(Knowledge for Development)

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS

2015/2016 ACADEMIC YEAR

FIRST YEAR SECOND SEMESTER

MAIN EXAMINATION

FOR THE DEGREE OF BACHELOR OF SCIENCE (MATHEMATICS) AND BACHELOR OF EDUCATION

COURSE CODE: **MAT 122**

COURSE TITLE: ELEMEMTARY APPLIED MATHEMATICS

DATE: 11/5/16 **TIME:** 9 AM -11 AM

INSTRUCTIONS TO CANDIDATES

Answer Question One and Any other TWO Questions

TIME: 2 Hours

QUESTION ONE COMPULSORY (30 MARKS)

(a) Briefly explain the following terms: (4 mks)

- (i) Momentum
- (ii) Impulse
- (iii) Newton's second law of motion
- (iv) Coefficient of restitution

(b) Find the equation of the straight line joining the origin to the point of intersection of $3x + y = 7$ and $5x - 2y - 14 = 0$ (4 mks)

(c) If θ is the angle between $\boldsymbol{a}$ and $\boldsymbol{b}$ prove that $\boldsymbol{a}.\boldsymbol{b} = \|\boldsymbol{a}\|\|\boldsymbol{b}\|cos\theta$ (5 mks)

(d) Triangle ABC has vertices at A(1,1), B(4,5) and C(6,3). Find the equation of the altitude from B (4 mks)

(e) Find the centre and radius of the circle passing through the points (5,3), (-2,2) and (2,4) (7 mks)

(f) Show that the points A(3,-5), B(2,5), C(0,6) and D(1,-4) are vertices of a parallelogram (6 mks)

QUESTION TWO (20 MARKS)

(a) If $\boldsymbol{p} = 3i + 2j - k$ and $\boldsymbol{q} = i - j + \frac{1}{2}k$ and $\boldsymbol{r} = 2i - k$ evaluate $\boldsymbol{p}.(2\boldsymbol{r} \times \boldsymbol{q})$ (5 mks)

(b) A plane is defined by 3 points as P(2,1,-1), Q(3,1,5) and R(-1,-2,4) find the vector that is orthogonal to the plane. (5 mks)

(c) Derive the equation of motion $v^2 = u^2 + 2as$ (6 mks)

(d) Write the equation of line L through A(-3,2,6) parallel to the vector $r = \langle 2, -3, 1 \rangle$ giving your answer in vector, parametric and symmetric forms (4 mks)

QUESTION THREE (20 MARKS)

(a) Convert into Cartesian coordinates $\left(3, \frac{\pi}{6}\right)$ (3 mks)

(b) If the direction cosines of a line are in the ratio $4:5:7$ find

- (i) The actual direction cosines (3 mks)
- (ii) Direction angles (3 mks)

(c) Find the line through the points $P_1(-4,2,-5)$ and $P_2(5,6,-7)$ in parametric and symmetric forms (4 mks)

(d) Prove that $\vec{A} \times (\vec{B} \times \vec{C}) = \vec{B}(\vec{A}.\vec{C}) - \vec{C}(\vec{A}.\vec{B})$ (7 mks)

QUESTION FOUR (20 MARKS)

(a) Consider the plane $P = 3x + 2y - 5z = 7$ find the point of intersection of the plane with the line $x = 2ty = 1 - t$ and $y = 3t + 1$ (4 mks)

(b) A particle of mass 50g travelling horizontally at 42 m/s hits a cliff and rebounds with a speed of 28 m/s. Find the impulse exerted on the ball. (4 mks)

(c) Find the area of the region enclosed by $r_1 = 3cos\theta$ and $r_2 = 1 + \cos\theta$ (5 mks)

(d) A ball is projected upwards with a velocity of 45 m/s from the ground. Calculate

(i) The time it takes to reach maximum height (2 mks)

(ii) Maximum height reached (2 mks)

(iii) Show that the velocity with which it lands on the ground is 45 m/s (take $g = 10/s^2$) (3 mks)

QUESTION FIVE (20 MARKS)

(a) Find the unit vector in the direction of $\boldsymbol{a} = 4i - 3j - 2k$ (2 mks)

(b) Find the angle between the planes $x + 5y - 2z = 6$ and $3x - 3y + z = 7$ (6 mks)

(c) Sketch the graph of $r = 1 - sin2\theta$ (6mks)

(d) Show that the equation of the circle through the midpoints of the sides of the triangle whose vertices are (a,0), (b,0) and (0,c) is $x^2 + y^2 - \frac{a+b}{2}x + \frac{ab-c^2}{2c}y = 0$ (6mks)