



# MACHAKOS UNIVERSITY

University Examinations 2023/2024 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

FIRST YEAR FIRST SEMESTER EXAMINATION FOR  
BACHELOR SCIENCE IN ELECTRICAL ENGINEERING  
BACHELOR SCIENCE IN MECHANICAL ENGINEERING  
BACHELOR SCIENCE IN CIVIL ENGINEERING

ECU 101/112: PHYSICS FOR ENGINEERS 1

DATE:

TIME:

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**INSTRUCTIONS:**

- The paper consists of **two** sections.
- Section **A** is **compulsory** (30 marks).
- Answer any **two** questions from section **B** (each 20 marks).

**SECTION A**

**QUESTION ONE (30 MARKS)**

- (a) What do you understand by the following terms
- (i) A rigid body (1 Mark)
  - (ii) Steady fluid flow (1 Mark)
- (b) An object accelerates uniformly at  $3\text{ms}^{-2}$ . If it attains a velocity of  $4\text{ms}^{-1}$  in 5 seconds, determine the initial velocity. (3 Marks)
- (c) Differentiate between torque and couple as applied in mechanics (2 marks)
- (d) What is meant by tensile strength of a material? (2 marks)
- (e) Derive the Second equation of linear motion (3 Marks)
- (f) A classical music vinyl record weighing 40 g has a radius of 30cm. If it acquires a speed of 33 *r.p.m* in 3 sec starting from rest, determine the torque acting on it. (3 Marks)
- (g) Briefly describe the principle behind the working of a water sprinkler nozzle. (3 Marks)
- (h) Name any one application of Pascal's principle in our day to day activities (2 Marks)
- (i) State the assumptions taken into account when developing the ideal gas model (5 Marks)

- (j) A 0.5 mole of gas at temperature 300 K expands isothermally from an initial volume of 2 L to 6 L
- (a) What is the work done by the gas? (2 Marks)
- (b) What is the final pressure of the gas? (The value of gas constant,  $R = 8.31 \text{ J mol}^{-1} \text{ K}^{-1}$ ) (3 Marks)

## SECTION B

### QUESTION TWO (20 MARKS)

- (a) A force  $F$  acts on a body at an angle  $\theta$  to the horizontal. Find the vertical and horizontal components of  $F$ . (3 Marks)
- (b) Use examples to answer the following questions:
- i) Can a body have a constant velocity and varying speed? (1 Marks)
- ii) Can the direction of a body's velocity change when it has constant acceleration? (1 Marks)
- (c) A car moving with a speed of 54Km/h accelerates uniformly at the rate of  $2\text{ms}^{-2}$ . Calculate the distance traveled from the place where the acceleration begun to that where the velocity reaches 72Km/h and the time taken to cover this distance. (6 Marks)
- (d) Elasticity of materials is an important aspect in structural strength applications. One measure of this property is Young's Modulus and Bulk modulus of the material. By citing one application, define what is meant by Young's Modulus. (2 Marks)
- (e) Explain what is meant by the following terms
- (i) Yield Strength (2Marks)
- (ii) Elastic limit (1 Mark)
- (f) Fill the table below with missing information

| Linear Motion     | Rotational dynamics |
|-------------------|---------------------|
| (i)..... (1 Mark) | $\alpha$            |
| s                 | (ii) ..... (1 Mark) |
| v                 | (iii) ..... (1Mark) |
| momentum          | (iv) ..... (1 Mark) |

### QUESTION THREE (20 MARKS)

- a) Differentiate between the concept of moment of a force and torque (4 Marks)
- b) State and explain five forms of energy that exist in nature. (5 Marks)
- c) A cruise missile is launched with an initial speed of  $72\text{kmh}^{-1}$  and at an angle  $25^\circ$  to the horizontal. Determine
- (i) the maximum height the projectile will attain (2 Marks)
- (ii) the time it takes for the missile to hit the target on the ground (5 Marks)
- (iii) Horizontal distance covered by the missile (2 Marks)
- (iv) Show that the range of the projectile is a maximum when angle of launch  $\theta = 45^\circ$  (2 Marks)

**QUESTION FOUR (20 MARKS)**

- a) List down ANY THREE applications of friction (3 Marks)
- b) A man weighing 80 Kg climbs up a slope 400m long inclined at an angle of  $5^\circ$  to the horizontal. Calculate the minimum work done by the man. (5 Marks)
- c) A stationary golf ball is hit with a club, which exerts an average force of 80N over a time of 0.025s. Calculate
- i. The change in momentum (4 Marks)
  - ii. The velocity acquired by the ball if it has a mass of 0.020 Kg. (3 Marks)
- d) State and explain ANY THREE areas where the concept of collision is used constructively in our day to day activities (6 Marks)

**QUESTION FIVE (20 MARKS)**

- a) Temperature has been known to be the property that describes quantitatively the thermal property of a system.
- (i) How is temperature related to the THERMAL EQUILIBRIUM of a system as applied in thermodynamics? (3 Marks)
  - (ii) Give one example in our daily lives where the phenomena in (i) above is experienced (3 Marks)
- b) (i) Briefly explain the physical implication of the difference between the specific heat for water ( $4186\text{J}/^\circ\text{C}$ ) and for copper ( $387\text{J}/^\circ\text{C}$ ) (4 Marks)
- (ii) Water finds a lot of industrial applications in cooling and heating systems, how does this property of heat capacity relate to some of the uses highlighted here? (4 Marks)
- c) Briefly describe using examples of each of the following modes of heat transfer take place.
- (i) Conduction (2 Marks)
  - (ii) Convection (2 Marks)
  - (iii) Radiation (2 Marks)