

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

**DEPARTMENT OF ARCHITECTURE**  
BACHELOR OF ARCHITECTURAL STUDIES (HONOURS) DEGREE

PART II SUPPLEMENTARY EXAMINATIONS – JULY 2003  
**AAR 2205 – STRUCTURAL DESIGN II**

**Instructions**

**Time : 3 Hours**

1. Answer any five questions
2. All Questions Carry equal marks (20)

**QUESTION 1**

- a) A timber beam of rectangular cross – section is 150 mm wide and 300 mm deep. The maximum allowable bending stress in tension and compression must not exceed  $6\text{N/mm}^2$ . What maximum bending moment in Nmm can the beam safely carry? [6]
- b) A timber beam is required to span 4m carrying a total uniform load (inclusive of the beams self weight) of 40KN. The safe allowable bending stress is  $8\text{ N/mm}^2$ . Choose a suitable depth for the beam if the width is to be 120mm. [14]

**QUESTION 2**

A reinforced concrete beam is required to transmit an ultimate bending moment of 140KNm, inclusive of its own weight. Determine the depth of beam required and the amount of steel needed in a 250 mm wide beam for the following combinations.

- a) Concrete  $f_{cu} = 30\text{N/mm}^2$  steel  $f_y = 250\text{N/mm}^2$
- b) Concrete  $f_{cu} = 35\text{N/mm}^2$  steel  $f_y = 460\text{ N/mm}^2$

**QUESTION 3**

A 250mm thick simply supported reinforced concrete slab spans 5m. Design a suitable slab using concrete  $f_{cu} = 30\text{ N/mm}^2$  and steel  $f_y 250\text{ N/mm}^2$  to support the imposed load =  $4.0\text{ KN/mm}^2$  and finishes =  $0.5\text{ KN/m}^2$ . Concrete =  $24\text{KN/m}^3$ .

**QUESTION 4**

A 250 mm square reinforced concrete column with an effective length of 3m contains four 25mm diameter longitudinal Bars. Calculate the safe axial load for the column if permissible stress in concrete =  $5.3\text{ N/mm}^2$  and steel =  $125\text{ N/mm}^2$ . If the column is designed as a square column containing 8.0% of steel for the calculated safe axial load, what is the required size of the column?

**QUESTION 5**

A rectangular timber beam 300mm deep and 250mm wide, freely supported on a span of 6m carries a uniform load of 3KN inclusive of self weight. What is the greatest central point load that can be added to this beam if the maximum bending stress is  $8\text{ N/mm}^2$ ?

**QUESTION 6**

A hollow steel pipe of 150 mm external and 100mm internal diameter is to span between two buildings. What is the greatest permissible span in meters if the stresses in tension and compression must not exceed 150 N/mm<sup>2</sup>? The unit weight of steel is 78 KN/m<sup>3</sup>.