DEDAN KIMATHI UNIVERSITY

BACHELOR OF SCIENCE IN (MATHEMATICS AND MODELLING PROCESSES. MECHATRONICS ENGINEERING / MECHANICAL ENGINEERING/ CIVIL ENGINNERING/CHEMICAL ENGINEERING AND INSTITUTE OF GEOMATICS, GIS AND REMOTE SENSING) ENGINEERING AND BACHELOR OF EDUCATION TECHNOLOGY (CIVIL AND MECHANICAL) ENGINEERING YEAR ONE END OF SEMESTER ONE REGULAREXAMINATION FOR 2020/ 2021 ACADEMIC YEAR

CODE: SMA 1109 TITLE: GEOMETRY AND LINEAR ALGEBRA

TIME: 2 Hours

INSTRUCTIONS TO ALL CANDIDATES

1. Question **ONE** is **Compulsory**.
2. Answer any other **two** questions of your choice

QUESTION ONE (Compulsory) (30MARKS)

a) Find the coordinates of the point R that divides the line segment with points (1,-6) and (10, 9) externallyin the ratio 7:3. (3mks)

b) Find the equation of a line passing through (1,-6) and is parallel to line $3x + 2y - 4 = 0$ (2mks)

c) Determine the equation of the tangent to an ellipse $4(x+1)^2 + 9(y-1)^2 = 36$ at the point(-1,2)(3mks)

d) Find the Centre and radius of a circle whose equation is $3x^2 + 3y^2 - 6x + 12y - 5 = 0$ (3mks)

e) A the vertices of a triangle ABC are $(a, 0), (-a, 0)$ and $C(0, a\sqrt{3})$, show that triangle ABC is Equilateral (3mks)

f) Determine the angle between the vectors given by $\mathbf{a} = 4\mathbf{i} + \mathbf{j} + \mathbf{k}$, $\mathbf{b} = 2\mathbf{i} + \mathbf{j} - 2\mathbf{k}$ (3mks)

g) Solve the equation$3\cos 2\theta = -\sin\theta + 1$ for $0 \leq \theta \leq 360$ (4mks)

h) Find the equation of a normal to an ellipse$(x + 1)^2 + 4(y - 1)^2 = 4$ at (-2,2) (4mks)

i) Sketch a parabola $y^2 = 16x$ and show the position of its directrix and focus (3mks)

j) A body moves along a straight line according to the law$h = \frac{1}{2}t^3 - 2t$. Find its velocity at$t = 2$ seconds. (2mks)

QUESTION TWO (20MARKS)

a) Two adjacent sides of a triangular plot of land are 52m and 34m respectively. If the area of the plot is$620m^2$. Find

   i) The length of fencing required to enclose the plot in centimeters (6mks)

   ii) The internal angles of the triangular plot (4mks)

b) Find the center and radius of the circle passing through the points (2,1), (0,5), and (-1,2). (5mks)

c) Sketch a graph of$9(x - 1)^2 + 4(y - 2)^2 = 36$ (5mks)

QUESTION THREE (20MARKS)

a) If Sin P = 0.8142 and Sin Q = 0.4432. Evaluate correct to 3 decimal places

   i) Sin (P - Q) (3mks)

   ii) Cos (P + Q) (4mks)

   iii) Tan (P + Q) (4mks)

b) Two ships S and T leave a port O at the same time. S moves at 22 km/hon a bearing of 125^0 and T on a bearing of 200^0. After the bearing of ship T from S is 240^0, calculate correct to one decimal place

i) The initial speed of ship T (6mks)

ii) The distance between the positions of the ships at that instance. (3mks)

QUESTION FOUR (20 MARKS)

a) Given that $\mathbf{p} = 4\mathbf{i} + 7\mathbf{j} - \mathbf{k}$ and $\mathbf{q} = -2\mathbf{i} + 4\mathbf{j} - 2\mathbf{k}$. Find

i) $\frac{1}{2}\mathbf{p} + 3\mathbf{q}$ (2mks)

ii) Find the cross product of $\mathbf{p}$ and $\mathbf{q}$ (2mks)

iii) Find the work done by a force $\mathbf{i} - 2\mathbf{j} + 4\mathbf{k}$ to move an object from (1, 5, 2) to (3, 4, 1). (3mks)

b) Three vectors $\vec{a}$, $\vec{b}$ and $\vec{c}$ are given by $\vec{a} = -\mathbf{i} - \mathbf{j} + \mathbf{k}$, $\vec{b} = 2\mathbf{i} - \mathbf{k}$ and $\vec{c} = 4\mathbf{j} + 5\mathbf{k}$ respectively. Find

i) $(\vec{a} - \vec{b}).(\vec{b} + \vec{c})$ (4mks)

ii) $\vec{a} . (\vec{b} \times \vec{c})$ (3mks)

c) Analyze the hyperbola given by the equation $9x^2 - 16y^2 - 18x - 64y - 199 = 0$ (6marks)

QUESTION FIVE (20MARKS)

a) Three lines $2y - x - 4 = 0$, $3y + x - 11 = 0$ and $y + x - 8 = 0$ intersect on a Cartesian plane at three points.

i) Determine the co-ordinates of the three points of intersections (5mks)

ii) Calculate the angle of inclination each line makes to the horizontal (5mks)

b) Plot a graph of $y = 0.5 \sin 2\theta$ for θ from 0° to 360°. (4mks)

Use your graph to find

i) The amplitude and period of the function (3mks)

ii) The value of θ if $\sin 2\theta = 1$ (3mks)