



TECHNICAL UNIVERSITY OF MOMBASA

A Centre of Excellence

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS AND PHYSICS

APRIL 2016 SERIES EXAMINATION

UNIT CODE: AMA 4102 UNIT TITLE: GEOMETRY

MAIN EXAMINATION

TIME ALLOWED: 2HOURS

INSTRUCTION TO CANDIDATES:

You should have the following for this examination

- Mathematical tables
- Scientific Calculator

This paper consists of **FIVE** questions

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

Maximum marks for each part of a question are as shown

QUESTION ONE COMPULSORY (30 MARKS)

- a. Prove that $\frac{1+\cot \theta}{1+\tan \theta} = \cot \theta$ (4 marks)
- b. Find the equation of the straight line whose unit normal is (5,2) and passes through the point (2,1). Write the equation in the form $Ax+By+Cz=0$ (4 marks)
- c. Determine the diameter and the circumference of a circle if an arc of length 4.75 subtends an angle of 0.91 rads (3 marks)
- d. Express (4.5, 5.16 rad) in Cartesian coordinate and hence present it on the axis (4 marks)
- e. A force of 4N is inclined at angle of 45° to a second force acting at a point. Find the magnitude of the resultant of these two forces and direction of the resultant with respect to the 7N force by triangle method and by measurement. (4 marks)
- f. Solve triangle DEF and find its area given that $EF=35\text{mm}$, $DE= 25\text{mm}$ and angle at E is 64° (6 marks)
- g. The equation of a circle is given by $x^2 - 6x + y^2 + 4y - 3 = 0$. determine the center and radius of the circle (5 marks)

QUESTION TWO (20 MARKS)

- a. Find the points in which the lines $5y = 3x - 5$ cuts the hyperbola $4x^2 - 25y^2 = 15$ and the equations of the tangent to the hyperbola at these points. (5 marks)
- b. Given the equation of the line in the form $\frac{x-2}{3} = \frac{y-4}{5} = \frac{z-7}{2}$. Express it in the form $r = a + tu$ hence determine whether the point (8, 14, 11) lies on the line. (6 marks)
- c. Determine the length of a tangent from the point (5,7) to the circle whose equation is $x^2 + y^2 - 4x - 6y + 9 = 0$ (5 marks)
- d. Two cars P and Q are travelling towards the junction of two roads which are at right angles to one another. Car P has a velocity of 45km/h due East and car Q has a velocity of 55km/h due south. Calculate
- The velocity of car P relative to car Q (2 marks)
 - The velocity of car Q relative to car P (2 marks)

QUESTION THREE (20 MARKS)

- a. Find the Cartesian equation of the polar equation $r \cos \left(\theta - \frac{\pi}{3} \right) = 3$ (5 marks)
- b. Find the distance from the point (2,1) to the line $4x + 2y + 7 = 0$ (4 marks)
- c. Find the equation of the two tangents that can be drawn from the point (2,3) to the parabola $y^2 = 4x$ (5 marks)
- d. Solve $3 \cos 2\theta + \sin \theta = 1$ for values of θ in the range $0 \leq \theta \leq 360^\circ$ (6 marks)

QUESTION FOUR (20 MARKS)

- a. Given that $p = 2i + j - k$ and $q = i - 3j + 2k$. Determine
- P.Q (1 mark)
 - P+Q (1 mark)
 - $|P + Q|$ (1 mark)
 - $|P| + |Q|$ (1 mark)
- b. Find the length of the tangent to the circle $x^2 + y^2 - 2x + 4y - 4 = 0$ from the center of the circle $x^2 + y^2 + 6x + 8y = 0$ (6 marks)
- c. Plot a graph of the polar equation $r = 3 \cos 3\theta$ in the range $0 \leq \theta \leq 360^\circ$ and hence state the rectangular coordinates from the polar equation (6 marks)
- d. Describe the circle represented by $x^2 + y^2 - 4x - 2y + 1 = 0$ and hence determine the equation of the tangent and the normal line at the point $(2 + \sqrt{3}, 2)$ (4 marks)

QUESTION FIVE (20 MARKS)

- a. If $4i + j - 2k, q = 3i - 2j + k$ and $r = i - 2k$. find
- $(p - 2q) \cdot r$ (2 marks)
 - $p \times (2r \times 3q)$ (3 marks)
- b. If $\cos A = \frac{2}{5}$, $\tan B = \frac{5}{12}$ and B being acute. Find the value of $\sin(A + B)$ (3 marks)
- c. Show that the distance between the line $Ax + By + C = 0$ and a point (x, y) is given by
- $$r = \frac{Ax + By + C}{\sqrt{A^2 + B^2}} \quad (7 \text{ marks})$$
- d. Find the equation for a hyperbola with asymptotes $y = \pm \frac{4}{3}x$ and a foci $(\pm 10, 0)$ (5 marks)

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