

MACHAKOS UNIVERSITY

DEPARTMENT OF CIVIL, ELECTRICAL AND MECHANICAL ENGINEERING

UNIVERSITY SUPPLEMENTARY EXAMINATIONS

UNIT CODE: ECU 104

UNIT NAME: ENGINEERING MATHEMATICS 1

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INSTRUCTIONS:

- 1) Answer Question ONE and any other TWO questions.
- 2) Mobile phones and any written material are prohibited in the examination room.
- 3) No writing should be done on this question paper. Any rough work should be done at the back of the answer booklet and canceled.
- 4) All answer booklets should be handed in at the end of the exam whether used or not.
- 5) Programmable calculators are prohibited

**QUESTION ONE (30 MARKS) ANSWER ALL QUESTION**

- (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  $\gamma$  and  $\beta$  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)