ENGINEERING TECHNICIAN MATHEMATICS I

UNIT CODE: 0541 441 05A

TVETCDACC UNIT CODE: ENG/CU/SPV/CC/01/5/MA
UNIT DURATION: 80 HOURS

Relationship to Occupational Standards

This unit addresses the Unit of Competency: Apply engineering technician mathematics

Unit Description

This unit describes the competencies required to apply a wide range of engineering technician mathematics. Competencies include: applying number systems, applying algebra, applying trigonometry and hyperbolic functions, performing coordinates geometry and carrying out binomial expansions.

Summary of Learning Outcomes

By the end of this unit of learning the trainee will be able to:

S/NO	Learning Outcome	Duration (Hours)
1.	Apply number systems	**5**
2.	Apply algebra	**20**
3.	Apply Trigonometry and Hyperbolic functions	**20**
4.	Perform coordinates geometry	**15**
5.	Carry out binomial expansions	**20**
TOTAL		**80**

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Apply number systems	1.1 Types of numbers 1.1.1 Rounding off numbers to the nearest tens, 1.1.2 hundreds, thousands, millions and billions 1.1.3 Whole numbers	• Written assessment • Practical assessment

	1.1.4 Odd numbers 1.1.5 Even numbers 1.1.6 Prime number 1.1.7 Ratio and proportions 1.2 Percentages 1.2.1 Word problems involving natural 1.2.2 Numbers 1.3 Factors 1.3.1 Factors of composite numbers 1.3.2 Prime factors 1.3.3 Factors in power form 1.4 Divisibility Test 1.4.1 GCD 1.4.2 Application of GCD/HCF to real life situations 1.5 LCM 1.5.1 Multiples of a number 1.5.2 LCM of a set of numbers 1.5.3 Application of LCM in real life situations 1.6 Integers 1.6.1 The number line 1.6.2 Operation on integers 1.6.3 Order of operations 1.6.4 Application to real life situation 1.7 Fractions 1.7.1 Proper, improper fractions and mixed numbers 1.7.2 Conversion of improper fractions to mixed numbers and vice versa 1.7.3 Comparing fractions	• Oral Questioning

	1.7.4 Operations on fractions 1.7.5 Order of operations on fractions 1.7.6 Word problems involving fractions in real life situations 1.8 Decimals 1.8.1 Fractions and decimals 1.8.2 Recurring decimals 1.8.3 Recurring decimals and fractions 1.8.4 Decimal places 1.8.5 Standard form 1.8.6 Operations on decimals 1.8.7 Order of operations 1.8.8 Real life problems involving decimals 1.9 Arithmetic operation 1.9.1 Addition 1.9.2 Subtraction 1.9.3 Multiplication 1.9.4 Division 1.10 Squares and square roots 1.10.1 Squares by multiplication 1.10.2 Square roots by factorization 1.10.3 Squares and Square roots using Calculators	
2. Apply algebra	2.1 Indices and logarithms 2.1.1 Indices (powers) and base 2.1.2 Laws of indices (including positive 2.1.3 integers, negative integers and fractional 2.1.4 indices) 2.1.5 Powers of 10 and common logarithms	• Written assessment • Practical assessment • Oral Questioning

	2.1.6 Common logarithms; 2.1.7 characteristics 2.1.8 mantissa 2.1.9 Logarithm tables 2.1.10 Application of common logarithms in 2.1.11 multiplication, division and finding 2.1.12 roots 2.2 Algebra 2.2.1 Algebraic expressions including algebraic fractions 2.2.2 Simplification of algebraic expressions 2.2.3 Factorization by grouping 2.2.4 Removal of brackets 2.2.5 Substitution and evaluation 2.2.6 Problem solving in real situation 2.3 Simultaneous Equation 2.4 Solve simultaneous equation by; 2.4.1 Elimination method 2.4.2 Substitution method 2.4.3 Graphical method 2.4.4 Solve real life problems 2.5 Quadratic expressions and equations 2.5.1 Expansion of algebraic expressions 2.5.2 The three quadratic identities 2.5.3 Using the three quadratic identities 2.5.4 Factorization of quadratic expressions 2.5.5 Solutions of quadratic equations by factor method	

	2.5.6 Formation and solution of quadratic equations	
3. Apply trigonometry and hyperbolic functions	3.1 Importance of trigonometry in engineering. 3.2 Trigonometric Ratios and Functions 3.2.1 Definitions of sine, cosine, tangent, cosecant, secant, and cotangent. 3.2.2 Unit circle and angle measurement 3.2.2.1 Degrees and radians 3.2.2.2 Graphs of trigonometric functions. 3.3 Trigonometric Identities 3.3.1 Fundamental identities 3.3.1.1 Pythagorean 3.3.1.2 Reciprocal 3.3.1.3 Quotient identities 3.3.2 Co-function identities and even-odd properties. 3.3.3 Sum and difference formulas, double-angle, and half-angle formulas. 3.4 Solving Trigonometric Equations 3.4.1 Basic Trigonometric Equations 3.4.1.1 Solving equations involving basic trigonometric functions. 3.4.1.2 Using identities to simplify and solve equations. 3.4.2 Inverse Trigonometric Functions 3.4.2.1 Definition and properties. 3.4.2.2 Solving equations using inverse trigonometric functions. 3.4.3 Applications of Trigonometric Equations 3.4.3.1 Engineering problems involving periodic functions and waveforms. 3.4.3.2 Harmonic motion and oscillations in mechanical systems. 3.5 Trigonometry in Triangles 3.5.1 Right-Angle Triangles	1. Written assessment 2. Oral assessment 3. Practical 4. Project 5. Third party report 6. Portfolio of evidence •

	3.5.1.1 Solving for sides and angles using trigonometric ratios. 3.5.1.2 Applications in engineering problems such as inclined planes and forces. 3.5.2 Non-Right-Angle Triangles 3.5.2.1 Law of Sines and Law of Cosines. 3.5.2.2 Solving oblique triangles. 3.5.2.3 Applications in engineering fields of structural analysis and navigation. 3.6 Introduction to Hyperbolic Functions 3.6.1 Definitions of hyperbolic sine, cosine, tangent, and their reciprocals. 3.6.2 Graphs and properties of hyperbolic functions. 3.7 Hyperbolic Identities 3.7.1 Fundamental identities 3.7.1.1 Pythagorean-like identities 3.7.2 Sum and difference formulas, double-angle, and half-angle formulas. 3.8 Solving Hyperbolic Equations 3.8.1 Basic Hyperbolic Equations 3.8.1.1 Solving equations involving basic hyperbolic functions. 3.8.1.2 Using identities to simplify and solve equations. 3.8.2 Inverse Hyperbolic Functions 3.8.2.1 Definition and properties. 3.8.2.2 Solving equations using inverse hyperbolic functions. 3.9 Applications of Hyperbolic Functions in Engineering	
4. Perform coordinates geometry	4.1 Polar equations 4.1.1 Definition of polar coordinates 4.1.2 Definition and examples of polar equations.	1 Written assessment 2 Oral assessment 3 Practical

	4.1.3 Representing curves using polar equations. 4.2 Cartesian equation 4.2.1 Definition of Cartesian coordinates. 4.2.2 Definition of a point in cartesian coordinates 4.2.3 Relationship between Cartesian and polar coordinates. 4.2.4 Definition and examples of Cartesian equations. 4.2.5 Representing lines, circles, parabolas, ellipses, and hyperbolas using Cartesian equations. 4.2.6 Conversion Between Polar and Cartesian Equations. 4.3 Graphs of polar equations 4.3.1 Plotting Polar Equations 4.3.1.1 Definition of a point in polar coordinates 4.3.1.2 Steps to graph polar equations. 4.3.1.3 Using symmetry and periodicity in polar graphs. 4.3.2 Analyzing Polar Graphs 4.3.2.1 Identifying key features intercepts, maxima, minima 4.3.3 Applications in engineering 4.4 Normal and tangents 4.4.1 Tangents to Curves 4.4.1.1 Definition of a tangent line. 4.4.1.2 Finding the slope of a tangent to a curve at a given point. 4.4.2 Normals to Curves 4.4.2.1 Definition of a normal line. 4.4.2.2 Finding the equation of a normal to a curve at a given point. 4.4.3 Tangents and Normals in Polar Coordinates	4 Project 5 Third party report • Portfolio of evidence

	4.4.3.1 Techniques for finding tangents and normals to curves defined by polar equations. 4.5 Loci 4.5.1 Introduction to Loci 4.5.1.1 Definition of Locus 4.5.1.2 Understanding the concept of a locus. 4.5.1.3 Importance of loci in engineering. 4.5.2 Locus in Relation to a Circle 4.5.2.1 Equations and properties of loci relative to circles. 4.5.2.2 Common loci problems involving circles 4.5.3 Applications in Engineering 4.5.3.1 Using loci to solve engineering problems: robotic arm movement 4.5.3.2 Analyzing Loci of Points: tracing the path of a point on a rotating arm 4.5.3.3 Using loci to optimize mechanical systems: designing cams, robotic path planning.	
5. Carry out binomial expansion	5.1 Basic concepts of binomial theorem 5.1.1 Binomial expressions and notation. 5.1.2 Factorials and their use in binomial coefficients. 5.1.3 Binomial Coefficients 5.1.3.1 Definition and calculation using combinations (nCr). 5.1.3.2 Pascal's Triangle as a tool for finding binomial coefficients. 5.2 Binomial Expansion 5.2.1 General form of the binomial expansion expression 5.2.2 Binomial Expansion of $(a+b)^n$ where $n = 2,3,4\ldots$	6 Written assessment 7 Oral assessment 8 Practical 9 Project 10 Third party report • Portfolio of evidence

	5.2.3 Special cases 5.2.3.1 When $(1+x)^n$ 5.2.3.2 Negative and fractional binomial expansions using the binomial series 5.3 Applications of Binomial Expansion 5.3.1 Simplifying algebraic expressions using binomial expansion. 5.3.2 Solving polynomial equations. 5.4 Engineering Applications 5.5 Estimating values in engineering calculations.	

Suggested Methods of Instruction

1. Practical
2. Demonstrations
3. Group discussion
4. Direct instructions

Recommended Resources for 25 Trainees

S/No.	Category/Item	Description/ Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	**Learning Materials**			
1.	Textbooks	Engineering Mathematics by John bird 8th edition	5 pcs	1:5

2.		Engineering Mathematics by A.K stround 8th edition	5 pcs	1:5
3.		SMP	25	1:1
B	**Learning Facilities & infrastructure**			
1	Lecture/theory room	50 m^2	1	1:25
C	**Consumable materials**			
1.	Charts	Manila papers		
2.	marker pens	Erasable		
D	**Tools and Equipment**			
24.	Calculators	Scientific	25 pcs	1:1