7.00 MATHEMATICS

7.01 INTRODUCTION

This course unit sets out to provide trainees with mathematical skills and techniques that they require to apply in their craft trades.

7.02 GENERAL OBJECTIVES

At the end of this course unit, the trainee should be able to :-

(a) use mathematical concepts and techniques in solving problems related to the respective trade.

(b) draw simple deductions and conclusions from given data.

(c) intrepret graphical representation of functions relevant to respective trade.

7.03 COURSE UNIT SUMMARY AND TIME ALLOCATION

STAGE I (66 HOURS)

TOPICS	SUB-TOPICS	TIME (HR
7.1.1.S SERIES	- Introduction to sequences and series - Progressions - Calculation of interest	8
7.1.2.S INDICES AND LOGARITHMS	- Number base systems - Laws of indices and solutions of exponential equations - Laws of logarithms and solutions of logarithmic equations	16
7.1.3.S RATIOS	- Rational and Irrational numbers - Conversions - Direct and Inverse proportion	8
7.1.4.S ALGEBRA	- Transposition of formulae - Manipulation of Algebraic expressions - Simultaneous equations - Quadratic equations	18
7.1.5.S GRAPES AND CHARTS	- Linear Graphs - Parabolic curves - Solutions of equations by the graphical method - Type of charts	8
7.1.6.S MENSURATION	- Perimeters - Areas - Volumes	8

COURSE UNIT SUMMARY AND TIME ALLOCATION

STAGE II (44 HOURS)

TOPICS		SUB-TOPICS	TIME (HRS
7.2.7.S	MATRICES	- Operations 2x2 matrices - Determinant of 2x2 matrix - Inverse of a 2 x 2 matrix - Application in solving simultaneous equations	8
7.2.8.S	PROBABILITY	- Dependent and Independent events - Laws of probability	4
7.2.9.S	STATISTICS	- Types of Data - Data collection - Tabulation - Data representation - Data interpretation	10
7.2.10.S	COMMERCIAL CALCULATIONS	- Exchange rates - Prices and profit - Calculation of average sales - Calculation of incomes.	
		STAGE III (22 HOURS)	
7.3.11.S	TRIGONO-METRY	- Circular measure - Trigonometric ratios - Simple Trigonometric identities. - Simple Trigonometric equations - Trigonometry of angles greater than a right angle. - Sine and Cosiue rules - Phasor representation	18
7.3.12.S	VECTORS	- Manipulation of vectors - Resolution of vectors	4

MATHEMATICS STAGE I (66 HOURS)

7.1.1S SERIES (8 HOURS)

7.1.1S1 Specific Objectives

At the end of this topic the trainee should be able to:-

(a) distinguish between a sequence and series

(b) solve problems involving series

(c) calculate simple and compound interest

7.1.1S11 Distinction between sequence and series

(i) Defination of a sequence

(ii) Defination of a series

(iii) Defination of progressions

(iv) Examples of sequences and series

7.1.1S12 Solution of elementary problems involving:-

(i) Arithmetic progressions

(ii) Geometric progressions

7.1.1S13 Calculation of:-

(i) Simple interest

(ii) Compound interest

- Reducing balance.

(ii) Division

$\text{Log } \frac{M}{N} = \log M - \log N$

(iii) Powers: $\log M^n = n \log M$

(iv) Roots

$\log \sqrt[n]{M} = \frac{\log M}{n}$

7.1.2S INDICES AND LOGARITHMS (16 HOURS)

7.1.2S1 Specific Objectives

At the end of this topic, the trainee should be able to:-

(a) Convert numbers from one base to another

(b) apply the laws of indices in solving exponential equations

(c) apply the laws of logarithms in solving logarithmic equations

7.1.2S11 Conversion of numbers from one base to another

(i) Decimal/denary

(ii) Duodecimal

(iii) Binary

7.1.2S12 Application of the laws of indices:-

(i) Multiplication

$$A^m \times A^n = A^{m+n}$$

(ii) Division

$$\frac{A^m}{A^n} = A^{m-n}$$

$$\frac{A^m}{A^m} = A^{m-m} = A^0 = 1$$

(iii) The root of $A^m = A^{m/n}$

(iv) The negative index

$$\frac{1}{A^n} = A^{-n}$$

7.1.2S13 Application of the laws of logarithms

(i) Multiplication

$$\text{Log } MN = \log M + \log N$$

7.1.3S RATIOS (8 HOURS)

7.1.3S1 Specific Objectives

At the end of this topic the trainee should be able to:-

(a) differentiate between rational and irrational numbers

(b) express ratios as percentages

(c) solve problems involving direct and inverse proportions.

7.1.3S11 Difference between rational and irrational numbers

7.1.3S12 Expression of ratios as percentages

7.1.3S13 Solutions of problems involving

(i) Explanation of dependent variable

(ii) Direct proportions - for y x

y = kx where k = constant

e.g. m = kv

where M = Mass, V = Volume

7.1.4S14 Solution of quadratic equations by the method of:-

(i) factorisation

(ii) completing squares

(iii) quadratic formula:-

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

7.1.5S GRAPHS AND CHARTS (8 HOURS)

7.1.5S1 Specific Objectives

At the end of this topic the trainee should be able to:-

(a) plot linear graphs

(b) make interpretations from linear graphs

(c) plot parabolic curves

(d) solve simultaneous and quadratic equations by the graphical method

(e) present data in appropriate charts

7.1.5S11 Plotting linear graphs

- Intercepts when y = 0, x = 0

7.1.5S12 Making interpretations

- intercepts

- gradients

7.1.5S13 Plotting parabolic curves of the form:-

$-y = ax^2 + bx + c$

(iii) Inverse proportion

For $Y = 1/x$

$Y = Kl/x$

eg., To cover a fixed distance D,

$t = \frac{Kl}{s}$

where t = time taken

s = average speed

k = D = fixed distance

7.1.4S ALGEBRA (8 HOURS)

7.1.4S1 Specific Objectives

At the end of this topic the trainee should be able to:-

(a) manipulate algebraic expressions

(b) transpose formulae

(c) solve simultaneous equations,

(d) solve quadratic equations.

7.1.4S11 Manipulation of algebraic expressions

- Addition
- Subtraction
- Multiplication
- Simplification

7.1.4S12 Transposition of formulae

- factorisation

7.1.4S13 Solution of simultaneous equations by the method of:-

(i) Elimination

(ii) Substitution

7.1.5S14 Solution of simultaneous and quadratic equations by plotting (linear and parabolic) graphs

7.1.5S15 Presentation of data in charts

- Pie chart
- Bar chart
- Pictogram
- Histogram

7.1.6S MENSURATION (8 HOURS)

7.1.6S1 Specific Objectives

At the end of this topic the trainee should be able to:-

(a) calculate perimeters of different types of figures

(b) calculate areas of regular and irregular figures

(c) calculate volumes of solids

7.1.6S11 Calculations of perimeters of the following figures:-

(i) Rectangle/squares

(ii) Triangle

(iii) Circle

7.1.6S12 Calculation of areas

(i) Areas of regular figures

- Rectangle/square
- Triangle
- Circle
- Trapezium

- Parallelogram/Rhombus
- Sector
- Segment
- Annulus

(ii) Surface areas of regular solids
- Spheres
- Cone
- Cylinders
- Pyramids

(iii) Areas of irregular figures by the following methods
- Trapezoidal rule
- Mid-ordinate rule
- Simpson's rule

7.1.6S13 Calculations of volumes of regular solids

(i) prisms

(ii) cone

(iii) pyramid

MATHEMATICS STAGE II - 44 HOURS

7.2.76 MATRICES (8 HOURS)

7.2.7S1 Specific Objectives

At the end of this topic the trainee should be able to:-

(a) operate on matrices

(b) calculate the determinant of a 2x2 matrix

(c) calculate the inverse of a 2x2 matrix

(d) apply matrices in solving simultaneous equations

7.2.7S11 Operations on matrices

(i) Types of matrices

(ii) Addition

(iii) Substraction

(iv) Multiplication

7.2.7S12 Calculation of the determinant of a 2x2 matrix

If $A = \begin{pmatrix} a & b \\ c & c \end{pmatrix}$

Then;

Det. of A - ad - cb

7.2.7S13 Calculation of the inverse of a 2x2 matrix

Inv. of $A = \frac{1}{\text{Det.}} \left(\frac{d}{c} - \frac{b}{a}\right)$

7.2.7S14 Application in the solution of simultaneous equations:

$$\begin{pmatrix} a & b \\ c & d \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$$

.2.8S PROBABILITY (4 HOURS)

7.2.8S1 Specific Objectives

At the end of this topic the trainee should be able to:-

(a) deduce whether two events are dependent or independent

(b) apply the laws of probability in finding the changes of an event occuring.

7.2.8S11 Application of laws of probability

Addition law

Multiplication law

7.2.9S STATISTICS (10 HOURS)

7.2.9S1 Specific Objectives

At the end of this topic the trainee should be able to:-

(a) differentiate between grouped and ungrouped data

(b) collect statistical data

(c) represent statistical data

(d) tabulate statistical data

(e) interpret statistical data

7.2.9S11 Difference between grouped and ungrouped data

7.2.9S12 Collection of data

- observation and recording

7.2.9S13 Tabulation of data

- class intervals
- frequencies
- class boundaries

7.2.9S14 Representation of data

- pictograms
- histograms
- pie charts
- bar charts
- frequency polygons
- graphs/frequency curves

7.2.9S15 Interpretation of data

- mean
- mode
- median
- range
- standard deviation
- quartiles
- percentiles

7.2.10S COMMERCIAL CALCULATIONS (22 HOURS)

7.2.10.1S0 Exchange rates

Specific Objectives

At the end of this topic, the trainee should be able to:-

(a) convert one currency to another

(b) calculate exchange rates

7.2.10.1S1 Conversion of one currency to another when the exchange rates are given

(i) Kenyan shilling to foreign currencies

(ii) foreign currency to Kenya shillings

(iii) foreign currency to some other currency

7.2.10.1S12 Calculation of exchange rates

- price level method
- effects of devaluation and revaluation on the exchange rates.

7.2.10.2S Prices and Profits

7.2.10.2S1 Specific Objectives

At the end of this sub-topic, the trainee should be able to:-

(a) calculate the selling price and buying price in a trading business

(b) calculate the gross and net profits of a small business.

7.2.10.2S12 Gross and Net profits

(i) Gross profit given the level of sales, purchase, returns in and out, carriage inwards and closing stock,

(ii) net profit given the gross profit and expenses

7.2.10.3S Calculation of taxes

7.2.10.3S1 Specific Objectives

At the end of this sub-topic the trainee should be able to:-

calculate income tax and sales tax

7.2.10.3S11 Calculation of:-

(i) income tax given the following:-

- insurance relief
- personal relief for
  - single persons
  - married persons
- special single relief
- income tax tables

(ii) Sales tax given selling price and selling rate of taxation.

7.2..4S Calculation of Average Sales

7.2.10.4S1 Specific Objectives

At the end of this sub-topic the trainee should be able to:-

calculate the average sales and hence stock turnover

7.2.10.4S11 Average sales and stock turnover

(i) Average sales = ½ (Highest sales + Lowest Sales)

(ii) Stock turnover = $\frac{\text{Cost of Sales}}{\text{Average Sales}}$

7.2.10.5S Calculation of Incomes

7.2.10.5S1 Specific Objectives

At the end of this sub-topic, the trainee should be able to:-

calculate salaries, wages, commissions, bonuses and dividends.

7.2.10.5S11 Calculation of:-

(i) salaries

- gross
- net

(ii) Wages

- time
- flat rate and overtime
- piece rate

(iii) Commissions and Bonuses

- percentages
- bonus

(iv) Dividends

STAGE III - 22 HOURS

7.3.12S TRIGONOMETRY (18 HOURS)

7.3.12S1 Specific Objectives

At the end of this topic the trainee should be able to:-

(a) convert degrees to radians and vice versa

(b) identify trigonometric ratios and their reciprocals

(c) prove simple trigonometric identifies

(d) solve simple trigonometric equations

(e) determine trigonometric ratios of angles greater than 90°

(f) solve triangles by use of the sine and cosine rules

(g) construct sine and cosine waves

7.3.12S11 Conversion of degrees to radias

7.3.12S12 Identification of trigonometric ratios and their reciprocals

- sine
- cosine
- tangent
- consecant
- secant
- contangent

7.3.12S13 Proof of simple trigonometric identies using pythagora's theorem

(i) $\sin^2 x + \cos^2 x = 1$

(ii) $1 + \tan^2 x = \sec^2 o$

(iii) $1 + \cot^2 x = \operatorname{cosec}^2 x$

7.3.12S14 Solution of simple trigonometric equations of the form:-

$a + b\sin x = c$

or

$a \sin^2 x + b\cos x = c$

7.3.12S15 Determination of trigonometric ratios of angles greater than 90^o

- CAST rule
- Calculation of acute supplementary angle

7.3.12S16 Solution of triangles

- Sine rule

$$\frac{a}{\text{Sine A}} = \frac{b}{\text{Sine B}} = \frac{c}{\text{Sine C}}$$

- Cosine rule

$a^2 = b^2 + c^2 - 2bc \cos A$

$b^2 = a^2 + c^2 - 2ac \cos B$

$c^2 = a^2 + B^2 - 2ab \cos c$

7.3.12S17 Construction of sine and cosine waves

(i) 0^o x 360^o

(ii) Amplitude

(iii) Phase angle

7.3.13S VECTORS (4 HOURS)

7.3.13S1 Specific Objectives

At the end of this topic the trainee should be able to:-

(a) manipulate vectors

(b) resolve vectors

7.3.13S11 Manipulation of vectors

- addition
- subtraction
- magnitude of a vector
- direction of a vector

7.3.13S12 Resolution of vectors

- vertical component
- horizontal component
- resultant vector
- triangles of forces
- parallelogram of forces