NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF CIVIL AND WATER ENGINEERING
FACULTY OF INDUSTRIAL TECHNOLOGY
BACHELOR OF ENGINEERING (HONOURS) DEGREE
PART III FIRST SEMESTER EXAMINATION- DECEMBER 2006
DESIGN OF STRUCTURES I– TCW 3103

INSTRUCTION

Answer Four Questions **Time: 4 hours**

Open Book Examination **Total Marks 100**

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QUESTION ONE

(a) Derive from first principles the following equation for the ultimate moment of resistance (M_u) of a singly reinforced concrete section assuming a rectangular stress-block distribution

$$M_u = 0.156\, f_{cu} b d^2$$ **Marks 10**

(b) Design the bending and shear reinforcement for a simply supported beam using the following information

Span l = 7.0 m; g_k = 20 kN/m ; q_k = 10 kN/m

f_{cu} = 25 N/mm^2 ; f_y = 460 N/mm^2 ; f_{yv} = 250 N/mm^2 **Marks 15**

QUESTION TWO

(a) Explain the difference between a short and a slender column

Marks 10

(b) An internal column in a multi-storey building supporting an approximately symmetrical arrangement of beams carries an ultimate load of 2000 kN. Assuming that the column is square, short and braced, calculate

(i) a suitable cross section for the column
(ii) the area of the longitudinal reinforcement
(iii) the size and spacing of the ties

f_{cu} = 30 N/mm^2 ; f_y = 460 N/mm^2 **Marks 15**

QUESTION THREE

A simply supported beam of span 10.0 m supports a uniformly distributed characteristic dead and imposed load of 5 kN/m. It also supports a characteristic imposed point load of 30 kN at mid-span. Assuming the beam is fully restrained laterally, select a suitable UB section in grade 43 steel to satisfy bending and shear considerations.

Marks 25

QUESTION FOUR

A proposed 5.0 m long internal column in a rigid jointed steel structure is to be loaded concentrically with a characteristic dead and imposed load of 1000 kN each. Assuming that the fixity at the top and bottom of the column gives effective rotational restraint, design a column section assuming the structure will be (a) braced and (b) unbraced

Marks 25

QUESTION FIVE

A timber beam with an effective span of 3.0 m supports a uniformly distributed load of 10 kN including self weight of the beam. Determine a suitable section for the beam using timber of strength class SC3. Assume that the beam is held in position.

Assume the following

Strength Class of timber	**SC 3**	**Modification Factors:**
For SC 3 Grade		**K3, duration of loading 1.0**
Bending stress parallel to grain	**= 5.3 N/mm^2**	**K8 Load sharing system 1.1**
Shear stress parallel to grain	**= 0.67 N/mm^2**	**K7 Depth factor**
		for d = 250 1.02
Modulus of Elasticity E	**= 5800 N/mm^2**	**for d = 225 1.032**
Long term loading		**for d = 200 1.046**

Marks 25