

**NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY**  
FACULTY OF THE BUILT ENVIRONMENT

**DEPARTMENT OF ARCHITECTURE**  
BACHELOR OF ARCHITECTURAL STUDIES (HONOURS) DEGREE  
2013-14 ACADEMIC YEAR  
PART II - SUPPLEMENTARY EXAMINATIONS – AUGUST 2014  
**AAR 2105 – Structural Design I**

**Instructions**

**Duration: 3 Hours**

***Answer all questions.***

**QUESTION 1**

In structural design there are two methods of design, (i) Limit state and (ii) Elastic theory.

- [a] For which construction materials are each of these methods of design used and why. [12]
- [b] What are the Ultimate limit states [ULS] and the Serviceability limit states [SLS] to be considered in design of elements. [13]
- Total Marks [25]

**QUESTION 2**

- [a] A reinforced concrete slab is 150 mm thick and it supports a characteristic dead load of  $0.75\text{kN/m}^2$  for finishes. The slab also supports a characteristic imposed load of  $2.5\text{kN/m}^2$ . Calculate the ultimate design load that the slab should be designed for. [12]
- [b] If the effective span for the slab in [a] is 4.5m calculate the design bending moment for the slab. [13]
- Total Marks [25]

**QUESTION 3**

- A reinforced concrete beam with an effective span of 7m is 500mm deep overall by 250mm deep. It supports a characteristic dead load of  $11\text{kN/m}$  in addition to its own weight and a characteristic imposed load  $9\text{kN/m}$ . Check that the beam depth is adequate and calculate the area of reinforcement. The material properties are
- Grade 30 concrete and Grade 460 reinforcement [25]

**QUESTION 4**

Design the joists for a timber floor supporting tongue and grooved floor boarding. The joists are at 400mm centres and span 4.0m. The load imposed by the self weight of the floor is  $0.1\text{kN/m}^2$  and by a plaster ceiling on the underside of  $0.21\text{kN/m}^2$ . Assume self weight of the joist as  $0.05\text{kN/m}$ . The floor is subjected to an imposed load of  $1.5\text{kN/m}^2$ . Use SC4 for the joist.

Select suitable modification factors

$K_1 = K_2 = 1.0$  ;  $K_3$ - load duration= 1.0 ;  $K_7$ -depth modification factor= 1.0;

$K_8$ - load sharing factor= 1.1

For SC4

Grade stress in bending parallel to grain =  $7.5\text{N/mm}^2$

Grade stress in shear parallel to grain =  $0.71\text{N/mm}^2$

E minimum =  $6600\text{N/mm}^2$

[25]