

1. Module details**Module name****Engineering Mathematics****Module duration**

It is expected that students with the appropriate entry knowledge and skills will successfully complete this module in 36 - 40 hours.

Module code

NUE061

Discipline code

0501125 Engineering Mathematics.

2. Module purpose

This module will enable students to gain additional mathematical knowledge and skills necessary for problem solving within electrical/electronic engineering.

3. Prerequisites

EA003 Engineering Mathematics B.

4. Relationship to competency standards

This module provides part of the underpinning knowledge and skills in the 'Evidence Guide' of specific units of competency in the National Electrotechnology Training Package and provides similar support, where mapped, to equivalent units in the National Metals and Engineering Competency Standards. For details refer to the module to unit maps, available from NUEITAB.

5. Content**Determinants in the solution of simultaneous equations**

Vocational examples of simultaneous equations

Introduction to matrices

Types of matrices

Determinants

Determinant solutions of simultaneous equations

Exponents and logarithms

Laws of indices:

positive /negative integer values

multiplication/division

exponentiation

fractional values

index equals zero

Logarithmic laws

multiply/divide/exponentiate

Solution of exponential equations using logarithms

Substitution and solution of relevant formulae involving

exponents or logarithms: Transposition where required

Graphs of exponential functions, 10^x and e^x and the inverses $\log_{10}(x)$ and $\log_e(x)$

Sketch given functions on log-linear graphs

Trigonometry of oblique angles

Pythagoras' Theorem

Degrees in sexagesimal and decimal form

The three ratios: sine, cosine, tangent

Trigonometry for right-angled triangles to solve for unknown side or angle

Trigonometric equations

Radian measure—conversion between degrees and radians

Symmetry properties of the unit circle.

Sketch graphs of $y = \sin x$ and $y = \cos x$

Using vocational applications of current or voltage as a function of frequency, consider changes in amplitude, consider changes in frequency. Examine relationships of frequency, period and angular velocity.

Sketch graphs of the form $f(t) = a \sin \omega t$ and $f(t) = a \cos \omega t$, where a is the peak voltage or current, and ω is the angular velocity

Solve graphically equations of the form $f(t) = a \sin \omega t$ and $f(t) = a \cos \omega t$

Introduction to vectors

The vector as an expression of magnitude and direction

Review of Pythagoras' theorem

The vector sum of x and y values in terms of magnitude and direction

Rectangular components of vectors in the form $x = r \cos \theta$ and $y = r \sin \theta$

Rectangular-polar and polar-rectangular conversion

Vector addition and subtraction

Complex numbers

Definitions and notation

Complex numbers as vectors on an Argand diagram

Conversion between polar and rectangular forms

The conjugate of a complex number

6. Assessment strategy**Assessment methods**

Assessment should be progressive reflecting a holistic approach to ensure the module purpose is met. To assist in ensuring validity, reliability and fairness assessment instruments should include practical exercises, assignments and written tests consisting of a number of item types, such as multiple choice, short answer and problem solving.

Conditions of assessment

Learning and assessment will take place in an environment that is conducive to a learner's development.

7. Learning outcome details**Learning outcome 1****Solve analytic and applied problems involving third order simultaneous equations using determinants.****Assessment criteria**

- 1.1 Solve problems involving more than two simultaneous equations.
- 1.2 State the limitations of graphical methods of solution.
- 1.3 Distinguish between matrices and arrays.
- 1.4 Describe the null, diagonal, and unit matrices.
- 1.5 Calculate the determinant of a matrix.
- 1.6 Describe and identify singular and non-singular matrices.
- 1.7 Solve three simultaneous equations by determinants.

Learning outcome 2**Solve logarithmic and exponential functions.****Assessment criteria**

- 2.1 State and apply the laws of indices.
- 2.2 Express logarithms as indices.
- 2.3 Perform logarithmic operations.
- 2.4 Determine logarithms and antilogarithms to base 10.
- 2.5 Determine logarithms and antilogarithms to base e .
- 2.6 Determining logarithmic values for base 10 and base e .
- 2.7 Operations requiring logarithms.

Learning outcome 3**Solve mathematics problems involving triangles using the sine and cosine rules.****Assessment criteria**

- 3.1 Express angles in sexagesimal degree and decimal degree form.
- 3.2 Solve simple problems using Pythagoras' Theorem.
- 3.3 Calculate the three ratios $\sin \theta$, $\cos \theta$ and $\tan \theta$ for various angles and given side lengths.
- 3.4 Determine values of $\sin \theta$, $\cos \theta$ and $\tan \theta$ for given angles in the range $0^\circ \leq \theta \leq 360^\circ$.

	3.5	Use trigonometry of right-angled triangles to solve for unknown side or angle.
	3.6	Apply trigonometry in vocational applications, including resolution of 2 Dimensional vectors in particular.
Learning outcome 4		Solve mathematics problems requiring solution of trigonometric equations.
Assessment criteria	4.1	Convert between radian measure and degree measure, including π notation.
	4.2	Show a positive or negative angle on the unit circle.
	4.3	Use symmetry properties to find trigonometric ratios for angles greater than $\pi/2$.
	4.4	Sketch graphs of voltage and current as functions of time with change of amplitude or frequency.
	4.5	Solve simple vocational problems relating period, frequency and angular velocity.
Learning outcome 5		Solve two dimensional mathematics problems by representing quantities as vectors.
Assessment criteria	5.1	Plot given vectors on graph paper, measure given vectors from diagrams.
	5.2	Given x and y values, determine vector magnitude and direction.
	5.3	Given magnitude and direction, determine x and y values.
	5.4	Formal descriptions of rectangular-polar and polar-rectangular conversions.
	5.5	Add and subtract given vector quantities.

Learning outcome 6	Solve mathematics problems requiring the representation and manipulation of quantities as vectors using vector analysis and complex numbers.
Assessment criteria	<p>6.1 Describe the square root of a negative number as a mathematical concept.</p> <p>6.2 Distinguish between real, imaginary and complex numbers.</p> <p>6.3 State the laws of complex numbers and apply the laws in suitable calculations.</p> <p>6.4 Plot complex numbers on the Argand plane.</p> <p>6.5 Express vectors as complex numbers and perform suitable calculations.</p> <p>6.6 Express complex numbers as points.</p> <p>6.7 Calculate the conjugate of a complex number.</p> <p>6.8 Demonstrate the principles of converting rectangular form to polar form.</p> <p>6.9 Demonstrate the principles of converting polar form to rectangular form.</p> <p>6.10 Use a calculator for rectangular-polar and polar-rectangular conversions.</p>
8. Delivery of the module	
Delivery strategy	<p>Delivery strategies must be suitable for learning both theoretical and practical aspects described in the module purpose. It is considered that the most effective method to achieve this is by integration of theory and practice where students learn by experimentation, research and reports. It is recommended that learning and assessment be facilitated in a holistic manner that may require learning outcome sequence other than that indicated in the module.</p>
Resource requirements	<p>Each learner must have a personal scientific calculator. Access to graphing calculators, or computer-based graphing programs, would be an advantage.</p>
Occupational health and safety requirements	<p>A safe and healthy environment will be provided for students and teachers as well as the particular safety procedures followed as part of the learning / teaching activity and content.</p>