

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

DEPARTMENT OF ARCHITECTURE  
BACHELOR OF ARCHITECTURAL STUDIES (HONOURS) DEGREE

PART II FIRST SEMESTER EXAMINATIONS – DECEMBER 2004  
AAR 2105 STRUCTURAL DESIGN I

Instruction:

Time: 3 Hours

Answer any four (4) questions. All questions carry equal marks

QUESTION 1

- a) The purpose of structural design is to provide a safe structure that can serve its intended purpose. Outline the various steps that a structural designer undergo to arrive at a safe and economical design. (20)
- b) Define 'detailed design' as used in design of structures. (5)

QUESTION 2

- a) There are three main design approaches in design of structures. What are they? Outline their major differences. (15)
- b) Determine the cross-sectional area of a brick pier which carries an axial load of; total dead load = 3.0 kN, imposed load = 2.0 kN. The characteristic yield stress of the brick pier is 5 N/mm<sup>2</sup>. Carry out the calculations using the following
- The load factor method with a load factor of 1.9
  - A permissible stress design with a factor of safety of 1.7.
  - A limit state design with the following factors of safety, 1.4 for the dead load, 1.6 for the imposed load and 1.15 for the brick strength. (10)

QUESTION 3

- a) What are the basic assumptions in the theory of simple bending? (5)
- b) Derive the moment-curvature equation for a beam loaded with lateral loads. (10)
- c) A steel plate is bent into a circular arc of radius 10 m. If the section be 12 cm thick, find the maximum stress induced and the bending moment which can produce this stress. Take  $E = 20 \times 10^6 \text{ N/cm}^2$  and  $I_{xx} = 8 \text{ cm}^4$  (10)

QUESTION 4

A simply supported 10 m long beam carries a uniformly distributed load of 5 kN/m on the left half of the beam and a point load of 15 kN at a distance of 3m from the right support end

- a) Draw the shear force and bending moment diagram. (20)
- b) What is the magnitude and position of the maximum bending moment and shear force? (5)

**QUESTION 5**

A simply supported beam is of effective span 6 m. The beam supports the following uniformly distributed loads:

Dead load = 40 kN/m (including self-weight)

Live load = 12 kN/m

The characteristic material strengths are  $f_{cu} = 30 \text{ N/mm}^2$  concrete,  $f_y = 460 \text{ N/mm}^2$  steel. Depth = 550 mm and breadth = 300 mm.

Find the area of reinforcement. Is the shear resistance of the beam satisfactory?

(25)