CROSS RIVER UNIVERSITY OF TECHNOLOGY, CALABAR
DEPARTMENT OF MATHEMATICS AND STATISTICS
2017/2018 SECOND SEMESTER EXAMINATION
MTH 1202: GENERAL MATHEMATICS III. TIME ALLOWED: 2½HOURS

INSTRUCTIONS: Answer question one and any three questions. Scientific calculator is allowed. Phones are not allowed into the examination hall. Any form of examination malpractice will be punished accordingly.

QUESTION ONE

a. Proof the equivalence of the Geometric and Component definitions of the scalar product of two vectors.
b. If the vectors q, r are represented by the sides QR, QS of a trainable QRS, what vectors are represented by
   (i) $\overrightarrow{RS}$ (ii) $\overrightarrow{SR}$ (iii) $\overrightarrow{QT}$
c. If $\phi = 2xyz^2$ and c is the curve $r = xi + yj + zk, where\ x = t^2, y = 2t, z = t^3, t$ varying from 0 to 1. Evaluate $\int \phi . dr$

QUESTION TWO

a. Given $a = (2, -3,1), b = (1,5, -2), c = (3, -4,3)$. Find the magnitude of the vectors $d = 2a - b + 3c$
b. Find the angle between vectors $a\ and\ d$ in (2a) above.

QUESTION THREE

a. State the conditions for (i) Parallelism (ii) Perpendicularity
b. The end points of the diameter of a circle have coordinates (2, 5) and (3, -2). Find the equation of the corresponding circle.

QUESTION FOUR

a. A particle moves along the curve $x = 3t^2 + 1, y = 2t^2, z = 3t + 6$, where t is the time. Find the component of its acceleration at time t=1 in the direction of $2i + 3j + 4k$.
b. If $a = \sqrt{4i} + \sqrt{3j}\ and\ b = -\sqrt{4i} + \sqrt{3j}$. Find the projection of vector a and b.

QUESTION FIVE

a. Define Linear Independent Vectors and state the condition(s) for linear dependence in $\mathbb{R}^n$
b. Determine whether the following vectors are linearly dependent or linearly independent in $\mathbb{R}^n$ if $v_1 = (1,1,2,1), v_2 = (0,2,1,1), v_3 = (3,1,2,0)$

QUESTION SIX

a. Graph the vertical parabola $y = 2x^2 + 4x - 3$ and find the vertex, axis of symmetry.
b. Find the equation of tangent to the curve $x^2y + y^3x + 3x - 13 = 0$ at the point (1, 2).

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QUESTION ONE

a. State the Parallelogram Law of Vector Addition and hence show that the addition of two vectors is commutative.
b. If the vectors q, r are represent by the sides QR, QS of a trainable QRS, what vectors are represented by
(i) $\overrightarrow{RS}$ (ii) $\overrightarrow{SR}$ (iii) $\overrightarrow{QT}$
c. If $x = 3cost, y = 3sint\ and\ z = 4t$, Find the (i) unit tangent vector (ii) unit normal vector
Hint: $r(t) = xi + yj + zk$

QUESTION TWO

a. What are these quantities, Vectors or Scalars?
(i) Temperature of 100^0C (ii) Acceleration of 9.8m/s towards earth (iii) Weight of a 2kg mass
(iv)The sum of five hundred naira (v) North easterly wind of 20 knots
b. If the position vectors of the points P and Q are $i + 3j - 7k\ and\ 5i - 2j + 4k$ respectively. Find
(i) $\overrightarrow{PQ}$ (ii) the length of $\overrightarrow{PQ}$ (iii) the direction cosines of PQ

QUESTION THREE

a. State the Geometric and Component definitions of the scalar product of two vectors.
b. Given the vectors $a = (1,1,0), b = (2,2,1), c = (0,1,1,)$. Find $d = a + \frac{1}{2}b + 2c$
c. Find the angle between vectors $b\ and\ d$ in (3a) above.

QUESTION FOUR

a. Define Linear Independent Vectors and state the condition(s) for linear dependence in $\mathbb{R}^n$
b. Determine whether the following vectors are linearly dependent or linearly independent in $\mathbb{R}^3$ if $v_1 = (1,3,5), v_2 = (2,5,9), v_3 = (-3,9,3)$
c. Find the equation of the circle with centre and radius $\sqrt{7}$

QUESTION FIVE

a. State the conditions for (i) Parallelism (ii) Perpendicularity
b. Use the definition of derivative to find the slope of the line $f(x) = \sqrt{x+2}\ at\ the\ point\ (7,3)$
c. Find the equation of tangent to the circle $(x-3)^2 + (y-4)^2 = 20\ at\ point\ (1,-2)$

QUESTION SIX

a. Find the point of intersection of the lines $4x + 2y - 8 = 0\ and\ 2x - 3y + 1 = 0$
b. If $a = \sqrt{2i} + \sqrt{3j}\ and\ b = \sqrt{2i} + \sqrt{3j}$. Find the projection of vector b and a.
c. Evaluate $\int$ Q.dr such that $Q = xyi + yzj + zxk\ and\ r = t^3i + t^2j + 2tk$ with t varying from -1 to 1.