



MACHAKOS UNIVERSITY

University Examinations 2016/2017

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

SECOND SEMESTER SUPPLEMENTARY EXAMINATION

BACHELOR OF ELECTRICAL AND ELECTRONICS ENGINEERING

BACHELOR OF MECHANICAL ENGINEERING

BACHELOR OF CIVIL AND BUILDING ENGINEERING

ECU 104: ENGINEERING MATHEMATICS I

DATE:..... TIME:.....

INSTRUCTION TO CANDIDATES:

ANSWER QUESTION ONE AND ANY TWO OTHER QUESTIONS.

QUESTION ONE COMPULSORY (30 MARKS)

- a) Determine the y and the x intercepts for the line through points $(-3, -28)$ and $(7, 52)$
(3 marks)
- b) Find the centre and the radius of the circle $x^2 + y^2 - 4x + 10y - 2 = 0$ (3 marks)
- c) Find the equation of the line through points $P_1(7, 3)$ and $P_2(-11, 9)$ lie on the line
(4 marks)
- d) Determine the equation of the tangent to the parabola $y^2 - 2y - 12x - 23 = 0$ at point $P(-7/4, 10)$
(5 marks)
- e) Find the equation of and sketch the ellipse whose eccentricity is $\frac{2}{3}$ centre at the origin
and directrix $x = 6$ and focus $(1, 0)$ (5 marks)

f) Calculate the distance from the point $(4, -9)$ to the line $x \cos 60^\circ + y \sin 60^\circ + 5 = 0$ and state the position in relation to the line and the origin (5 marks)

g) Find the points on the circle $x^2 + y^2 + 12x + 4y + 15 = 0$ through which the tangents from the point $P(1, -3)$ pass. Also find the equation of the chord of contact. (5 marks)

QUESTION TWO (20 MARKS)

a) Determine whether the point $(3, 4)$ lies on, inside or outside the circle $x^2 + y^2 = 31$. (3 marks)

b) Find the polar equation of the parabola $y^2 = 4ax$ (3 marks)

c) Determine the equation of the tangent to circle $x^2 + y^2 + 10x - 6y - 66 = 0$ at the point $(3, -3)$ (4 marks)

d) Determine the focus, the center, the eccentricity and directrix of the ellipse whose equation is $x^2 + 4y^2 + 4x - 24y + 24 = 0$. (10 marks)

QUESTION THREE (20 MARKS)

a) Find the polar equation of the circle whose centre has the Cartesian coordinates $C(5, 8)$ and the radius is 10. (5 marks)

b) Find the equation of the chord joining two points whose eccentric angles are ϕ_1 and ϕ_2 on the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ (5 marks)

c) Consider a parabola with a vertical axis, focus and vertex being $F(h, k)$, $V(c_1, c_2)$ and directrix $y = d$, then show that the equation of the parabola is $(x - c_1)^2 = 4a(y - c_2)$ (10 marks)

QUESTION FOUR (20 MARKS)

a) Determine the general and normal equations to the line through point $(2, 5)$ and $(3, 7)$ (10 marks)

b) Show that the circles $x^2 + y^2 + 6x - 4y - 12 = 0$ and $x^2 + y^2 - 20x - 4y - 40 = 0$ are orthogonal. (10 marks)

QUESTION FIVE (20 MARKS)

a) Determine the point on the directrix of the hyperbola $x = 7 \sec \phi, y = 2 \tan \phi$ which the tangent at the point $(7 \sec 60, 2 \tan 60)$ passes through. (10 marks)

b) Consider point $P_1(a_1, b_1)$ outside the $(x - h)^2 + (y - k)^2 = r^2$. Let B_1 be a point on the circle such that it lies on the line segment P_1C , C being the center of the circle. Show that distance d from point $P(a, b)$ to the circle $(x - h)^2 + (y - k)^2 = r^2$. (10 marks)