REPUBLIC OF KENYA

NATIONAL OCCUPATIONAL STANDARDS

FOR

ELECTRICAL ENGINEERING TECHNICIAN (POWER OPTION)

KNQF LEVEL: 6

ISCED OCCUPATIONAL STANDARD CODE: 0713 554B

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APPLY ENGINEERING MATHEMATICS

UNIT CODE:ENG/OS/PO/CC/01/6/B

UNIT DESCRIPTION

This unit describes the competencies required by an Electrical Technician to apply a wide range of engineering mathematics in their work. This includes applying Algebra, Apply Trigonometry and hyperbolic functions, Apply complex numbers, Apply Coordinate Geometry, Carry out Binomial Expansion, Apply Calculus, Solve Ordinary differential equations, Apply Laplace transforms, Apply Power Series, Apply Statistics, Apply Fourier Series, Apply Vector theory, Apply Matrix, Apply Numerical methods, Apply concept of probability for work, Perform commercial calculations and Perform Estimations, Measurements and calculations of quantities.

ELEMENTS AND PERFORMANCE CRITERIA

ELEMENT These describe the key outcomes which make up workplace function.	**PERFORMANCE CRITERIA** These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range.***
1. Apply Algebra	1.1 Calculations involving Indices are performed as per the concept 1.2 Calculations involving Logarithms are performed as per the concept 1.3 Scientific calculator is used in solving mathematical problems in line with manufacturer's manual 1.4 Simultaneous equations are performed as per the rules 1.5 Quadratic equations are calculated as per the concept
2. Apply Trigonometry and hyperbolic functions	2.1 Calculations are performed using trigonometric rules 2.2 Calculations are performed using ***hyperbolic functions***
3. Apply complex numbers	3.1 Complex numbers are represented using Argand diagrams 3.2 Operations involving complex numbers are performed 3.3 Calculations involving complex numbers are performed using De Moivre's theorem

4. Apply Coordinate Geometry	1.1 Polar equations are calculated using coordinate geometry 1.2 Graphs of given polar equations are drawn using the Cartesian plane 1.3 Normal and tangents are determined using coordinate geometry
5. Carry out Binomial Expansion	5.0 Roots of numbers are determined using binomial theorem 5.1 Errors of small changes are determined using binomial theorem
6. Apply Calculus	6.0 Derivatives of functions are determined using Differentiation 6.1 Derivatives of hyperbolic functions are determined using Differentiation 6.2 Derivatives of inverse trigonometric functions are determined using Differentiation 6.3 Rate of change and small change are determined using Differentiation. 6.4 Calculation involving stationery points of functions of two variables are performed using differentiation. 6.5 Integrals of algebraic functions are determined using integration 6.6 Integrals of trigonometric functions are determined using integration 6.7 Integrals of logarithmic functions are determined using integration 6.8 Integrals of hyperbolic and inverse functions are determined using integration
7. Solve Ordinary differential equations	7.0 First order and second order differential equations are solved using the method of undetermined coefficients 7.1 First order and second order differential equations are solved from given boundary conditions
8. Apply Laplace transforms	1.1 Laplace transforms are solved using initial and final value theorems 1.2 Inverse Laplace transforms are solved using partial fractions 1.3 Differential equations are solved using Laplace transforms

2. Apply Power Series	2.1 Power series are obtained using Taylor's Theorem 2.2 Power series are obtained using Maclaurin's theorem
3. Apply Statistics	10.1 Identification, Collection and Organization of data is performed 10.2 Interpretation, analysis and presentation of data in appropriate format is performed 10.3 Mean, median ,mode and Standard deviation are obtained from given data 10.4 Calculations are performed based on Laws of probability 10.5 Calculation involving probability distributions , mathematical expectation sampling distributions are performed
11. Apply Fourier Series	11.1 Fourier series coefficients are obtained using Fourier series techniques 11.2 Fourier series for 2π to T is are obtained using Fourier series techniques 11.3 Fourier series for odd and even functions are obtained using Fourier series techniques 11.4 Harmonic analysis is performed using numerical methods
12.Apply Vector theory	12.1 Calculations involving vector algebra, dot and cross products using vector theory 12.2 Gradient, Divergence and Curl are obtained 12.3 Vector calculations are performed using Green's theorem 12.4 Vector calculations are performed using Stoke's theorem 12.5 Conservative vector fields and line and surface integrals are obtained using Gauss's theorem
13. Apply Matrix	13.1 Determinant and inverse of 3x3 matrix are obtained 13.2 Solutions of simultaneous equations are obtained 13.3 Calculation involving Eigen values and Eigen vectors are performed
14. Apply Numerical methods	14.1 Roots of polynomials are obtained using iterative numerical methods 14.2 Interpolation and extrapolation are performed using numerical methods

15. Apply concepts of probability for work	15.1 Probability events are determined from dependent, independent and mutually exclusive 15.2 Counting is done using permutation, combination, tree diagrams and Venn diagrams techniques
16. Perform commercial calculations	16.1 Exchange rate calculations are done using devaluation and revaluation 16.2 Sales, stock turnover and profit and loss are determined 16.3 Incomes, salaries and wages are calculated
17. Perform estimations, measurements and calculations of quantities	17.1 Measurement information in workplace is extracted and interpreted 17.2 Appropriate workplace measuring tools and equipment are identified and selected 17.3 Conversions are performed between units of measurement 17.4 Measurements are estimated and taken 17.5 Length, width, height, perimeter, area and angles of ***figures*** are calculated 17.6 Volume and surface area of figures are calculated 17.7 Information is recorded using mathematical language and symbols appropriate for the task

RANGE

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

Variable	**Range**
1. Hyperbolic functions may include but not limited to:	• Sinh x • Cosh x • Cosec x • Coth x • Tanh x • Sech x
2. Figures may include but not limited to:	• Triangles • Squares

	• Rectangles • Circles • Spheres • Cylinders • Cubes • Polygons • Cuboids • Pyramids
3. Quantities may include but not limited to:	• Weight, • Mass • Area • Volume • Length • Width • Depth • Perimeter

REQUIRED SKILLS AND KNOWLEDGE

This section describes the skills and knowledge required for this unit of competency.

Required Skills

The individual needs to demonstrate the following skills:

- Applying fundamental operations (addition, subtraction, division, multiplication)
- Using and applying mathematical formulas
- Logical thinking
- Problem solving
- Applying statistics
- Drawing graphs
- Using different measuring tools

Required knowledge

The individual needs to demonstrate knowledge of:

- Fundamental operations (addition, subtraction, division, multiplication)
- Calculating area and volume
- Types and purpose of measuring instruments
- Units of measurement and abbreviations
- Rounding techniques
- Types of fractions
- Types of tables and graphs
- Presentation of data in tables and graphs
- Vector operations
- Matrix operations

EVIDENCE GUIDE

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills, knowledge and range.

1. Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1 Applied Trigonometry and hyperbolic functions 1.2 Applied complex numbers 1.3 Determined angles and length in triangles 1.4 Applied Calculus 1.5 Solved Ordinary differential equations 1.6 Applied Laplace transforms 1.7 Applied Power Series 1.8 Applied Fourier Series 1.9 Applied Vector theory 1.10 Applied Matrix 1.11 Identified and selected measuring equipments 1.12 Collected, Analyzed and presented data 1.13 Applied Numerical methods
2.0 Resource Implications	The following resources should be provided: 2.1 Access to relevant workplace or appropriately simulated environment where assessment can take place 2.2 Measuring equipment 2.3 Materials relevant to the proposed activity or tasks

3.0 Methods of Assessment	Competency in this unit may be assessed through: 3.1 Direct Observation 3.2 Demonstration with Oral Questioning 3.3 Written tests
Context of Assessment	Competency may be assessed 4.1 On job 4.2 Off job 4.3 During Attachment
Guidance information for assessment	Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.