JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF ENGINEERING AND TECHNOLOGY

UNIVERSITY EXAMINATIONS FOR THE DIPLOMA IN BUILDING AND CIVIL ENGINEERING

3RD YEAR 1ST SEMESTER 2018/2019 ACADEMIC YEAR

CENTRE: MAIN CAMPUS

COURSE CODE: TBC 2311

COURSE TITLE: STRUCTURAL DESIGN I

EXAM VENUE: **STREAM: DIP BLD & CIVEN**

DATE: ../12/2018 **EXAM SESSION:**

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)

a) The aim of safe design is that the structure should be fit for use during its design life. Explain the two limit states that is the criteria for safe design. (8 Marks)

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

c) Explain how the following, resulting from poor workmanship, would affect the structural integrity of a reinforced concrete structure (8 marks)

i. Grout Leakage
ii. Poor curing
iii. Poor compaction
iv. Inadequate cover to reinforcement

d) The type of foundation to be used depends on a number of factors. Explain three such factors. (3 marks)

e) With the aid of neat sketches, describe any three types of foundations used in reinforced concrete structures. (6 marks)

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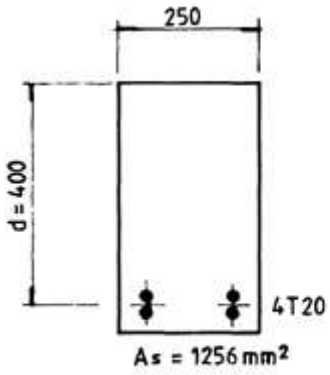
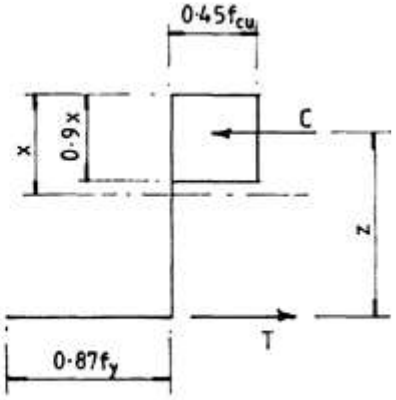
QUESTION TWO (15 Marks)

a) Calculate the moment of resistance of the singly reinforced beam section shown below. The materials are grade 30 concrete and grade 460 reinforcement. (9 Marks)



(a)



(b)

b) A simply supported rectangular beam of 6.5 m span carries a design load of 15 kN/m. The beam dimensions are breadth 230 mm and effective depth 380 mm. Find the steel area required. The concrete is grade 25 and the steel grade 460. (6 marks)

QUESTION THREE (15 Marks)

a) With the aid of neat sketches, explain the difference between the following (6 marks)
   i) Short and Slender Columns
   ii) One way spanning and two way spanning slabs

b) A short braced column has to carry an ultimate axial load of 1366 kN. The column size is 250 mm×250 mm. Find the steel area required for the longitudinal reinforcement and select suitable bars. The materials are grade 30 concrete and grade 460 reinforcement. (4 marks)

c) A rectangular beam is fixed on both ends over a span of 6m and carries a dead load of 8KN/m and an imposed load of 4KN/m. The beam is 200mm by 350mm effective depth and the inset of compression steel is 60mm. Design the steel for mid span of the beam for grade 30 concrete and grade 460 reinforcement. (5 marks)

QUESTION FOUR (15 Marks)

A column 400 mm × 400 mm carries a dead load of 800 kN and an imposed load of 300 kN. The safe bearing pressure of the soil is 200 kN/m^2. Design and detail a square base to resist the loads. The concrete is grade 35 and the reinforcement grade 460. (15 Marks)

QUESTION FIVE (15 Marks)

An exterior panel with one long edge discontinuous is 4.5m long and 3m wide. The characteristic loads on the slab are Dead load = 8KN/m^2 and Imposed load = 1.5KN/m^2. Design and detail the slab to BS 8110 – Part 1. F_{cu}=30 and , f_y= 460N/mm^2, conditions of exposure are mild and a 1.5hrs fire duration is recommended. Make any other assumptions where necessary. (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