



**MASINDE MULIRO UNIVERSITY OF  
SCIENCE AND TECHNOLOGY  
(MMUST)**

**UNIVERSITY EXAMINATIONS  
2021/2022 ACADEMIC YEAR**

**FIRST YEAR FIRST SEMESTER PART-TIME EXAMINATIONS**

**FOR THE DEGREE  
OF  
BACHELOR OF EDUCATION SCIENCE**

**COURSE CODE:   SPH 112**

**COURSE TITLE:   MECHANICS**

**DATE: TUESDAY 19<sup>TH</sup> APRIL, 2022    TIME: 9:00 AM - 12:00 PM**

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**INSTRUCTIONS TO CANDIDATES**

TIME: 2 Hours

**Answer question ONE and any TWO of the remaining.**

**Symbols used bear the usual meaning.**

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 3 Printed Pages. Please Turn Over. 

**Question One (30 marks)**

- a) What is classical mechanics? (2 marks)
- b) What is dimensional analysis? (2 marks)
- c) Explain the parallel axis theorem. (2 marks)
- d) What is kinematics? Give one example of such motion. (3 marks)
- e) A point has polar coordinate  $(5, 30^\circ)$ . Convert this into rectangular coordinates. (3 marks)
- f) State LAMI'S theorem for three forces in equilibrium. (3 marks)
- g) A particle P of mass 6kg has velocity  $(4i+2j)$  m/s collides head on with another particle of mass 10kg travelling with a velocity of  $(i-4j)$  m/s. Find their total momentum before collision (3 marks)
- h) A point has rectangular coordinates; (3, 4). Convert this into polar coordinates. (3 marks)
- i) The rotor on a helicopter turns at an angular speed of 320 revolutions per minute. Express this in radians per second. (3 marks)
- j) Differentiate between a one dimensional and a two dimensional kinematics. Give an example of each. (3 marks)
- k) State three newton's laws of motion. (3 marks)

**Question Two (20 marks)**

- a) Write down the four assumptions for free fall motion. (4 marks)
- b) A particle starts upward motion with a velocity of  $(2i+3j)$  m/s. How high will it be after 0.5 s. Take  $g=9.82j$  m/s<sup>2</sup>. (5 marks)
- c) Show whether the following equations are dimensionally correct or not.

$w = \frac{1}{2}mv^2 - mgh$  where, w, is the work done, m, is the mass of the object, v, is the speed of the body, g, is the gravitational force and h, is the height of motion. (5 marks)

- d) A wheel turns through 90 revolutions in 15 seconds. Its angular speed at the end of the period is 10 rev/s.
- i) Find angular speed at the beginning of the 15s interval. (6 marks)
- Assume acceleration is constant.**

**Question Three (20 marks)**

- a) A wheel turns through 90 revolutions in 15 seconds. Its angular speed at the end of the period is 10 rev/s.
- I) Find angular speed at the beginning of the 15s interval. (6 marks)
- Assume acceleration is constant.**
- II) How much time has elapsed between the time when the wheel was at rest and the beginning of the 15s interval? (4 marks)
- b) A centrifuge with a radius of 10m starts to rotate according to the equation

$$\theta = 0.3t^2$$

Where,  $t$ , is in seconds and theata is radians. After five seconds, what is; its angular velocity, Linear speed, tangential acceleration and radial acceleration? (10 marks)

**Question Four (20 marks)**

- a) State the zeroth law in thermodynamics. (2 marks)
- b) Explain with examples the quasi static process. (4 marks)
- c) Interpret each term in the equation below and enunciate the law connected to it. (4 marks)
- $$dQ = dU + dW$$
- d) Define  $C_p$  and  $C_v$  and prove qualitatively that  $C_p > C_v$  (2 marks)
- e) What is the angular speeds and angular accelerations of the second, minute and hour hands of an accurate watch? (8 marks)

**Question Five (20 marks)**

- a) Show whether the following equations are dimensionally correct or not.
- I)  $v = ut + at$  Where,  $u$  and  $v$ , are the initial and final speeds of the body,  $a$ , is the linear acceleration and,  $t$ , is the time of motion. (5 marks)
- II)  $v^2 = u^2 + 2ax$  Where,  $u$  and  $v$ , are the initial and final speeds of the body,  $a$ , is the linear acceleration and,  $x$ , is the distance covered. (5 marks)
- b) Explain the following terms; Angular position, Angular displacement, Angular velocity and Angular acceleration. (4 marks)
- c) Three particles of masses  $m_1 = 1.2 \text{ kg}$ ,  $m_2 = 2.5 \text{ kg}$ ,  $m_3 = 3.4 \text{ kg}$  form an equilateral triangle of edge length 140 cm. The coordinates of the three particles are (0,0), (140cm,0) and (70 cm,121 cm) respectively. Find the center of mass of this three particle system. (6 marks)