



MACHAKOS UNIVERSITY

University Examinations 2020/2021 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

FIRST YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONICS ENGINEERING)

BACHELOR OF SCIENCE (MECHANICAL ENGINEERING)

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

BACHELOR OF SCIENCE IN ACTUARIAL SCIENCES

ECU 104: ENGINEERING MATHEMATICS 1

DATE: 24/2/2021

TIME: 8.30-10.30 AM

INSTRUCTIONS:

Answer Question One and Any Other Two Questions

Programmable calculators are prohibited

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Find the equation of a line with gradient $-\frac{1}{3}$ passing through the point $(2, -1)$. (3 marks)
- b) Show that the point $(1,1)$ is equidistant from the lines $3x + 4y = 12$ and $5x - 12y + 20 = 0$. (5 marks)
- c) Find the equations of a circle with centre on y-axis, which cuts orthogonally each of the circles; $x^2 + y^2 + 6x + 2y - 9 = 0$ and $x^2 + y^2 - 2x - 2y + 1 = 0$. (6 marks)
- d) Given the parabola whose equation is $y^2 + 8y - 6x + 4 = 0$, determine the coordinates of the vertex, the coordinates of the focus and the equation of the focus and the equation of the directrix. (5 marks)
- e) Find the equations to the hyperbola $9x^2 - 4y^2 = 36$ at point $(4, 3\sqrt{3})$. (6 marks)
- f) $F = 10i + 2j - k$ newtons displaces an object from $A = i + j + k$ to $B = 2i - j + 3k$ (in metres). Find the work done in newtons metre. (5 marks)

QUESTION TWO (20 MARKS)

- a) Prove that the circles $5x^2 + 5y^2 - 32x - 24y + 75 = 0$ and $x^2 + y^2 - 16x - 12y + 75 = 0$ touch each other and then find the equation of the common tangent at their point of contact. (10 marks)
- b) Find the equations of the tangents to the circle $xy = 6$ which is parallel to the line $3y + 2x = 0$. (7 marks)
- c) If the two lines L_1 and L_2 have the equations $3x - 2y = 5$ and $4x + 5y = 1$ respectively intersect, determine the angle between them. (3 marks)

QUESTION THREE (20 MARKS)

- a) Solve for γ and β given that $\gamma(3,4) + \beta(1,-1) = (1,2)$. (4 marks)
- b) (i) Differentiate between a vector quantity and a scalar quantity. (2 marks)
- (ii) For vectors $p = i + 4j - 2k$ and $q = 2i - j + 3k$, find
- i. $p \times q$ (3 marks)
- ii. $|p \times q|$ (3 marks)
- c) Find the moment and the magnitude of the moment of a force of $(i + 2j - 3k)$ newtons about a point B having coordinates $(0,1,1)$ when the forces acts on a line through A whose coordinates are $(1,3,4)$. (8 marks)

QUESTION FOUR (20 MARKS)

- a) A point moves so that the product of its directed distances from the lines $3x - 4y + 1 = 0$ and $3x + 4y - 7 = 0$ is $\frac{144}{25}$. Find the equation of its locus. What curve is it? Sketch the curve. (12 marks)
- b) Determine the equation of a parabola with latus rectum joining points $(3,5)$ and $(3,-3)$. (8 marks)

QUESTION FIVE (20 MARKS)

- a) Find
- i. The Cartesian coordinates of the point whose polar coordinates are $(5, \frac{\pi}{4})$. (3 marks)
- ii. The polar coordinates of the point whose Cartesian coordinates are $(-1,1)$. (3 marks)
- iii. Convert the rectangular equation $x^2 + y^2 - 2ax = 0$ to polar form. (4 marks)

- b) Given the equation of the ellipse as $25x^2 + 9y^2 - 100x + 54y - 44 = 0$, Find
- i. The centre (3 marks)
 - ii. Vertices (2 marks)
 - iii. Foci (2 marks)
 - iv. Diretrices (2 marks)
 - v. Sketch the curve. (1 mark)