

**1. Module details****Module name****Applied Mathematical Concepts 1****Module duration**

It is expected that students with the appropriate entry knowledge and skills will successfully complete this module in 54-60 hours.

**Module code**

NUE081

**Discipline code****2. Module purpose**

This module shows the need for mathematical process in engineering situations. In particular it allows the student to:

- understand and apply the concept of error to linear measurement;
- calculate volume and surface area of a range of solids;
- develop competence in the manipulation of the 3 trigonometric ratios;
- apply the sine & cosine rules and the area of a triangle formula to problems;
- demonstrate competence in the algebraic skills needed in the sketching of graphs;
- present clear and mathematically correct graphs (including linear, quadratic, trigonometric and exponential);
- solve equations (including simultaneous) by both algebraic and graphical means;
- apply knowledge of graphs and equations to a variety of workplace problems.

**3. Prerequisites**

Nil

**4. Relationship to competency standards**

This module provides part of the underpinning knowledge and skills identified in the 'Evidence Guide' of specific units in the National Electrotechnology Competency Standards. Namely UTE NES 057A.

**5. Content****1. Linear Measurement**

Precision and error of measurement

- significant figures, relative and % errors
- scientific notation on a calculator

Conversion of linear units

- review of perimeter of plane figures

Pythagoras' theorem. Perimeter of polygons

Arc lengths. Perimeter of shapes involving arcs

**2. Spatial Measurement**

Areas of combined shapes

Volume and surface area of solids

Applied problems

- 3. Right triangle trigonometry**
  - Revision of right-angled triangles trigonometry
  - Angles of elevation/depression, and compass directions (bearings)
  - Vocational problems involving both trigonometric ratios and Pythagora's Rule
  - Applications to the inclined plane
- 4. Sine and Cosine Rule**
  - Sine rule and area of a triangle rule
  - Cosine rule
  - Applications of the three rules
- 5. Surveying**
  - Radial survey
  - Triangulation survey using sine rule
  - Use of Simpson's rule to find the area between a curve and a straight line
- 6. Algebra**
  - Algebraic operations
  - Solutions of linear equations
  - Substitution into simple non-linear equations
  - Transposition of non-linear equations
- 7. Linear Graphs**
  - Graphing linear functions
  - Application of the linear function
    - derive formula from graphs and tables
  - Simultaneous equations – both graphical and algebraic solutions
  - Practical applications (cost/revenue, supply/demand)
  - Find line of best fit graphically, then determine equation
- 8. Polynomials**
  - Types of polynomials
    - add/subtract, multiply polynomials
  - Factorising trinomials
  - Solution of quadratic equations using both factorising method and formula
- 9. Quadratic Graphs**
  - Properties of the parabola – symmetry, axis of symmetry, turning point
  - Graphic quadratic functions  $y = ax^2 + bx + c$
  - Finding maximum and minimum values of quadratic functions by using axis of symmetry/turning point
  - Application of quadratic functions to problems
    - maxima and minima problems
    - solution of quadratic equations graphically
- 10. Applications**
  - Graphic trig functions (sine/cosine only)
  - Applications in the physical sciences

**6. Assessment strategy****Assessment methods**

Assessment should be progressive reflecting an 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**

Normally learning and assessment will take place in an environment that is conducive to learning.

**7. Learning outcome details****Learning outcome 1**

**Apply the principles of mathematical linear measurement to engineering situations**

**Assessment criteria**

- 1.1 Apply precision and error in mathematical computations and display mathematical outcomes in the correct format using the appropriate significant figures and in scientific notation
- 1.2 Determine the perimeters of plane figures, polygons and the perimeter of shapes involving arcs
- 1.3 Apply Pythagoras' theorem to engineering situations

**Learning outcome 2**

**Apply the principles of mathematical spatial measurement to engineering situations**

**Assessment criteria**

- 2.1 Determine the areas of combined shapes
- 2.2 Calculate the volume and surface areas of solids

**Learning outcome 3**

**Apply right triangle trigonometry to engineering problem solving**

**Assessment Criteria**

- 3.1 Solve problems using the six trigonometrical ratios
- 3.2 Solve problems involving compass bearings and angles of elevation/depression
- 3.3 Apply trigonometrical concepts to problems involving inclined planes, vectors and forces and electrical sinusoidal waveforms

**Learning outcome 4**

**Apply the sine and cosine rules to practical applications**

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| <b>Assessment Criteria</b> | 4.1 Use the sine rule to solve unknown dimensions/angles in triangles  |
|                            | 4.2 Use the cosine rule to solve unknown dimensions/angles in triangles  |
| <b>Learning outcome 5</b>  | <b>Apply mathematical concepts to basic surveying and computation of areas</b>                                       |
| <b>Assessment criteria</b> | 5.1 Apply mathematical concepts to radial and triangulation surveys  |
|                            | 5.2 Apply Simpson's Rule to engineering applications   |
| <b>Learning outcome 6</b>  | <b>Apply basic algebra to engineering calculations</b>   |
| <b>Assessment criteria</b> | 6.1 Undertake basic operations involving substitutions, additions, removal of brackets, multiplication and divisions |
|                            | 6.2 Solve linear equations   |
|                            | 6.3 Substitute into non-linear equations   |
|                            | 6.4 Transpose non-linear equations   |
| <b>Learning outcome 7</b>  | <b>Use linear graphical techniques in engineering problem solving</b>  |
| <b>Assessment criteria</b> | 7.1 Graph linear functions   |
|                            | 7.2 Derive equations from graphs and tables  |
|                            | 7.3 Solve simultaneous equations algebraically and graphically   |
|                            | 7.4 Determine the <i>best line of fit</i> graphically and determine equation   |
| <b>Learning outcome 8</b>  | <b>Undertake mathematical computations involving polynomials</b>   |
| <b>Assessment criteria</b> | 8.1 Add, subtract and multiply polynomials   |
|                            | 8.2 Factorise trinomials   |
|                            | 8.3 Solve quadratic equations  |
| <b>Learning outcome 9</b>  | <b>Undertake mathematic computations involving quadratic graphs</b>  |
| <b>Assessment criteria</b> | 9.1 Graph quadratic functions  |

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|  | <p>9.2 Determine maxima and minim</p> <p>9.3 Solve quadratic equations graphically</p> <p>9.4 State the properties of a parabola and state applications of parabolas in engineering applications</p>   |
| <b>Learning outcome 10</b>                         | <b>Apply trigonometry and graphical techniques to engineering outcomes</b>   |
| <b>Assessment criteria</b>                         | <p>10.1 Graph trigonometric functions e.g. <math>V = V_m \sin \theta</math>, <math>I = I_m \cos \theta</math></p> <p>10.2 Add equations such as <math>v \sin \theta + u \sin(\theta + \phi)</math> graphically</p> <p>10.3 Use Simpson's Rule to determine the average and root mean square values of a sinusoidal waveform</p>  |
| <b>8. Delivery of the module</b>                   |  |
| <b>Delivery strategy</b>                           | <p>Delivery strategies must be suitable for learning described in the module purpose. It is considered that the most effective way to achieve this is by the integration of theory and practical applications where students learn by applying theory to workplace situations. It is recommended that learning and assessment be facilitated in a holistic manner which may require learning outcome sequence other than that indicated in the module.</p> |
| <b>Resource requirements</b>                       | <p>Resources should be sufficient for students to work on an individual basis.</p>   |
| <b>Occupational health and safety requirements</b> | <p>A safe and healthy environment will be provided for students and teachers as well as safety procedure with regard to learning / teaching activity</p>   |