45	0.80	0.80	0.1439	18.995
0.50	0.78	0.78	0.1554	21.105

Table 4: Nominal Cover to all reinforcement (including links) to meet durability requirements

Conditions of Exposure	Nominal Cover, mm				
Mild	25	20	20	20	20
Moderate	-	35	30	25	20
Severe	-	-	40	30	25
Very Severe	-	-	50	40	30
Most Severe	-	-	-	-	50
Lowest Grade of Concrete	C30	C35	C40	C45	C50

Table 5: Nominal Cover to all reinforcement (including links) to meet specified periods of fire

Fire Resistance, hrs	Nominal Cover, mm					Minimum Beam Width, b, mm	Minimum Thickness of floors, h, mm
	Beams		Floors		Columns		
	Simply supported	Continuous	Simply Supported	Continuous			
0.5	20	20	20	20	20	200	75
1	20	20	20	20	20	200	95
1.5	20	20	25	20	20	200	110
2	40	30	35	25	25	200	125
3	60	40	35	35	25	240	150
4	70	50	55	45	25	280	170