# NAMIBIA UNIVERSITY
## OF SCIENCE AND TECHNOLOGY

## FACULTY OF HEALTH AND APPLIED SCIENCES

### DEPARTMENT OF MATHEMATICS AND STATISTICS

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| **QUALIFICATION:** Bachelor of science in Applied Mathematics and Statistics | |
| **QUALIFICATION CODE:** 07BAMS | **LEVEL:** 7 |
| **COURSE CODE:** MCS702S | **COURSE NAME:** MECHANICS |
| **SESSION:** JANUARY 2019 | **PAPER:** THEORY |
| **DURATION:** 3 HOURS | **MARKS:** 83 |

| SECOND OPPORTUNITY EXAMINATION QUESTION PAPER | |
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| **EXAMINER** | Dr I.K.O. AJIBOLA |
| **MODERATOR:** | PROF D. MAKINDE |

| INSTRUCTIONS |
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| 1. Answer ALL the questions in the booklet provided. |
| 2. Show clearly all the steps used in the calculations. |
| 3. All written work must be done in blue or black ink and sketches must be done in pencil. |

## PERMISSIBLE MATERIALS

1. Non-programmable calculator without a cover.

**THIS QUESTION PAPER CONSISTS OF 3 PAGES** (Including this front page)

**QUESTION1 (16 marks)**

1.1    If vectors   $\bar{a} = i + 2j + 3k$ and $\bar{b} = 4i - 5j - 5k$

        1.1.1 Obtain the unit vectors of $\bar{a}$ and $\bar{b}$ in their directions        [5]

        1.1.2  Calculate the angle between the two 3D vectors $\bar{a}$ and $\bar{b}$        [6]

1.2    Given three 3-dimensional vectors *A, B, and C* :

        1.2.1     find the scalar triple product                        [2]

        1.2.2     show that the product $\bar{A} \bullet (\bar{B}X\bar{C}) = \bar{B} \bullet (\bar{C}X\bar{A})$      by a cyclic change

                of the vectors *A, B, and C*                             [3]


**Question 2 (21 marks)**

       A sports car is sitting at rest in a freeway entrance ramp. The driver sees a break in traffic and floors the car's accelerator to a constant acceleration of 4.9 metre per second square as it moves in a straight line onto the highway.

2.1    What distance does the car travelled in reaching the freeway at 30m/s ?        [6]

2.2     Given two vectors $\bar{A} = 2i + 3j - 5k$ and $\bar{B} = 4i - j + 3k$

        obtain the size and direction of their vector product.              [6]

2.3    The acceleration of a point in rectilinear motion is given by $a = -9.8$ It is observed that the velocity V is zero and the displacement x is +25 when t = 0.
        Determine the equation of the displacement.                 [9]


**QUESTION 3 (15 marks)**

3.1     A vehicle's lateral acceleration is 0.92g. If this represents maximum centripetal acceleration that can be attained without skidding out of the circular path and velocity of the car is 45m/s. What is the minimum radius of curve the car can negotiate (assume an unbanked curve)

                                                                         [5]

3.2     Passengers in a carnival ride travel in a circle with radius 5.0 meter, making one complete circle in a time T = 4.0s. What is their acceleration.           [10]

**QUESTION 4 (14 marks)**

4.1    Describe a simple 2D projectile motion along a trajectory.          [8]

4.2    A five dollar coin is dropped from a height of a tall building. It starts from rest and falls
         freely. Compute its position and velocity after
4.2.1    1.0 second          [2]
4.2.1    2.5 seconds          [2]
4.2.3    3.75 seconds

                                                                                                          [2]


**QUESTION 5 (17 marks)**

5.1    State and explain the law of conservation of energy of
         an isolated system giving at least two examples          [4]


5.2    Give an expression for the work done by an object that undergoes a
         displacement $\vec{S}$ along a straight line, with a constant force $\vec{F}$ of
         magnitude $F$ making an angle $\phi$ with $\vec{S}$ when acting on the object          [3]


5.3    Using the work-kinetic energy theorem, show that the work done by a particle or object
         with mass $m$ moving in the $x$-direction under a constant net force $F_{total}$, with constant

         acceleration is given by $F_{total} \cdot S = \frac{1}{2} m \left( v_f + v_i \right) \left( v_f - v_i \right)$ where,

         $v_i$ and $v_f$ are the initial and final speeds of the particles.          [4]

   5.4    A ball of mass 0.250 kg is thrown straight up in the air, giving it an
         initial velocity of magnitude 23.0 m/s. Use the law of conservation of
              energy to find how far up it goes, (ignoring air resistance).          [6]


**END OF EXAMINATION**