054206T4AST

APPLIED STATISTICS LEVEL 6

MATH/OS/AS/CC/01/6/A

APPLY MATHEMATICS FOR STATISTICS

July/August 2024

TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

WRITTEN ASSESSMENT

3 HOURS

INSTRUCTIONS TO CANDIDATES

1. This paper consists of **TWO** sections: **A** and **B**.
2. Answer **ALL** the questions in sections **A** and any **THREE** questions in section **B** in the answer booklet provided.
3. Marks for each question are indicated in brackets.
4. Do not write on this question paper.
5. Answer all the questions in **English.**

This paper consists of FOUR (4) printed pages

Candidates should check the question paper to ascertain that all pages are printed as indicated and that no questions are missing.

SECTION A (40 MARKS)

*Answer **all** questions in this section.*

1. Solve the equation $(2x + 3)\log_3 9 + (4x - 12)\log_2 4 = 6$. (5 marks)
2. Given that $\sin A = \frac{15}{17}$ and $\cos B = \frac{12}{13}$, where A is obtuse angle and B is acute angle, determine $\cos(B - A)$. (5 marks)
3. Find the derivative of $f(x) = 3x^2$ from first principles. (4 marks)
4. A curve C has Cartesian equation $(x^2 + y^2)^2 = a^2(x^2 - y^2), a \neq 0$. Determine a polar equation for C. (4 marks)
5. Simplify by rationalizing the denominator $\frac{5+2i}{3-i}$. (3 marks)
6. Determine the middle term of binomial expression $(2x + 3y)^6$. (4 marks)
7. Solve the equation $8^{x+1} + 2^{3x+1} = 160$. (4 marks)
8. Determine the sum of the first 110 terms of the series $21 + 25 + 29 + \cdots$. (3 marks)
9. Show that the iterative formula to estimate the root of $2x^3 - 5x + 7 = 0$ is given by

   $x_{n+1} = \frac{4x_n^3 - 7}{6x_n^2 - 5}$ (4 marks)
10. Determine the values of α and β given that $5\sinh x - 3\cosh x = \alpha e^x + \beta e^{-x}$. (4 marks)

SECTION B (60 MARKS)

*Answer **any THREE** questions in this section.*

11. (a) Solve the following system of simultaneous equations by inverse matrix method. (12 marks)

$$2x + 3y - z = 5$$
$$x - 2y + 4z = -2$$
$$3x + y + 2z = 8$$

(b) Find the particular solution of the differential equation $\frac{dy}{dx} + 3y = 6x$ given that when $x = 0$, y = 2. (8 marks)

12. (a) Given vectors $\overrightarrow{\boldsymbol{A}} = 3\boldsymbol{i} + 4\boldsymbol{j}$ and $\overrightarrow{\boldsymbol{B}} = -2\boldsymbol{i} + 6\boldsymbol{j}$. Find:

(i) The magnitude of vector $\overrightarrow{A}$. (2 marks)

(ii) The direction of vector $\overrightarrow{B}$ in degrees. (3 marks)

(b) Figure 1 shows a system of forces acting on a welded joint.

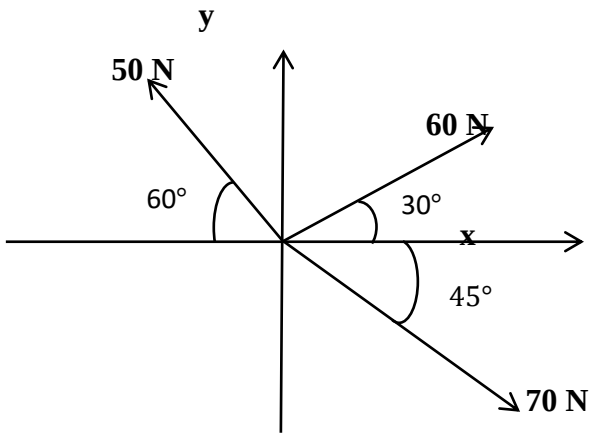

Figure. 1

Use resolution of forces to determine the magnitude of the resultant force. (6 marks)

(c) Table 1 shows data obtained from an experiment**,** determine the value of $f(2.04)$ using Newton-Gregory backward interpolation method correct to 3 decimal places. (9 marks)

Table 1

x	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7
$f(x)$	2.7183	2.8758	3.0042	3.1582	3.3201	3.4903	3.6693	3.8574

13. (a) An open rectangular box can hold 108 cm^3 of fluid. Use partial differentiation to determine the dimensions of the box, if the surface area of the material used to make the box is to be a minimum. (8 marks)

(b) Use De Moivre's theorem to show that $\cos 5A = 16\ cos^5 A - 20cos^3 A + 5\cos A$. (7 marks)

(c) A juice production company produces two types of juice, J_1 and J_2. The production of the juice requires two types of raw materials, R_1 and R_2. The availability of these raw materials requires the following:

- Each unit of J_1 requires 1 unit of R_1 and 3 units of R_2.
- Each unit of J_2 requires 2 units of R_1 and 1 unit of R_2.
- The company has 8 units of R_1 and 12 units of R_2 available.
- The profit from each unit of J_1 is Ksh 20.
- The profit from each unit of J_2 is Ksh 25.

Formulate a linear programming problem using the simplex method to maximize the total profit. (5 marks)

14. (a) Determine the first four non zero terms of the Maclaurin's series for $f(x) = cos\, x$. (9 marks)

(b) Evaluate the integral $\int_0^{\frac{\pi}{2}} (6 \sin 2x - cos^2 x + 2)dx$ (5 marks)

(c) Convert $0.\dot{4}\dot{5}$ into a fraction by use of geometric progression method. (6 marks)

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