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(Knowledge for Development)

KIBABII UNIVERSITY
UNIVERSITY EXAMINATIONS
2019/2020 ACADEMIC YEAR
FIRST YEAR SECOND SEMESTER
SPECIAL/SUPPLIMENTARY EXAMINATION
FOR THE DEGREE OF BACHELOR OF EDUCATION AND
BACHELOR OF SCIENCE

COURSE CODE: MAA 122/MAT 122

COURSE TITLE: ELEMENTARY APPLIED
MATHEMATICS

DATE: 05/02/2021

TIME: 11 AM -1 PM

INSTRUCTIONS TO CANDIDATES

Answer Question One and Any other TWO Questions

TIME: 2 Hours

This Paper Consists of 3 Printed Pages. Please Turn Over.

QUESTION ONE (30 MARKS)

- a) Sketch the curve given by the equation $r = 1 + \sin \theta$ (7 marks)
- b) The equation of a second curve is given by $r = 3 \sin \theta$, find;
- The point of intersection of the two curves (4 marks)
 - The area enclosed between the curves (6 marks)
- c) Express the two curves in Cartesian coordinates (4 marks)
- d) Find the angle between the vectors $\mathbf{a} = \langle 2, 4, 1 \rangle$ and $\langle 3, 1, 2 \rangle$. Round off your answer to two decimal places. (5 marks)
- e) Given two vectors $\mathbf{v} = 4\mathbf{j} + 3\mathbf{k} + \mathbf{j}$ and $\mathbf{w} = \mathbf{j} + 2\mathbf{k}$, find the vector perpendicular to both \mathbf{v} and \mathbf{w} . (4 marks)

QUESTION TWO (20 MARKS)

- a) Write the equation of a circle $(x - 2)^2 + (y + 3)^2 = 9$ in polar form. Simplify your answer. (5 marks)
- b) Two vectors $\mathbf{u} = \langle 2, x, x \rangle$, and $\mathbf{v} = \langle 0, -x, 1 \rangle$ are perpendicular to each other. Find the possible values of x (4 marks)
- c) A line through the point (2, 5, 6) passes through the origin. Find the equation of the line in parametric form. (3 marks)
- d) An object is projected vertically upwards with an initial velocity of 10m/s. find the maximum vertical height. (take $g = 10\text{m/s}^2$) (4 marks)
- e) An object moves along a circular path of radius 0.5 meters at 120 revolution per second. Calculate its velocity at any particular point (4 marks)

QUESTION THREE (20 MARKS)

- (a) A circle passes through the points P(-1, -3), Q(4, 2), R(3,5). Find the centre and radius of the circle (11 marks)
- (b) Given that v, ω, r and T are velocity, angular velocity, radius and periodic time respectively, derive the relationship $\omega = 2\pi f$ (5 marks)
- a) If $\mathbf{v} = \langle 2, 4, 1 \rangle$ and $\mathbf{w} = \langle 2, 0, 1 \rangle$, find
- The vector projection of \mathbf{v} onto \mathbf{w} (3 marks)
 - The cross product of the two vectors (3 marks)
 - The magnitude of the vector $\mathbf{v} + \mathbf{w}$ (3 marks)

QUESTION FOUR (20 MARKS)

A triangle has vertices A(2, 4), B(5, 4) and C(5, 8). Find

- a) The equation of the median from A (4 marks)
- b) Altitude from B (4 marks)
- c) Perpendicular bisector of AB and BC (6 marks)
- f) Two points (2, 4) and (4, 6) are on the ends of a diameter of a circle. Find the equation of the circle in the form $(x - h)^2 + (y - k)^2 = r^2$ and hence identify if a point (2,3) lies inside outside or on the circumference of the circle (6 marks)

QUESTION FIVE (20 MARKS)

- b) A line L meets a line $3y = -2x + 11$ along the line $x = 1$. If the two lines are perpendicular to each other, find the equation of L in the form $y = mx + c$. (4 marks)
- (c) A stone is projected horizontally from the roof of a house with a horizontal velocity of 10m/s. If the object hits the ground after 5 seconds, find;
- The horizontal distance from the bottom of the house to the point where the stone hit the ground (2 marks)
 - The height of the house (3 marks)
- c) Given two vectors \mathbf{a} and \mathbf{b} and an angle between them θ . Show that $\mathbf{a} \cdot \mathbf{b} = \|\mathbf{a}\| \|\mathbf{b}\| \cos \theta$ (5 marks)
- d) Equation of a circle touching the three vertices of an the triangle $x^2 + y^2 + ax + by + c = 0$ (6 marks)