MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

FIRST YEAR SECOND SEMESTER EXAMINATION FOR

CERTIFICATE IN MECHANICAL ENGINEERING

1503/102: APPLIED SCIENCE

DATE: 18/4/2019 **TIME:8.30-11.30 AM**

INSTRUCTIONS:

- ***This paper consists of FIVE questions***
- ***Answer all questions***

QUESTION ONE (20 MARKS)

a) Define the following terms

i. Mechanical advantage

ii. Velocity ratio (4 marks)

b) In a certain wheel and axle machine, the diameters of the wheel and the axle are 450 mm and 60 mm respectively. The efficiency is 97% when a body having a mass of 40 kg is being lifted. Calculate:-

i. The velocity ratio

ii. Ideal effort

iii. The actual effort

iv. The mechanical advantage (8 marks)

c) A body having a mass of 200 kg is resting on top of a screw jack. The screw jack has a lead (pitch) of 8 mm and an effort of 36 N has to be applied tangentially at a radius of 250 mm to lift the load. Calculate

i. The velocity ratio

ii. Mechanical advantage

iii. Efficiency (8 marks)

QUESTION TWO (20 MARKS)

a) In relation to light and sound state the laws of:-

i. reflection

ii. refraction (4 marks)

b) A light ray strikes an air/water surface at an angle of 46^0 with respect to the normal. The refractive index for air is 1 and water is 1.33. find the angle of refraction when the direction of ray is:-

i. From air to water

ii. From water to air (16 marks)

QUESTION THREE (20 MARKS)

The table below shows the values of load-effort during a test series for a lifting appliance. The velocity ratio of the machine was 3. Draw the load-effort graph and determine:-

a) Law of the machine

b) Effort and efficiency while lifting a load of 50

c) Limiting efficiency (20 marks)

Load (N)	14	28	42	56	70	84
Effort (N)	14.5	20.5	26	32	38.5	44.5

QUESTION FOUR (20 MARKS)

a) Define the following

i. Transverse wave.

ii. Longitudinal wave.

iii. Refractive index. (6 marks)

b) A concave spherical mirror has a radius of curvature 4 m and the object is 5 cm placed 3 m in front of the mirror. Determine the:-

i. Position of the image.

ii. Height of the image (7 marks)

c) A swimmer is treading water (with her head above the water) at the surface of 3 m-deep pool. She sees a coin on the bottom directly below. How deep does the coin appear to be? The refractive index of water is 1.33 and air is 1. (7 marks)

QUESTION FIVE (20 MARKS)

For a screw jack, what load will be lifted by an effort of 120 N, if the velocity ratio is 18 and efficiency of the machine at this load is 60%? Determine the law of the machine, if it is observed that an effort of 200 N is required to lift a load of 2600 N and find the effort required to run the machine at a load of 3.5 kN. (20 marks)