ENGINEERING MATHEMATICS

UNIT CODE: ENG/CU/EIT/CC/01/6/A

Relationship to Occupational Standards

This unit addresses the unit of competency: Apply engineering mathematics

Duration of Unit: 150 hours

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 algebraic functions, trigonometry and hyperbolic functions, complex numbers, coordinate geometry, binomial expansion, calculus, ordinary differential equations, Laplace transforms, power series, Statistics, Fourier series, vector theory, matrix, numerical methods, probability, commercial calculations, estimations and measurements in solving problems

Summary of Learning Outcomes
1. Apply Algebra
2. Apply Trigonometry and hyperbolic functions
3. Apply complex numbers
4. Apply Coordinate Geometry
5. Carry out Binomial Expansion
6. Apply Calculus
7. Solve Ordinary differential equations
8. Apply Laplace transforms
9. Apply Power Series
10. Apply Statistics
11. Apply Fourier Series
12. Apply Vector theory
13. Apply Matrix
14. Apply Numerical methods
15. Apply concept of probability for work
16. Perform commercial calculations
17. Perform Estimations, Measurements and calculations of quantities

Learning Outcomes, Content and Suggested Assessment Methods

Electrical Curriculum

Learning Outcome	Content	Suggested Assessment Methods
1. Apply Algebra	- Base and Index - Law of indices - Indicial equations - Laws of logarithm - Logarithmic equations - Conversion of bases - Use of calculator - Reduction of equations - Solution of equations reduced to quadratic form - Solutions of simultaneous linear equations in three unknowns - Solutions of problems involving AP and GP	- Written tests - Oral questioning - Assignments - Supervised exercises
2. Apply Trigonometry and hyperbolic functions	- Half -angle formula - Factor formula - Trigonometric functions - Parametric equations - Relative and absolute measures - Measures calculation - Meaning of hyperbolic equations - Properties of hyperbolic functions - Evaluations of hyperbolic functions Hyperbolic identities - Osborne's Rule - Ashx+bshx=C equation - One-to-one relationship in functions - Inverse functions for one-to-one relationship - Inverse functions for trigonometric functions - Graph of inverse functions - Inverse hyperbolic functions	- Written tests - Oral questioning - Assignments - Supervised exercises

3. Apply complex numbers	❑ Meaning of complex numbers ❑ Stating complex numbers in numbers in terms of conjugate argument and ❑ Modulus ❑ Representation of complex numbers on the Argand diagram ❑ Arithmetic operation of complex numbers Application of De Moivre's theorem ❑ Application of complex numbers to engineering	❑ Assignments ❑ Oral questioning ❑ Supervised exercises ❑ Written tests
4. Apply Coordinate Geometry	❑ Polar equations ❑ Cartesian equation ❑ Graphs of polar equations ❑ Normal and tangents ❑ Definition of a point ❑ Locus of a point in relation to a circle ❑ Loci of points for given mechanism	❑ Written tests ❑ Oral questioning ❑ Assignments ❑ Supervised exercises
5. Carry out Binomial Expansion	❑ Binomial theorem Power series using binomial theorem Roots of numbers using binomial theorem. ❑ Estimation of errors of small changes using binomial theorem.	❑ Written tests ❑ Oral questioning ❑ Assignments ❑ Supervised exercises

6. Apply Calculus	❑ Meaning of derivatives of a function ❑ Differentiation from fist principle ❑ Tables of some common derivatives ❑ Rules of differentiation ❑ Rate of change and small change ❑ Stationery points of functions of two variables ❑ Meaning of integration ❑ Indefinite and definite integral ❑ Methods of integration application of integration. ❑ Integrals of hyperbolic and inverse functions	❑ Written tests ❑ Oral questioning ❑ Assignments ❑ Supervised exercises
7. Solve Ordinary differential equations	❑ Types of first order differential equations ❑ Formation of first order differential equation ❑ Solution of first order differential equations ❑ Application of first order differential equations ❑ Formation of second order differential equations for various systems ❑ Solution of second order differential equations ❑ Application of second order differential equations	❑ Written tests ❑ Oral questioning ❑ Assignments ❑ Supervised exercises
8. Apply Laplace transforms	❑ Meaning of Laplace transforms deriving Laplace transforms from first principles ❑ State properties of Laplace transform ❑ Determination of inverse LT of simple transforms and partial fractions ❑ Solution of differential equation by LT	❑ Written tests ❑ Oral questioning ❑ Assignments ❑ Supervised exercises

	❑ Solution of simultaneous differential equation by given initial conditions	
9. Apply Power Series	❑ Meaning of the term power series ❑ Taylor's theorem ❑ Deduction of Maclaurin's theorem to obtain power series ❑ Application of Taylor's theorem and Maclaurin's theorems in numerical work	❑ Written tests ❑ Oral questioning ❑ Assignments ❑ Supervised exercises

10. Apply Statistics	❑ Classification of data
	    Grouped data
	    Ungrouped data
	❑ Data collection
	❑ Tabulation of data
	    Class intervals
	    Class boundaries
	    Frequency tables
	❑ Diagrammatic and graphical presentation of data e.g.
	    Histograms
	    Frequency polygons
	    Bar charts
	    Pie charts
	    Cumulative frequency curves
	❑ Measures of central tendency mean, mode and median
	❑ Measures of dispersion
	    Variance and standard deviation
	❑ Definition of probability
	❑ Laws of probability
	❑ Expectation variance and S.D.
	❑ Types of distributions
	❑ Mean, variance and SD of probability distributions
	❑ Application of probability distributions
		❑ Assignments
		❑ Oral questioning
		❑ Supervised exercises
		❑ Written tests
		❑ Simulation
		❑ Data modelling

11. Apply Fourier Series	❑ Determination of the Fourier series as a periodic function of	❑ Assignments ❑ Oral questioning

	the period 2π and extend to π ❏ Determination of Fourier series of non-periodic functions over a given range ❏ Determination of Fourier series for even and odd functions and the half-range series for a given function	❏ Supervised exercises ❏ Written tests
12. Apply Vector theory	❏ Definition of dot and cross product of vectors ❏ Solution of problems involving dot and cross production of cross ❏ Definition of operators ❏ Definition of vector field ❏ Solutions of problems involving vector fields ❏ Definition of Gradient, Divergence and curl ❏ Solutions of involving Gradient, Divergence and curl ❏ Application of vectors	❏ Assignments ❏ Oral questioning ❏ Supervised exercises ❏ Written tests
13. Apply Matrix methods	❏ Matrix operation ❏ Determinant of 3x3 matrix ❏ Inverse of 3x3 matrix ❏ Solutions of linear simultaneous equations in three unknowns ❏ Application of matrices	❏ Assignments ❏ Oral questioning ❏ Supervised exercises ❏ Written tests
14. Apply Numerical methods	❏ Meaning of interpolation and extrapolation ❏ Application of interpolation ❏ Application of interactive methods to solve equations ❏ Application of interactive methods to areas and volumes	❏ Assignments ❏ Oral questioning ❏ Supervised exercises ❏ Written tests

15. Apply concepts of probability in work	❏ Meaning of probability
	 ❏ Types of probability events
	    • Dependent
	    • Independent
	    • Mutually exclusive
	 ❏ Laws of probability
		❏ Written tests
		 ❏ Assignments
		 ❏ Supervised exercises

	❑ Counting techniques	
	• Permutation	
	• Combination	
	• Tree diagrams	
	• Venn diagrams	

16. Perform commercial calculations	❑ Product pricing
	❑ Average sales determination
	❑ Stock turnover
	❑ Calculation of incomes
	❑ Profit and loss calculations
	❑ Salaries
	    • Gross
	    • Net
	❑ Wages
	    • Time rate
	    • Flat rate
	    • Overtime
	    • Piece rate
	    • Commission
	    • Percentage
	    • Bonus
	❑ Conversion of one currency to another
	❑ Exchange rates calculation
	    • Devaluation
	    • Revaluation
		❑ Oral questioning
		❑ Written tests
		❑ Assignments
		❑ Supervised exercises

17. Perform estimations, measurements and calculations of quantities	❑ Units of measurements and their symbols ❑ Conversion of units of measurement ❑ Calculation of length, width, height, perimeter, area and angles of figures ❑ Measuring tools and equipment ❑ Performing measurements and estimations of quantities	❑ Assignments ❑ Oral questioning ❑ Practical tests ❑ Observation ❑ Supervised exercises ❑ Written tests

Suggested Methods of Instruction
  • Group discussions

- Demonstration by trainer
- Exercises by trainee

Recommended Resources
- Scientific Calculators
- Rulers, pencils, erasers
- Charts with presentations of data
- Graph books
- Dice
- Computers with internet connection