(Knowledge for Development)

KIBABII UNIVERSITY COLLEGE

A CONSTITUENT COLLEGE OFMASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY

UNIVERSITY EXAMINATIONS

2014/2015 ACADEMIC YEAR

FIRST YEAR SECOND SEMESTER

MAIN EXAMINATION

FOR THE DEGREE OF BACHELOR OF SCIENCE

(COMPUTER SCIENCE & INFORMATION SCIENCE)

COURSE CODE: **MAT 111**

COURSE TITLE: **GEOMETRY AND ELEMENTARY APPLIED MATHEMATICS**

DATE: 30/4/15 **TIME:** **3.00PM-5.00PM**

INSTRUCTIONS TO CANDIDATES

Answer Question One in and Any other TWO Questions

TIME: 2 Hours

QUESTION ONE (30marks)

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

(b).Find the mass that must be hung $1.7m$ to the right of a fulcrum of uniform mass bar to balance a $69k$ mass suspended $1m$ to the left of the fulcrum. (2mks)

(c) Find the rectangular coordinates of a point whose polar coordinates are $(6, 135^{C})$. (3mks)

(d) Show that the circles $x^2 + y^2 - 4x + 6y + 1 = 0$ and $x^2 + y^2 + 2x - 2y - 11 = 0$ are orthogonal. (4mks)

(e) Find the equation of circle passing through the origin with centre at $(2, -1)$. (3mks)

(f) Find the equation of the tangent and normal to the curve $y = 3x^2 - 8x + 5$ at the point where $x = 2$. (3mks)

(g)State the three equations of linear motion (3mks)

(h) Given $u = \begin{Bmatrix} p \\ q \\ r \end{Bmatrix}$, $b = \begin{Bmatrix} s \\ t \\ u \end{Bmatrix}$, and $c = \begin{Bmatrix} v \\ w \\ x \end{Bmatrix}$. Show that $u.(b + c) = u.b + u.c$ where u , b a c are not necessarily coplanar and state this property. (4mks)

(i) Find a polar equation for a circle whose Cartesian equation is $x^2 + y^2 = 4x$. (2mks)

(j) A box of mass $8k$, standing on a rough horizontal ground is pulled by a string inclined at 30^{C} to the horizontal . If the body is about to slide and $\mu = 0.5$, find the tension in the string. (3mks)

QUESTION TWO (20 MKS)

(a).Verify that the point (1,2) lies on the circle $x^2 + y^2 - 6x + 4y - 7 = 0$ and find the equation of the tangent at this point.(3 mks)

(b) Express $(4, -4)$ in polar coordinates. (2mks)

(c) Find the Cartesian equation for the polar equation given by $r = a(1 + 2c$).(3mks)

(d) Find the arc length of the spiral $r = e^{\theta}$ between $0 \leq \theta \leq 1$. (3mks)

(e) A light rod A rests to support one at A and one at B.The rod is in equilibrium when mass of $5k$ and mass of $2k$ are placed at $0.6\ m$ and $0.5m$ from ends A and B respectively. Given that the length of the rod is $2m$, find the reaction at the supports. (3mks)

(f) Derive the equation of motion $v^2 = u^2 + 2a$. (3mks)

(g) Show that if you can find $g^2 + f^2 - c \geq 0$, then the equation $x^2 + y^2 + 2g \quad + 2f \quad + c = 0$ represents a circle. (3mks)

QUESTION THREE (20 MKS)

(a).Determine the point of intersection and the angle between the pair of lines

$$r = i + j - 3k + \lambda(2i + j + 2k)$$

$$r = 9i + 2j + k + \mu(2i + j + 2k).$$ (5mks)

(b). Find to the nearest tenth of a degree, the acute angle between

$r = i + 4k + s(2i - 3j + k)$ and the plane $r(i + 5j - 2k) = 17.$ (4mks)

(c) .Find the distance of the point $P(-1,5)$ from the line $l: x - 2y - 4 = 0.$(4mks)

(d). The motion of an object is governed by the equation $s = 60t - 2t^2$,where t is the time in seconds and s is the height of the object above the ground in metres. (take $g = 9.8m/s^2$).

(i) .Determine its velocity after 2 seconds. (2mks)

(ii).What is the maximum height reached by the object. (3mks)

(e). Find the Cartesian equation for the plane that contains the point $(-1,3,6)$ and is perpendicular to the vector $\begin{pmatrix} 2 \\ 4 \\ -1 \end{pmatrix}$. (2mks)

QUESTION FOUR (20MKS)

(a)Find the equation of the common chord to the two circles $x^2 + y^2 - 14x + 2y + 40 = 0$ and $x^2 + y^2 - 2x - 4y - 20 = 0$ and hence find the coordinates of the points of intersection of the two circles. (4mks)

(b) A block of wood is placed on a horizontal plank. The plank is tilted so that the angle of inclination increases to 25^{0}.At this angle the block begins to slide down the plank. Find the coefficient of friction.(4mks)

(c) Find the area of the region R in the first quadrant within the cardioid $r = 1 - c$. (4mks)

(d) Find the slope of the tangent line to the curve $r = 4c$ at the point where $\theta = \frac{\pi}{4}$. (4mks)

(e) Find the stationery points of $r = 1 + s$ and sketch the graph showing the relative positions of these points. (4mks)

QUESTION FIVE (20 MKS)

(a). Find the equation of the circle which passes through the points $A(6,2)$, $B(8,-2)$ and $C(-1,1)$.(5mks)

(b).Show that $(1,2)$, $(4,7)$ $(-6,13)$ and $(-9,8)$ are vertices of a rectangle. (4mks)

(c) .Find the length of the tangents from the point $(8,5)$ to the circle $(x-2)^2+(y+1)^2=16$. (4mks)

(d).Find the equation of the set of points $P(x,y)$ that are equidistant from the origin O and the line $L: x=4$. (4mks)

(e). Find the polar coordinates of the point P whose rectangular coordinates are $(-2,2\sqrt{3})$. (3mks)