



MACHAKOS UNIVERSITY

University Examinations 2020/2021 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

FIRST YEAR SPECIAL/SUPPLEMENTARY 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: 11/8/2021

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)