



TECHNICAL UNIVERSITY OF MOMBASA

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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  
SPECIAL/ SUPPLEMENTARY 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.**

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**Question ONE (Compulsory)**

- Sketch a graph of stress versus strain for a ductile material and identify any four important points on that curve (5 marks)
- A vector **A** has a magnitude of 50.0 m and points in a direction  $20.0^\circ$  below the positive  $x$ -axis. A second vector **B**, has a magnitude of 70.0 m and points in a direction  $50.0^\circ$  above the positive  $x$ -axis. Draw the vectors **A**, **B**, and **C=A+B** on a Cartesian plane and determine the magnitude and direction of vector **C**. (5 marks)
- A wheel of diameter 540 mm is rotating at  $(1500/\pi)$  rev/min. Calculate the angular velocity of the wheel and the linear velocity of a point on the rim of the wheel. (4 marks)
- i) Differentiate between work and power.

- ii) Determine the power required to lift a load through a height of 20 m in 12.5 s if the force required is 2.5 kN. (6 marks)

### Question TWO

- a) Differentiate between Energy, heat and power. (3 marks)
- b) State the law of conservation of mechanical energy. (2 marks)
- c) The resistance to a cutting tool varies during the cutting stroke of 800 mm as follows: First, the resistance increases uniformly from an initial 5000 N to 10000 N as the tool moves 500 mm, and second, the resistance falls uniformly from 10000 N to 6000 N as the tool moves 300 mm. Draw, to scale, the work diagram and calculate the work done in one cutting stroke. (10 marks)
- d) Determine the output energy of an electric motor which is 60% efficient if it uses 2 kJ of electrical energy. (5 marks)

### Question THREE

- a) Differentiate between destructive and non-destructive material testing methods (2 marks)
- b) Below is a data obtained during a tensile test on a mild steel specimen:

Diameter of specimen = 12.0 mm; Gauge length = 76 mm;  
 Diameter at fracture = 9.2 mm. Gauge length at fracture = 95 mm  
 Maximum load carried = 40 kN Load at fracture = 29 kN

Load (kN)	2.47	4.97	7.40	9.86	12.33	14.80	17.27	19.74	22.20	24.7	27.13	29.60	31.10	33.30
Extension (m ×10 <sup>-6</sup> )	5.6	11.9	18.2	24.5	31.5	38.5	45.5	52.5	59.5	66.5	73.5	81.2	89.6	112

- i) Plot a load/extension graph using the data tabulated above. (4 marks)

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

- (ii) Young's modulus of elasticity; (4 marks)
- iii) The ultimate tensile stress; (2 marks)
- iv) The percentage reduction of area; (3 marks)
- v) The percentage elongation; (2 marks)
- vi) The actual stress at fracture. (3 marks)

### Question FOUR

- a) Define the following terms (3 marks)
- i) Mass
  - ii) Length
  - iii) Particle
- b) State the Newton's Laws of motion (3 marks)
- c) Two forces  $F_1$  and  $F_2$  act on a hook as shown in Fig Q1. The force  $F_1$  makes angles  $45^\circ$ ,  $60^\circ$ , and  $120^\circ$  with  $x$ -,  $y$ -, and  $z$ - axes respectively. Determine the magnitude of  $F_2$  and its coordinate direction angles, given that the resultant force  $R$  acts along the positive  $y$ -axis and has magnitude of 1200 N. (14 marks)

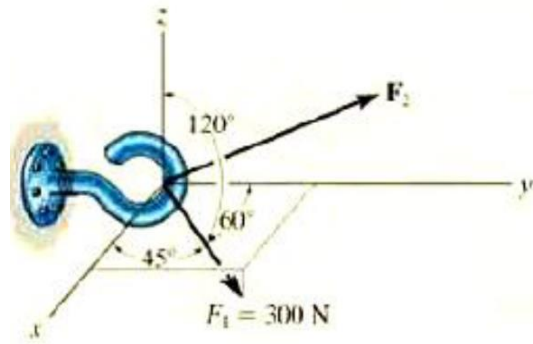


Fig. Q5

### Question FIVE

- a) An object is suspended by a thread 200 mm long and both object and thread move in a horizontal circle with a constant angular velocity of 2.5 rad/s. If the tension in the thread is 12 N, determine the mass of the object. (4 marks)
- b) A ball of mass 50 g is moving with a velocity of 4 m/s when it strikes a stationary ball of mass 25 g. The velocity of the 50 g ball after impact is 2.5 m/s in the same direction as before impact. Determine the velocity of the 25 g ball after impact. (7 marks)
- c) i) The speed of a shaft increases uniformly from 300 revolutions per minute to 800 revolutions per minute in 10s. Find the angular acceleration of the shaft (5 marks)
- ii) If the diameter of the shaft in problem c (i) above is 50 mm, determine the linear acceleration of the shaft on its external surface, correct to 3 significant figures. (4 marks)