MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

UNIVERSITY EXAMINATIONS
2022/2023 ACADEMIC YEAR

FIRST YEAR SECOND SEMESTER MAIN EXAMINATIONS

FOR THE DEGREE

OF
BACHELOR OF SCIENCE (MATHEMATICS)

COURSE CODE: MAT 122

COURSE TITLE: ELEMENTARY APPLIED MATHEMATICS

DATE: 19th April ,2023   **TIME:** 12.00noon -2.00pm

INSTRUCTIONS TO CANDIDATES

- Answer question ONE (COMPULSORY) and any other TWO questions

Time: 2 hours

QUESTION ONE (30mks)

a) Find moment of F about P given $\theta = 35^0, F = 8, d = 14$. (3mks)

b) Find the value of β for which the vectors $\vec{u} = \beta i + 3j$ and $\vec{v} = (\beta - 5)i + 2j$ are orthogonal. (4mks)

c) A ball is fired at an angle of 30^0 to the horizontal at the velocity of 25m/s. Determine its time of flight and range. (Take g = 10m/s²). (4 Mark)

d) A body of mass 2kg moving with speed 5m/s collides directly with another of mass 3 kg moving with speed 4m/s in the same direction. The coefficient of restitution is 2/3. Find the velocities after collision. (5mks).

e) Show that $2y + 4x + 3 = 0$ is a straight line and find its gradient and intercept hence sketch the line. (4mks)

f) The force $\vec{F_1} = 3\vec{i} + 4\vec{j} + \vec{k}$ acts on a particle thereby displacing it from point A (1, 0, 1) to B (4, 2, 6). Find the work done by this force. (4mks)

g) State the laws of friction. (4mks)

h) A man lifts a weight of 300N through a vertical height of 2m in 6 seconds. What is the power developed. (3mks)

QUESTION TWO (20mks)

a) Suppose that there is a non-uniform rod AB of length 10m and weight 15N. It is in a horizontal position and rests on supports at C & D. The distance AC=3m and AD=7m. The magnitude of the reaction at C is four times the magnitude of the reaction at D. Find the distance of the center of mass of the rod from A. (6mks)

b) A nail of mass 0.02 kg is driven into a fixed wooden block, its initial speed is 30 m/s and it is brought to rest in 5ms. Find the impulse and the value of the force (assume this constant) on the nail. (5mks)

c) Use the distance formula to find an equation for the set of points such that the distance of p from the line $X = -3$ is 3 times its distance from (1,0). (3mks)

d) A 2kg block A is released from rest falls a distance $h = 0.5m$ and strikes plate B (3kg mass). The coefficient of restitution between A and B is $e = 0.6$, and the spring stiffness is $k = 30N/m$. Find the velocity of block A just after the collision. (6mks)

QUESTION THREE (20mks)

a) A block whose weight is 100N rests on an inclined plane inclined at 16^0 to the horizontal. Determine the value of the horizontal force that will make it slide down the plane. Take the coefficient of friction as 0.4. (8mks)

b) State the laws of motion. (3mks)

c) Show that the displacement S of a body moving in a straight line with uniform acceleration is given by $S = ut + \frac{1}{2}at^2$ (4mks)

d) A car of mass 500kg is travelling along a horizontal road. The engine of the car is working at a constant rate of 5Kw. The total resistance to motion is constant and is 250N. What is the acceleration of the car when its velocity is 5m/s. (5mks)

QUESTION FOUR (20mks)

a) A ball is thrown vertically upwards at 20m/s, find;

i)   The maximum height reached. (3mks)

ii)   The time taken to reach maximum height. (3mks)

iii)   The time of flight (take g = 10m/s²). (2mks)

b) A car that has been travelling at 60m/s is brought to a stop at constant deceleration 180m from where the brakes were applied. How far has the car moved when its velocity has been reduced by 10m/s. (8mks)

c) Given $\vec{u} = i - 2j - 2k \quad and \quad \vec{v} = 6i + 3j + 2k$ find $\vec{u} \; x \; \vec{v}$ (4mks)

QUESTION FIVE (20mks)

a) Find the direction cosines and direction angles of the vector $v = i - 3j + 7k$ (4mks)

b) A car of mass $2000kg$ is travelling at $40m/s$.

i)   What is its kinetic energy? (2 Marks)

ii)   If the car slows down to $20m/s$ what is its energy now? (1 Mark)

iii)   What is the change in kinetic energy? (1 Mark)

iv)   If it takes $80m$ to slow down to $20m/s$, what is the average braking Force and deceleration? (3 Marks)

c) A particle moves according to the law of motion $S = f(t) = t^3 - 12t + 36t, t \geq 0$, where t is measured in seconds and S in feet. (9mks)

i) Find the velocity at time t

ii)   What is the velocity after $3s$

iii)   When is the particle at rest?

iv)   When is the particle moving in the positive direction?

v)   Find the total distance travelled during the first $8s$