



MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS, STATISTICS AND ACTUARIAL SCIENCE

FIRST YEAR FIRST SEMESTER SPECIAL/ SUPPLEMENTARY EXAMINATION FOR BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONICS)

BACHELOR OF SCIENCE (MECHANICAL ENGINEERING)

BACHELOR OF CIVIL ENGINEERING

ECU 104 : ENGINEERING MATHEMATICS 1

DATE: 23/7/2019

TIME: 2:00 – 4:00 PM

INSTRUCTIONS: Attempt Question 1 and any other 2 Questions.

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Show that the triangle with vertices $A(1, -2)$, $B(-4, 2)$ and $C(1, 6)$ is isosceles. (5 marks)
- b) Find the centre and radius of the circle with the following equation $x^2 + y^2 - 4x + 2y + 5 = 0$ (5 marks)
- c) Find the focus, vertex, directrix and axis of the parabola $x^2 + 2y - 3x + 5 = 0$ (5 marks)
- d) An equation is given in polar coordinates as $x^2 + y^2 + 2x - 4y = 0$. Find an equation in polar coordinates which describes the same graph (5 marks)
- e) Find θ , the angle between $\mathbf{v} = 3\mathbf{i} - 4\mathbf{j}$ and $\mathbf{w} = 5\mathbf{i} + 12\mathbf{j}$ (5 marks)
- f) Find the cosine of the angle between the line L_1 , passing through the points $P_1(1, 4, 2)$ and $P_2(3, -1, 3)$ and the line $Q_1(3, 1, 2)$ and $Q_2(2, 1, 3)$. Find the 2 angles. (5 marks)

QUESTION TWO (20 MARKS)

- a) Find the equation of the line through $(-2, -3)$ and parallel to the line $3x - 7y + 4 = 0$ (5 marks)
- b) Find the equation of the perpendicular bisector of the line segment joining $(3, -1)$ and $(5, 2)$ (8 marks)
- c) Find the equation of the line passing through $(5, -1)$ and through the intersection of $2x + y - 3 = 0$ and $x + 4y - 7 = 0$ (7 marks)

QUESTION THREE (20 MARKS)

- a) If $L_1: 2x + 3y = 5$ and $L_2: 3x + 2y = 1$, find θ , the angle from L_1 to L_2 (6 marks)
- b) Find the equations of the two bisectors of the angles formed by the lines $2x + y + 5 = 0$ and $x + 2y - 3 = 0$ (6 marks)
- c) Find the equation of the line normal to the given circle $2x^2 + 2y^2 + 3x + 5y + 2 = 0$ at the point $p(2, -3)$ on the circle (8 marks)

QUESTION FOUR (20 MARKS)

- a) In the equation of the ellipse $9x^2 + 16y^2 = 144$, find the lengths of the major and minor axes, the coordinates of the foci, and the eccentricity. Sketch the curve. (10 marks)
- b) Given the equation of the hyperbola $4x^2 - 12xy + 9y^2 - 52x + 26y + 81 = 0$ reduce it to the standard form by eliminating B, D and E. Identify the curve and locate the principal quantities (10 marks)

QUESTION FIVE (20 MARKS)

- a) Find the area inside the circle $r = 5\cos\theta$ and outside the curve $r = 2 + \cos\theta$ (7 marks)
- b) Find θ the angle of intersection between the planes $2x - y + 3z - 5 = 0$ and $3x - 2y + 2z - 7 = 0$ (3 marks)
- c) Find the point of intersection of the line $3x - y + 2z - 5 = 0$ and the plane $\frac{x-1}{2} = \frac{y+1}{3} = \frac{z-1}{-2}$ (3 marks)
- d) Show that $\mathbf{u} = \mathbf{i} - \mathbf{j} + \mathbf{k}$, $\mathbf{v} = -\mathbf{i} + 2\mathbf{j} - \mathbf{k}$, $\mathbf{w} = 2\mathbf{i} - \mathbf{j} + \mathbf{k}$ are linearly independent and express $\mathbf{r}$ in terms of $\mathbf{u}$, $\mathbf{v}$ and $\mathbf{w}$. (7 marks)