



# TECHNICAL UNIVERSITY OF MOMBASA

## FACULTY OF ENGINEERING AND TECHNOLOGY

### DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

#### UNIVERSITY EXAMINATION FOR:

#### DIPLOMA IN MECHANICAL ENGINEERING YEAR I SEMESTER II

#### EME 2106 : MECHANICAL SCIENCE II

#### 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, examination pass and student ID

This paper consists of **FIVE** questions. Attempt any **THREE** questions.

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

#### Question ONE

##### Question ONE

- State FOUR laws of friction. (4 marks)
- Using first principles, show that for a body moving up the plane, pull  $P$  parallel to the plane is given by:-  
 $F = \mu R_N$  for limiting friction and hence  $P = F + W \sin\theta$  when resolved parallel to the plane. (6 marks)
- A carriage of mass 1 tonne is to be pulled up a track inclined at  $30^\circ$  to the horizontal by a force  $P$  inclined at  $20^\circ$  to and above the track. Calculate the value of  $P$  if the effective coefficient of friction is 0.15. (11 marks)

#### Question TWO

- Define the following terms:-
  - Energy
  - Work
  - Potential Energy
  - Frictional Resistance (4 marks)
- Using relevant examples, state the law of conservation of energy. (3 marks)
- Differentiate between Joule and Kilowatt Hour. (2 marks)

- d. A vehicle of mass 1600kg moves a distance 200m from rest directly down a slope of 1 in 120. From there it moves over a horizontal road until it comes to rest because of a tractive resistance of 96N which remains constant for the total distance of motion. Calculate the maximum velocity reached and the horizontal distance travelled before coming to rest. (11 marks)

### Question THREE

- a. State the law of the machine hence define the coefficients of the statement and constants. (4 marks)
- b. List THREE types of lifting machines. (3 marks)
- c. In a certain lifting machine, efforts 14N and 36N were required to lift respective loads of 20kg and 60kg. Calculate:-
- The law of the machine
  - The load that will be lifted by an effort of 60N.
  - The efficiency of the machine when 60kg is being lifted with a velocity of 39.
  - If the machine will run back. (13 marks)

### Question FOUR

- a. State THREE Newton's laws of Momentum. (3 marks)
- b. Show proof that the rate of change of momentum is given by:- (6 marks)
- $$F_a = \frac{m(v-u)}{t}$$
- c. Define the term "impulsive force" and show its relationship with the change in momentum.(2 marks)
- d. A total force of 2kN is applied to a truck having a mass of 3 metric tonnes to accelerate in directly up an inclined plane of 1 in 30. The truck is originally at rest, the tractive resistance is constant at 275N and the force is applied parallel to the plane. Calculate velocity of the track after 30 seconds. (9 marks)

### Question FIVE

- a. Define the following terms:- (4 marks)
- Intensity of direct strain
  - Shearing stress and strain
- b. Show using a well labelled diagram, a simple pulley block with a velocity ratio of 5. (4 marks)
- c. A copper wire 1.6mm diameter, 4m long extends 1.7mm when carrying a mass of 98N. Calculate:-
- The stress and strain in the wire at this load
  - The modulus of elasticity of copper
  - The factor of safety if the ultimate tensile strength of copper is 220N/mm<sup>2</sup> (6 marks)
- d. A specimen of low carbon steel (En 3B) was subjected to a tensile test to destruction and the following results and details were obtained.

Maximum Load = 34.04kN  
 Yield Load = 31.39kN  
 Limit of proportionality load = 22.08kN  
 Gauge Length = 50mm  
 Final distance between gauge lengths = 58mm  
 Original cross sectional area = 64mm<sup>2</sup>

Diameter at fracture = 6mm

Calculate:-

- i. The tensile strength
- ii. The yield stress
- iii. The limit of proportionality stress.

(6 marks)