



MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY

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UNIVERSITY EXAMINATIONS 2023/2024

FIRST YEAR, SECOND SEMESTER, EXAMINATION FOR DIPLOMA IN
AUTOMOTIVE ENGINEERING, CIVIL ENGINEERING, ELECTRICAL
ENGINEERING, MECHANICAL PLANT, MECHANICAL PRODUCTION, WATER
AND SANITATION, MECHATRONIC ENGINEERING AND BUILDING TECHNICAN
AND CONSTRUCTION MANAGEMENT

EG/CU/AUT/CC/1/6/WAT/CU/WSET/CC/02/6/A: ENGINEERING MATHEMATICS B

DATE: APRIL 2024

TIME: 3 HOURS

INSTRUCTIONS: Answer Question ONE and any other Three questions.

QUESTION ONE (40 MARKS)

1. Solve the quadratic equation $2x^2 + 3x + 4 = 0$ [3 Marks]
2. Evaluate $(-2 + j6) - (3 - j2)$ and represent it on an Argand diagram [3 Marks]
3. Evaluate the following integrals:
 $\int_2^4 2x^3 dx$ [4 Marks]
4. Evaluate. $\int_0^{\frac{\pi}{2}} 3 \sin 2x dx$ [4 Marks]
 $\int_1^2 4e^{2x} dx$ [4 Marks]
5. Solve the equation $(x - j2y) - (y - jx) = 2 + j$ [3 Marks]
6. Find the rate of change of y with respect to x given that $y = 3\sqrt{x} \ln 2x$ [3 marks]
7. Evaluate $\frac{dy}{dx}$ at $\theta = \frac{\pi}{6}$ radians for the hyperbola whose parametric equations are
 $x = 3 \sec \theta, y = 6 \tan \theta.$ [4 Marks]
8. Find $\frac{dy}{dx}$ given $4x^2 + 2xy^3 - 5y^2 = 0$ [4 Marks]



9. Determine the equations of the tangent and normal to the curve $y = \frac{x^3}{5}$ at the point $(-1, -\frac{1}{5})$ [4 Marks]
10. Resolve the acceleration vector of 17 m/s^2 at an angle of 120° to the horizontal into a horizontal and a vertical component [4 Marks]

SECTION B (60 MARKS)

11. a. Given the vectors $\vec{A} = 2\mathbf{i} + 3\mathbf{j} - 2\mathbf{k}$ and $\vec{B} = -3\mathbf{i} + \mathbf{j} + \mathbf{k}$ find;

i. $\vec{A} \cdot \vec{B}$ [5 Marks]

ii. $\vec{A} \times \vec{B}$ [7 Marks]

b. Calculate the magnitude and direction of the resultant of these three coplanar forces when they act at a point.

Force A, 10 N acting at 45° from the positive horizontal axis.

Force B, 87 N acting at 120° from the positive horizontal axis.

Force C, 15 N acting at 210° from the positive horizontal axis. [8 Marks]

12. a. It is expected that 10% of production from a continuous process will be defective. Find the probability that in a sample of 10 units chosen at random;

i) Exactly two will be defective [3 Marks]

ii) At least two will be defective [3 Marks]

iii) At most one will be defective [3 Marks]

b. If the mean and variance of a binomial distribution are 12 and 4 respectively. Determine the number of trials (n) and probability of success (p). [5 Marks]

c. If 4% of pesticides manufactured by a firm are ineffective, find the probability that in a sample of 200 pesticides;

i. At most 2 are ineffective [3 Marks]

ii. At least 3 are ineffective [3 Marks]

13. a. Determine;

i) $\int \frac{2x^3 - 3x}{4x} dx$ [3 Marks]

ii) $\int (1 - t)^2 dt$ [3 Marks]



iii) $\int x^3 \ln x \, dx$ [4 Marks]

b. Using the substitution $u = 1 + \sin x$, evaluate $\int_0^{\frac{\pi}{2}} \frac{\cos x}{1 + \sin x} dx$ [5 Marks]

c. The velocity at time t of a particle moving along a straight line is given by the equation $v = 3t^2 - 4t + 4$. Find the distance the particle covered between $t = 2$ and $t = 5$ [5 Marks]

14. Given $Z_1 = 1 + j2$, $Z_2 = 4 - j3$, $Z_3 = -2 + j3$, $Z_4 = -5 - j$. Evaluate in the form $a + jb$

i. $Z_1 + Z_2 - Z_3$ [2 Marks]

ii. $Z_1 Z_2$ [3 Marks]

iii. $Z_1 Z_2 Z_3$ [2 Marks]

iv. $\frac{Z_1 Z_3}{Z_1 + Z_3}$ [4 Marks]

a) State De Moivre's theorem and therefore express in polar form $(-2 - j)^5$ [4 Marks]

b) Find the modulus and argument of $\frac{-9 + 3j}{1 - 2j}$ where $j = \sqrt{-1}$ [5 marks]