



MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY

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University Examinations 2022/2023

SECOND YEAR, SECOND SEMESTER SPECIAL/SUPPLEMENTARY EXAMINATION FOR
THE DEGREE OF BACHELOR OF TECHNOLOGY IN CIVIL ENGINEERING

SMA 3200: MATHEMATICS III/GEOMETRY

DATE: AUGUST 2023

TIME: 2 HOURS

INSTRUCTIONS: Answer question one and any other two questions

QUESTION ONE (30 MARKS)

- a) Find the equation of a perpendicular bisector of a line segment from $A(3,9)$ to $B(-1, 4)$
(4 marks)
- b) Determine the vector having the initial point $P(2, 7, -5)$ and the terminal point $Q(0, -3, 2)$ and find the unit vector having the same direction
(4 marks)
- c) Find the centre and the radius of a circle whose equation is given by
 $x^2 + y^2 + 6x + 4y + 9 = 0$ and hence sketch it
(4 marks)
- d) Three forces \vec{P} , \vec{Q} and \vec{R} act on an object. If $\vec{P} = 2i - j + k$, $\vec{Q} = i + j + 2k$ and
 $\vec{R} = 3i + 2j + 4k$, find the magnitude of the resultant force
(4 marks)
- e) The equation of parabola is given by $4x + 4y^2 + 12 = 0$. Find the vertex, focus and directrix
(5 marks)
- f) The equation of an ellipse is given as $\frac{(x+2)^2}{16} + \frac{(y-1)^2}{9} = 1$. Determine its centre and vertices
(4 marks)
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- g) A particle moves along a curve whose parametric equations are $x = 2e^{-3t}$, $y = 3\cos 4t$, $z = 3\sin 5t$, where t is the time
- (i) Find its velocity and acceleration at time t (3 marks)
- (ii) Find the magnitude of velocity and acceleration at $t = 0$ (2 marks)

QUESTION TWO (20 MARKS)

- a) Find the area of triangle ABC if $\overrightarrow{AB} = 2i - j - 6k$ and $\overrightarrow{AC} = i + 3j - k$ (6 marks)
- b) A particle travels so that the acceleration is given by $a = 2e^{-t}\hat{i} + 5\cos t\hat{j} - 3\sin t\hat{k}$. If the particle is at $(1, -3, 2)$ at time $t = 0$ and is moving with velocity given by $4i - 3j + 2k$. Find
- (i) The velocity at any time t (4 marks)
- (ii) The displacement of the particle (5 marks)
- c) A particle of unit mass moves in force field given by $F = (3t^2 - 4t)i + (12t - 6)j + (6t - 12t^2)k$ where t is time. Find the change in momentum of the particle from time $t = 1$ to $t = 2$ (5 marks)

QUESTION THREE (20 MARKS)

- a) Find the equation of the tangent to the circle given by equation $x^2 + y^2 = 9$ at a point on the first quadrant when $x = 2$ (6 marks)
- b) Find the distance from the point $(3, -5)$ to the line whose equation is $4x - 3y = 24$ (6 marks)
- c) Given that $A = i + 4j - 2k$ and $B = 2i - j + 3k$, find $A \times B$ (4 marks)
- d) Resolve the acceleration vector of 20m/s^2 at an angle of 120° into horizontal and vertical components (4 marks)

QUESTION FOUR (20 MARKS)

- a) For the Parabola whose equation is given by $\frac{(x-3)^2}{25} - \frac{(y+1)^2}{49} = 1$. Find vertices, foci, centre and the asymptotes. Hence sketch the hyperbola (10 marks)
- b) Prove the following hyperbolic identities
- (i) $\cosh^2 x - \sinh^2 x = 1$ (5 marks)
- (ii) $\cosh 2x = \cosh^2 x + \sinh^2 x$ (5 marks)



QUESTION FIVE (20 MARKS)

- a) A line through the Point (5,4) is parallel to another line whose equation is $3x + 4y - 7 = 0$. Find the equation of the line in the form $y = mx + c$. Give the x-intercept and y-intercept (5 marks)
- b) Find the equation of the tangent to a circle at the point (7,2) given that the equation of the circle is $x^2 - 8x + y^2 - 6y + 15 = 0$ (5 marks)
- c) Given that $\sinh = \frac{8}{15}$, calculate the value of $\cosh x$ and $\tanh x$ (5 marks)
- d) Line PQ is a diameter of a circle. Find the equation of the circle given that the coordinates of P and Q are (-6, -2) and (2, -4) respectively (5 marks)

