NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF ARCHITECTURE AND QUANTITY SURVEYING

DEPARTMENT OF ARCHITECTURE
BACHELOR OF ARCHITECTURAL STUDIES (HONOURS) DEGREE

PART II SECOND SEMESTER EXAMINATIONS – MAY 2003
AAR 2205 – STRUCTURAL DESIGN II

Instructions *Time: 3 hours*
Question 1 and 2 are compulsory
Answer any 3 from the remaining questions
All Questions carry 20 marks.

Question 1

A section of floor is to be carried by 150 mm x 75 mm timber joists spanning 3m. The bending stress must not exceed 4.6 N/mm^2 with the total inclusive load of floor estimated to be 2.0 kN/ mm^2. At what cross centres in mm must the timber beams be fixed?

Question 2

A R.C.short column of square section is to support an axial load of 700 kN. Calculate the size of reinforcement required and the maximum effective height for the column if it is to be considered as a short column by permissible stress method. Size of column 300 mm x 300 mm. Suggest a suitable size of footing for the column. Safe bearing capacity of the soil = 200 kN/m^2. Assume the permissible stress for the concrete in direct compression = 5.3 N/ mm^2 , Permissible compressive stress in steel = 130 N/mm^2

Question 3

Design a simply supported slab having clear dimensions of 2.5m x 10 m by limit state theory. The long sides of the slab are supported on 230 mm thick brick walls on one side and 300 mm beam on the other side. Live load on the roof = 4.0 kN/m^2 f_y = 250 N/mm^2 , f_{cu} = 25 N/ mm^2

Question 4

A timber cantilever beam of 2m effective length carries a 6kN point load at the free end. The beam is 150mm wide throughout, but varies in depth at the bottom from 150mm at free end to 250mm at the support. Calculate the stress in the extreme fibres,
(a) at the support
(b) at a point 1m from the support.
Ignore the weight of the beam.

Question 5

A simply supported RC beam is to span 5m carrying a total uniform load of 60kN inclusive of self weight, and a point load of 90kN from a secondary beam at middle point of beam. The width of beam = 200mm. Choose a suitable overall depth and area of tensile steel reinforcement for the beam by limit state theory.
f_{cu} = 30 N/ mm^2 , f_y = 250 N/mm^2

Question 6

A reinforced concrete column 30 cm x 30 cm in section is reinforced with 8 bars of 20 mm diameter. If the permissible stress in concrete is 4 N/mm^2, find the safe compressive load for the column, by simple elastic theory, and as per code take modular ratio = 18. Permissible stress in steel = 130 N/mm^2

TABLE 3 Permissible Shear Stress in Concrete

$\left(\frac{100\ A_s}{bd}\right)$	Permissible shear stress in concrete τ_c N/mm² Grade of concrete					
	M-15	M-20	M-25	M-30	M-35	M-40
0.25	0.22	0.22	0.23	0.23	0.23	0.23
0.50	0.29	0.30	0.31	0.31	0.31	0.32
0.75	0.34	0.35	0.36	0.37	0.37	0.38
1.00	0.37	0.39	0.40	0.41	0.42	0.42
1.25	0.40	0.42	0.44	0.45	0.45	0.46
1.50	0.42	0.45	0.46	0.48	0.49	0.49
1.75	0.44	0.47	0.49	0.50	0.52	0.52
2.00	0.44	0.49	0.51	0.53	0.54	0.55
2.25	0.44	0.51	0.53	0.55	0.56	0.57
2.50	0.44	0.51	0.55	0.57	0.58	0.60
2.75	0.44	0.51	0.56	0.58	0.60	0.62
3.00 and above	0.44	0.51	0.57	0.60	0.62	0.63

Table 2. Areas of Groups of Bars (Area in mm²)

Diameter	*Number of bars*									
mm	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
6	28	56	84	113	141	169	197	226	254	282
8	50	100	150	201	251	301	351	402	452	502
10	79	157	235	314	392	471	549	628	706	785
12	113	226	339	452	565	678	791	904	1017	1131
14	154	307	461	615	769	923	1077	1231	1385	1539
16	201	402	603	804	1005	1206	1407	1608	1809	2010
18	254	508	763	1017	1272	1526	1781	2035	2290	2544
20	314	628	942	1256	1570	1885	2199	2513	2827	3141
22	380	760	1140	1520	1900	2280	2660	3041	3421	3801
25	491	981	1472	1963	2403	2945	3436	3927	4417	4908
28	616	1231	1847	2464	3078	3694	4310	4926	5541	6157
32	804	1608	2412	3217	4021	4825	5629	6434	7238	8042
36	1018	2035	3053	4071	5089	6107	7125	8143	9160	10178