



# TECHNICAL UNIVERSITY OF MOMBASA

## FACULTY OF ENGINEERING AND TECHNOLOGY

### DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

### UNIVERSITY SPECIAL/SUPPLEMENTARY EXAMINATION FOR:

### BACHELOR SCIENCE IN MECHANICAL ENGINEERING

### EME 2211 : MECHANICAL ENGINEERING

### END OF SEMESTER EXAMINATION

**SERIES:** APRIL 2016

**TIME:** 2 HOURS

**DATE:** Pick Date May 2016

#### Instructions to Candidates

You should have the following for this examination

*-Answer Booklet, pocket calculator, examination pass and student ID*

This paper consists of **FIVE** questions. Attempt question ONE (Compulsory) and any other TWO questions.

**Do not write on the question paper.**

#### Question ONE

- a) Explain the following terms
- i) Plain Stress and plain strain condition **(4marks)**
  - ii) Solid or Hysteretic damping **(4marks)**
- b) Derive using diagram and formula the damping constant for parallel plates separated by viscous fluid one plate moving with a velocity  $v$  relative to the other. **(7marks)**
- c) A tensile test is carried out on a bar of mild steel of diameter 2cm. The bar yields under a load of 80kN. It reaches a maximum load of 150kN, and breaks finally at a load of 70kN.  
Estimate:
- i) The tensile stress at the yield point
  - ii) The Ultimate stress tensile stress:
  - iii) the average stress at the breaking point, if the diameter of the fractured neck is 1cm **(6 marks)**
- d) A pipe as shown in figure 1(d) of the given dimensions and parameters has water flowing under pressure from section 1 to 2. Determine the pressure  $P_1$  if the discharge in the pipe is 30 litres/sec and the head loss in the pipe from section to 1 to 2 is given by  $0.4(V_2-V_1)^2/2g$ . Take the density of water as  $1000\text{kg/m}^3$ . **(9 marks)**

## Question TWO

Construct the bending moment and shearing force diagrams for the beam shown in figure 2. **(20 marks)**

## Question THREE

Two wooden planks 150 mm x 50 mm each are connected to form a T - section of a beam. If a moment of 3.4 kNm is applied around the horizontal neutral axis, including tension below the neutral axis,

Find;

- a) The stresses at the extreme fibres of the cross – section **(17 marks)**
- b) The total tensile force on the cross section **(3 marks)**

Refer to Figure 3.

## Question FOUR

- a) Derive the pure bending formula for a rectangular beam **( 8 marks)**
- b) The helicopter rotor starts from rest. The moment exerted on it (in Nm) is given as a function of the angle through which it has turned in radians by  $M=6500-20\theta$ . The rotor's moment of inertia is  $I=540\text{kgm}^2$ . Determine the rotor's angular velocity (in rpm) when it has turned through 10 revolutions. **(7 marks)**
- c) Illustrate by use of diagrams the sign convention of a loaded beam **(5 marks)**

## Question FIVE

- a) Explain the following terms:
  - i) Kinematics and kinetics of a body
  - ii) Steady uniform flow and Unsteady uniform flow **(4marks)**
- b) Determine the mass discharge of air through a tube with a smooth circular entrance and a cylindrical part of a diameter 200mm, if the measure of vacuum pressure in the form of a vertical column of water  $h= 250\text{mm}$ ,  $\rho_{air} = 1.25\text{kg} / \text{m}^3$  and coefficient of loss at the entrance is  $\zeta = 0.1$ . Refer to figure 5(b) **(8 marks).**
- c) A piston raises a column of water to a height  $h_1=4\text{m}$ . Determine the force necessary to retain the piston at a height  $h_2=3\text{m}$  over the surface in the well given that the diameter of the piston is  $D=100\text{mm}$ . Diameter of piston load  $d=30\text{mm}$ . Neglect the weight of the piston rod. Refer to figure 5(c) **(8marks)**

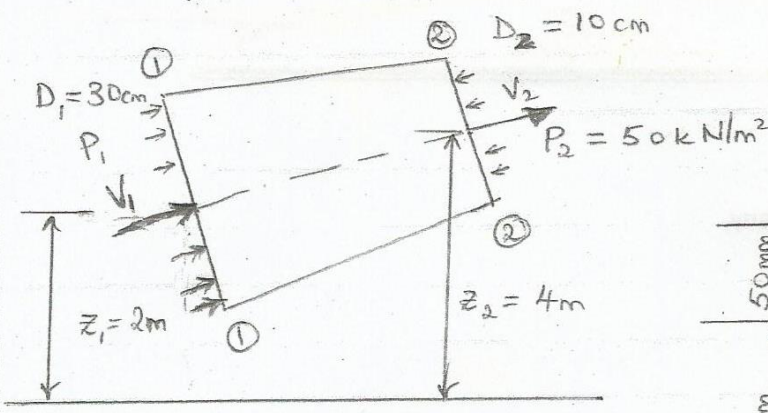


Fig 1(d)

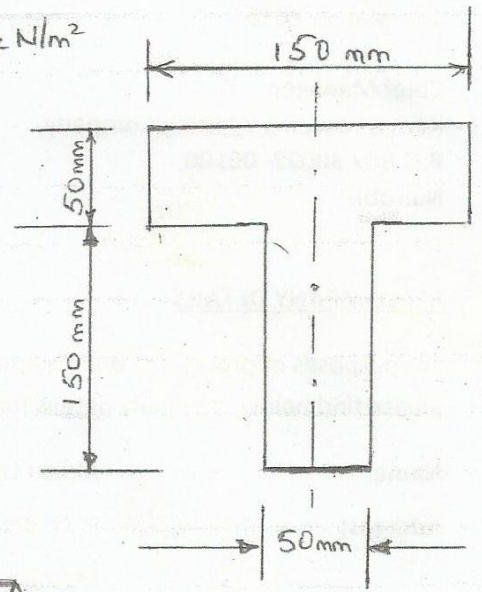


Fig 3

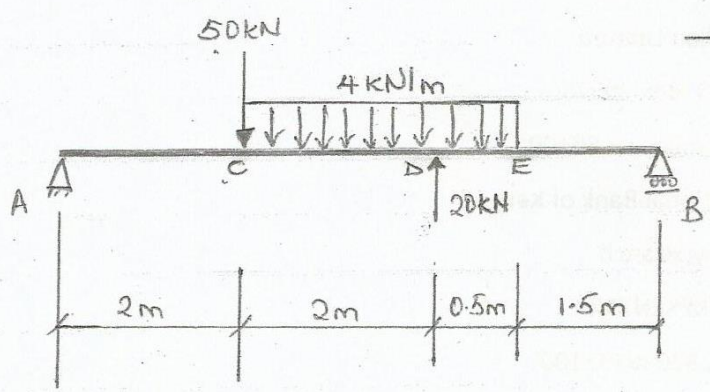


Fig 2

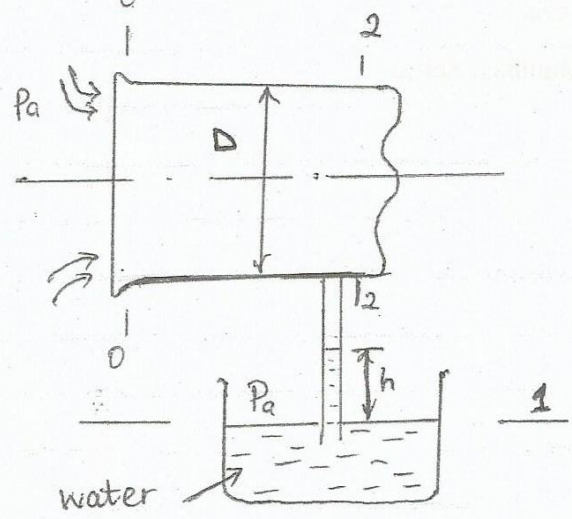


Fig 5(b)

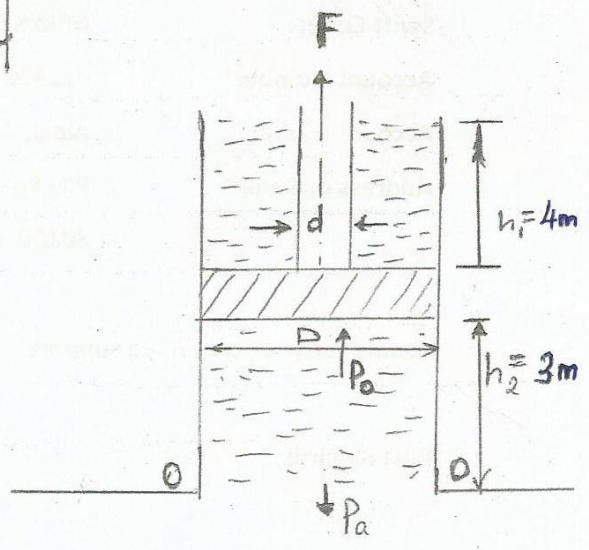


Fig 5(c)