NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF INDUSTRIAL TECHNOLOGY
DEPARTMENT OF CIVIL AND WATER ENGINEERING
BACHELOR OF ENGINEERING (HONOURS) DEGREE
PART 1 EXAMINATIONS – APRIL 2009
ENGINEERING MECHANICS 1: STATICS
TCW 1101

INSTRUCTIONS

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

Time: 3 hours
Total marks: 100

QUESTION 1

(a) Determine the horizontal and vertical components of reactions at the pins A, B and C of the two member frame shown in Fig 1.1 [8]

(b) Determine the normal stress and average shear stress at sections *a-a* and *b-b*. Member BC has a cross section of 40mm diameter. [7]

(c) Determine the forces in all the members of the truss shown in Fig1.2. Indicate whether the bar is a tie or strut. Use the graphical method. [10]

QUESTION 2

(a) A pin- jointed frame is loaded as shown in Fig 2.1. Determine the force in members BK, MC, JO, JD and PE. Indicate whether the forces are tensile or compressive. [20]

(b) Define the following terms:

(i) Double Shear

(ii) Punching Shear

(iii) Permanent Set

(iv) Geometric Stability

(v) Fracture stress [5]

QUESTION 3

(a) State the perpendicular axis theorem and explain the importance of the parallel axis theorem. [5]

For the section shown in Fig 3.1, calculate

(b) The second moment of area about the centroidal axes [15]

(c) The moment of inertia about the axes QQ. [5]

All dimensions in mm.

QUESTION 4

(a) A simple supported beam is loaded as shown as in Fig 4.1.

i) Draw the shear force and bending moment diagrams

(ii) Calculate the absolute shear force and bending moment

(iii) What are the positions of the maximum shear force and bending moment [20]

(b) A block of mass 200kg is to be pulled up an incline of 30^0 by a force at an angle to the incline. Calculate the least force required to move the block and its direction to the horizontal. Take the coefficient of friction as 0.28 [5]

QUESTION 5

(a) Two blocks A and B connected together by pulleys C and D are shown in Fig 5.1. Determine the maximum weight of block A for equilibrium of the system. The weight of block B is 600N. The coefficient of static friction between block A and the incline is 0.18 and that between the block and the horizontal plane is 0.40. Assume that pulleys C and D are frictionless. [11]

(b) A slender rod of length 300mm, shown in Fig 5.2 is subjected to an increase of temperature along its axis, which creates a normal strain in the rod. The strain is given by the relationship;

$$\varepsilon_y = 60 \times 10^{-3} y^{½}$$

where y is in metres. Determine the displacement of the end B of the rod due to the temperature increase and the average normal strain in the rod. [7]

(b) An aluminum specimen of gauge length 50mm and diameter 12.5mm is subjected to a test to determine its shear modulus. From the elastic portion for the stress-strain diagram a modulus of elasticity of $45GN/m^2$. When the applied load is 10kN, the new diameter of the specimen is 12,48375mm. Calculate the shear modulus (G) for the aluminium. [7]