

ENGINEERING TECHNICIAN MATHEMATICS I

UNIT CODE: 0541 441 05A

TVET CDACC UNIT CODE: ENG/CU/MDE/CC/01/5/MA

UNIT DURATION: 60 hours.

Relationship to Occupational Standards

This unit addresses the unit of competency: Apply engineering technician mathematics I.

Unit Description: This unit describes the competencies required by a technician in order to apply engineering technician mathematics. It enables the learner to; apply algebra, carry out mensuration, apply number systems, apply trigonometry and apply hyperbolic functions.

Summary of Learning Outcomes

S/No.	Learning Outcome	Duration in hours.
1.	To apply algebra	12
2.	To carry out mensuration	12
3.	To apply number systems	12
4.	To apply trigonometric functions	12
5.	To apply hyperbolic functions	12
	TOTAL	60

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

1. Apply algebra	<p>1.1.Importance of algebra in engineering</p> <p>1.2.Indices and logarithms</p> <ul style="list-style-type: none"> 1.1.1. Indices <ul style="list-style-type: none"> 1.1.1.1.Define Base and index 1.1.1.2.Laws of indices 1.1.1.3.Indicial equations 1.1.2. Logarithms <ul style="list-style-type: none"> 1.1.2.1.Laws of logarithm 1.1.2.2.Logarithmic equations 1.1.2.3.Conversion of bases 1.1.3. Use of calculator <p>1.3.Linear Equations</p> <ul style="list-style-type: none"> 1.2.1. Definition and standard form. 1.2.2. Methods of solving: Graphical, substitution, and elimination methods. 1.2.3. Applications in engineering problems. <p>1.4.Quadratic Equations</p> <ul style="list-style-type: none"> 1.3.1. Definition and standard form. 1.3.2. Methods of solving: Factoring, completing the square, and quadratic formula. 1.3.3. Real-world engineering applications. <p>1.3. Algebraic functions and graph</p> <ul style="list-style-type: none"> 1.3.1. Types of functions <ul style="list-style-type: none"> 1.4.1.1.Linear, quadratic, polynomial, rational, and exponential functions 1.4.1.2.Characteristics and properties of each function type. 1.3.2. Graphing Functions 	<ul style="list-style-type: none"> • Practical Assessment • Project • Third Party Report • Portfolio of Evidence • Written Assessment • Oral Questioning
------------------	---	--

	<p>1.4.1.3. Cartesian coordinate system.</p> <p>1.4.1.4. Plotting and interpreting graphs of algebraic functions.</p> <p>1.4.1.5. Using graphs to solve engineering problems.</p>	
2. Carry out mensuration	<p>1.1. Basic Concepts of mensuration</p> <p>1.1.1. Importance of mensuration in engineering and real-world applications</p> <p>1.1.2. Units of measurement</p> <p>1.1.2.1. SI units</p> <p>1.1.2.2. Imperial units</p> <p>1.1.2.3. Conversion between different units.</p> <p>1.2. Plane Geometry</p> <p>1.2.1. Area and Perimeter of Basic Shapes</p> <p>1.2.1.1. Squares, rectangles, parallelograms, triangles, and trapezoids.</p> <p>1.2.1.2. Formulas for area and perimeter.</p> <p>1.2.2. Circles and Ellipses</p> <p>1.2.2.1. Circumference and area of circles.</p> <p>1.2.2.2. Properties and formulas for ellipses.</p>	<ul style="list-style-type: none"> • Practical Assessment • Project • Third Party Report • Portfolio of Evidence • Written Assessment • Oral Questioning

	<p>1.2.3. Composite Figures</p> <p>1.2.3.1. Methods to find the area and perimeter of composite shapes.</p> <p>1.2.3.2. Decomposition into simpler shapes.</p> <p>1.3. Solid Geometry</p> <p>1.3.1. Surface Area and Volume of Prisms and Cylinders</p> <p>1.3.1.1. Rectangular prisms, cubes, and general prisms.</p> <p>1.3.1.2. Right circular cylinders.</p> <p>1.3.2. Surface Area and Volume of Pyramids and Cones</p> <p>1.3.2.1. Square pyramids, triangular pyramids (tetrahedrons), and general pyramids.</p> <p>1.3.2.2. Right circular cones.</p> <p>1.3.3. Surface Area and Volume of Spheres and Spheroids</p> <p>1.3.3.1. Spheres and oblate/prolate spheroids.</p> <p>1.3.4. Composite Solids</p> <p>1.3.4.1. Methods to find the surface area and volume of composite solids.</p> <p>1.3.4.2. Decomposition into simpler solids.</p> <p>1.3.4.3. Engineering applications and problem-solving.</p> <p>1.4. Frustums of Cones and Pyramids.</p> <p>1.4.1. Surface area and volume.</p> <p>1.5. Sector and Segment of a Circle</p>	
--	---	--

	<p>1.5.1. Area of a sector and length of an arc.</p> <p>1.5.2. Area of a segment</p> <p>1.5. Engineering applications</p>	
2. Apply number systems	<p>1.1. Types of numbers</p> <p>1.1.1. Round off numbers to the nearest tens,</p> <p>1.1.2. hundreds, thousands, millions and billions</p> <p>1.1.3. Whole numbers</p> <p>1.1.4. Odd numbers</p> <p>1.1.5. Even numbers</p> <p>1.1.6. Prime number</p> <p>1.1.7. Ratio and proportions</p> <p>1.1.8. Percentages</p> <p>1.1.9. Word problems involving natural numbers</p> <p>1.1.10. Numbers</p> <p>1.2. Factors</p> <p>1.2.1. Factors of composite numbers</p> <p>1.2.2. Prime factors</p> <p>1.2.3. Factors in power form</p> <p>1.3. Divisibility Test</p> <p>1.3.1. GCD</p>	<ul style="list-style-type: none"> • Practical Assessment • Project • Third Party Report • Portfolio of Evidence • Written Assessment • Oral Questioning •

	<p>1.3.2. Application of GCD/HCF to real life situations</p> <p>1.4.LCM</p> <ul style="list-style-type: none"> 1.4.1. Multiples of a number 1.4.2. LCM of a set of numbers 1.4.3. Application of LCM in real life situations <p>1.5.Integers</p> <ul style="list-style-type: none"> 1.8.1. The number line 1.8.2. Operation on integers 1.8.3. Order of operations 1.8.4. Application to real life situation <p>1.6.Fractions</p> <ul style="list-style-type: none"> 1.6.1. Proper, improper fractions and mixed numbers 1.6.2. Conversion of improper fractions to mixed numbers and vice versa 1.6.3. Comparing fractions 1.6.4. Operations on fractions 1.6.5. Order of operations on fractions 1.6.6. Word problems involving fractions in real life situations <p>1.7.Decimals</p> <ul style="list-style-type: none"> 1.7.1. Fractions and decimals 1.7.2. Recurring decimals 1.7.3. Recurring decimals and fractions 1.7.4. Decimal places 1.7.5. Standard form 1.7.6. Operations on decimals 1.7.7. Order of operations 1.7.8. Real life problems involving
--	---

	<p>decimals</p> <p>1.8.Arithmetic operation</p> <ul style="list-style-type: none"> 1.8.1. Addition 1.8.2. Subtraction 1.8.3. Multiplication 1.8.4. Division <p>1.9.Squares and square roots</p> <ul style="list-style-type: none"> 1.9.1. Squares by multiplication 1.9.2. Squares from Calculators 1.9.3. Square roots by factorization <p>2.1.Square roots from Calculators</p>	
3. Apply trigonometry functions	<p>3.1.Importance of trigonometry in engineering.</p> <p>3.2.Trigonometric Ratios and Functions</p> <ul style="list-style-type: none"> 3.2.1 Definitions of sine, cosine, tangent, cosecant, secant, and cotangent. 3.2.2 Unit circle and angle measurement 3.2.3 Degrees and radians 3.2.4 Graphs of trigonometric functions. <p>3.3.Trigonometric Identities</p> <ul style="list-style-type: none"> 3.3.1 Fundamental identities <ul style="list-style-type: none"> 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. <p>3.4 Solving Trigonometric Equations</p> <ul style="list-style-type: none"> 3.4.1 Basic Trigonometric Equations 	<ul style="list-style-type: none"> • Practical Assessment • Project • Third Party Report • Portfolio of Evidence • Written Assessment • Oral Questioning

	<p>3.4.1.1 Solving equations involving basic trigonometric functions.</p> <p>3.4.1.2 Using identities to simplify and solve equations.</p> <p>3.4.2 Inverse Trigonometric Functions</p> <p>3.4.2.1 Definition and properties.</p> <p>3.4.2.2 Solving equations using inverse trigonometric functions.</p> <p>3.4.3 Applications of Trigonometric Equations</p> <p>3.4.3.1 Engineering problems involving periodic functions and waveforms.</p> <p>3.4.3.2 Harmonic motion and oscillations in mechanical systems.</p> <p>3.5 Trigonometry in Triangles</p> <p>3.5.1 Right-Angle Triangles</p> <p>3.5.1.1 Solving for sides and angles using trigonometric ratios.</p> <p>3.5.1.2 Applications in engineering problems such as inclined planes and forces.</p> <p>3.5.2 Non-Right-Angle Triangles</p> <p>3.5.2.1 Law of Sines and Law of Cosines.</p> <p>3.5.2.2 Solving oblique triangles.</p> <p>3.5.2.3 Applications in engineering fields of structural analysis and navigation.</p>	
--	---	--

<p>4 Apply hyperbolic functions</p>	<p>4.1 Introduction to Hyperbolic Functions</p> <p>4.1.1 Definitions of hyperbolic sine, cosine, tangent, and their reciprocals.</p> <p>4.1.2 Graphs and properties of hyperbolic functions.</p> <p>4.2 Hyperbolic Identities</p> <p>4.2.1 Fundamental identities</p> <p>4.2.1.1 Pythagorean-like identities</p> <p>4.2.2 Sum and difference formulas, double-angle, and half-angle formulas.</p> <p>4.3 Solving Hyperbolic Equations</p> <p>4.3.1 Basic Hyperbolic Equations</p> <p>4.3.1.1 Solving equations involving basic hyperbolic functions.</p> <p>4.3.1.2 Using identities to simplify and solve equations.</p> <p>4.3.2 Inverse Hyperbolic Functions</p> <p>4.3.2.1 Definition and properties.</p> <p>4.3.2.2 Solving equations using inverse hyperbolic functions.</p> <p>4.4 Applications of Hyperbolic Functions in Engineering</p>	<ul style="list-style-type: none"> • Practical Assessment • Project • Third Party Report • Portfolio of Evidence • Written Assessment • Oral Questioning
-------------------------------------	---	--

Suggested Delivery Methods

- Demonstration
- Discussions
- Practical
- Project work

- Direct instruction

List of Recommended Resources for 25 trainees

S/No.	Category/Item	Description/ Specifications	Quantity	Recommended Ratio (Item: Trainee)
A	Learning Materials			
1.	Textbooks	Engineering Mathematics by K.A. Stroud Advanced Engineering Mathematics by Erwin Kreyszig	5 pcs 5 pcs	1:5 1:5
B	Learning Facilities & infrastructure			
2.	Lecture/theory room	60m ²	1	1:25
3.	Computer	Operating System: 64-bit Windows 11 or 10 version 1809 or above Processor: 2.5 GHz (3+ GHz recommended), Memory: 8 GB (32GB recommended) Disk space: 10 GB Display: 1920 x 1080	25 pcs	1:1

		resolution Display Card: 2 GB GPU (8 GB recommended) and DirectX 11 compliant (DirectX 12 recommended)		
4.	Projector		1	1:25
5.	Interactive screen	Specifications: 77-inch interactive whiteboard with touch and pen functionality.	1	1:25
C	Software			
6.	MATLAB	License: Educational licenses available. Features: Matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, interfacing with programs in other languages.	Installed in 25 computers	1:1
7.	GeoGebra	License: Free educational software. Interactive geometry,	Installed in 25 computers	1:1

		algebra, statistics, and calculus applications		
D	Consumables			
8.	Pens, pencils, rulers and paper	Whiteboard markers, 2H pencils, plastic rulers, A2 white papers	Enough	