TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology
Department of Electrical & Electronics Engineering
UNIVERSITY EXAMINATION FOR:
Diploma in Technology in Electrical and Electronics Engineering (DTEEE)
EME 2130**:** Mechanical Engineering Science
END OF SEMESTER EXAMINATION
SERIES: AUGUST 2019
TIME: 2 HOURS
DATE: Pick Date **Aug 2019**

Instruction to Candidates:

You should have the following for this examination

- *Student I.D. Card & Examination Pass*
- *Answer booklet*
- *Non-programmable Scientific Calculator*

This paper consists of **FIVE** questions. Attempt question **ONE (Compulsory),** and any other **TWO** question from section.
Maximum marks for each part of a question are as shown.
Do not write on the question paper.

Question ONE (Compulsory)

a) i) State Hooke's Law (1 mark)

ii) A force of 10 kN applied to a component produces an extension of 0.1 mm. Determine the force needed to produce an extension of 0.12 mm. (2 marks)

b) A car towing another at 54 km/h exerts a steady pull of 800 N. Determine the work done in 0.5 hours. (3 marks)

c) A vehicle of mass 900 kg travels round a bend of radius 180 m, at 48.4 km/h. Determine the centripetal force acting on the vehicle. (3 marks)

d) Calculate the force needed to accelerate a boat of mass 22 tonne uniformly from rest to a speed of 24.6 km/h in 12 minutes. (6 marks)

e) The link in **Fig Q1 (e)** is subjected to two forces F_1 and F_2. Determine the magnitude of the resultant force. (5 marks)

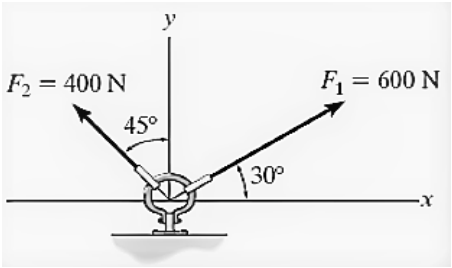

Fig Q1 (e)

Question TWO

a) A car is travelling at 64.8 km/h and has wheels of diameter 600 mm.
   i) Find the angular velocity of the wheels in both rad/s and rev/min.
   ii) If the speed remains constant for 1.44 km, determine the number of revolutions made by a wheel, assuming no slipping occurs.

(7 marks)

b) Three balls, ***A***, ***B***, and **C** lie in a straight line. ***A*** has a mass of 6 kg and is moving towards ***B*** at 10 m/s. ***B*** has a mass of 10 kg and a velocity of 7 m/s, and is moving towards ***C***. Ball ***C*** is moving at 2 m/s. ***A*** collides with ***B***, and ***A*** and ***B*** then collide with ***C***. Determine the mass of ball ***C*** assuming all three balls have a common velocity of 3 m/s after the collision of ***A*** and ***B*** with **C**.

(13 marks)

Question THREE

a) Define the following terms (3 marks)

   i) Scalar quantity
   ii) Length
   iii) Mass

b) State the Newton's Laws of motion (3 marks)

c) Forces F_1, F_2, and F_3 are acting at point A of the bracket as shown in **Fig Q3 (c)** Using the components method, determine the magnitude and direction of the resultant ***R***. (14 marks)

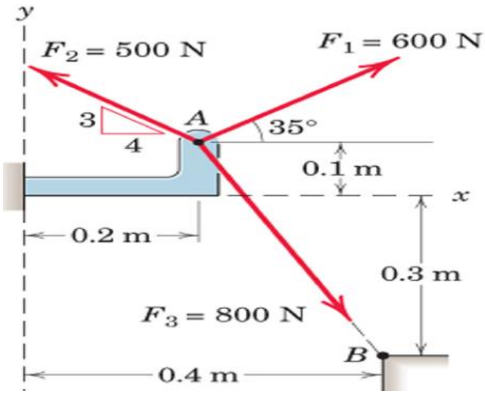

Fig Q3 (c)

Question FOUR

a) Differentiate between work and energy. (2 marks)

b) State the law of conservation of energy. (2 marks)

c) The potential energy of a mass is increased by 20.0 kJ when it is lifted vertically through a height of 25.0 m. It is now released and allowed to fall freely. Neglecting air resistance, find its kinetic energy and its velocity after it has fallen 10.0 m. (8 marks)

d) A load is hoisted 42 m and requires a force of 100 N. The efficiency of the hoist gear is 60% and that of the motor is 70%. Determine the input energy to the hoist. (8 marks)

Question FIVE

a) Differentiate between shear and tensile strains using diagrams (3 marks)

b) A zinc specimen of circular cross-section is subjected to a tensile test and the data from the test is shown below:

Diameter of specimen = 12 mm; Gauge length = 135 mm;
Extension at fracture = 5 mm; Final Diameter = 8 mm

Load (kN)	10	15	20	25	30	35	40	37	34	32
Extension (m $\times 10^{-6}$)	0.15	0.25	0.35	0.45	0.80	1.15	1.90	2.80	3.50	4.60

i) Plot a load/extension graph using the data tabulated above. (3 marks)

Using the graph and the other information supplied, determine the values of:

(ii) The stress at limit of proportionality (3 marks)
(ii) Young's modulus of elasticity; (4 marks)
(iv) The ultimate tensile stress; (2 marks)
iv) The percentage elongation; (2 marks)
v) The stress at a strain of 0.01 (3 marks)