## THE TECHNICAL UNIVERSITY OF MOMBASA

# FACULTY OF ENGINEERING AND TECHNOLOGY DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

## DEE2

## **EME 2130 MECHNANICAL SCIENCE**

## SERIES: APRIL/ MAY 2016

## TIME: 2 HOURS

#### Instructions to candidates

You should have the following for this examination:-

- Answer booklet
- Scientific calculator
- Drawings instruments

The paper consists of FIVE Questions. Answer any THREE questions

## **Question One**

- (a) Define the following terms:-
  - (i) Work
  - (ii) Energy
  - (iii) Power
  - (iv) Kinetic energy

(4 marks)

(b) State the principle of conservation of energy

(2 marks)

- (c) A body having a mass of 80N rests on a horizontal surface. Assuming the coefficient of friction is 0.25, calculate the force applied to the body at an upward angle of 30° with the horizontal, to just:-
  - (i) Pull the body over the surface
  - (ii) Push the body over the surface,

with constant velocity in each case

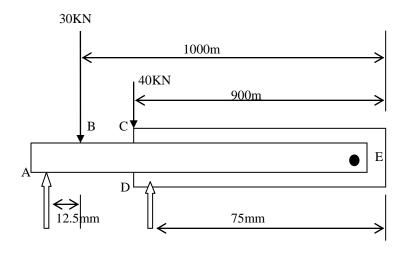
(14 marks)

## **Question Two**

- (a) Define the following terms:-
  - (i) Moment
  - (ii) Couple
  - (iii) Torque

(3 marks)

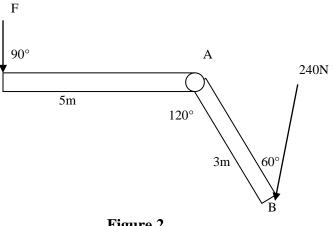
(b) The compound lever shown below is made up of two levers AE and CE, pinned at a common point E. AE carries a 30KN load at B and rests on a knife edge at A. CE carries a 40KN load at C and rests at a knife edge at D. Calculate the vertical force required at the pin E to hold the two levers horizontal.





(8 marks)

(c) Calculate the magnitude and direction of the reaction at the pivot point A of the lever shown in the diagram. The lever is in equilibrium.





(9 marks)

## **Question Three**

- Define the following terms:-(a)
  - (i) Stress
  - (ii) Strain
  - (iii) Modulus of elasticity

(3 marks)

(b) The following results were obtained for a gauge length of 60mm in a tensile test on a specimen of black mild steel of 12mm diameter.

| Load, W (KN)                   | 5  | 10   | 15 | 20 | 25   | 30   | 35 | 40  |
|--------------------------------|----|------|----|----|------|------|----|-----|
| Extension x10 <sup>-3</sup> mm | 14 | 27.2 | 41 | 54 | 67.6 | 81.2 | 96 | 112 |

When tested to destruction:-

Maximum load = 65KN Load at fracture = 50KN Diameter at fracture = 7.5mm Total extension gauge length = 17mm

Calculate:-

- (i) Young's Modulus
- (ii) Specific modulus
- (iii) Ultimate tensile stress
- (iv) Breaking stress
- (v) Stress at fracture
- (vi) Percentage elongation

Hint: Relative density of steel = 7.8

(13 marks)

(c) Discuss your results in 3(b) above in relation to:-

- (i) Failure, a factor of safety
- (ii) Ductility
- (iii) Resilience and toughness
- (iv) Brittle materials

(4 marks)

#### **Question Four**

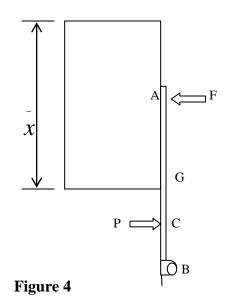
- (a) Define the following terms:-
  - (i) Pressure
  - (ii) Density
  - (iii) Specific gravity

- (iv) Specific weight
- (v) Centre of pressure

(5 marks)

- (b) A fuel tank contains oil of specific gravity 0.7. In one vertical side is cut a circular opening 1.8m diameter closed by a trap door hinged at the lower end B and held by a bolt at the upper edge A. If the fuel level is 1.8m above the top edge of the opening, calculate:-
  - (i) The total force on the door,
  - (ii) The force F in the bolt
  - (iii) The force on the hinge.

Density of water =  $1 Mg/m^3$ 



(15 marks)

## **Question Five**

- (a) During three consecutive seconds it is observed that a particle moves with constant acceleration through distances of 240m, 486m and 5m. Calculate:-
  - (i) The acceleration and velocity at the beginning and end of the period of the observation
  - (ii) The distance traversed during the third second of observation and the total distance covered in six seconds.

(10 marks)

- (b) A pulley A, diameter 800mm is accelerated by means of a belt drive from 60r/min to 240r/min during which it turns through 360 revolutions. This pulley is attached by means of a belt to a driven pulley B, with a diameter 200mm. Calculate:-
  - (i) The angular acceleration of the belt if there is no slip
  - (ii) The initial and final velocity of pulley B in r/min and rad/s respectively.

(10 marks)