Specification of Generic (Foundation) Competencies

Numeracy

**Summary Table of Units of Competency
and
Description of each Unit of Competency**

Summary Table of Units of Competency (Numeracy)

Skills \ Descriptors	Level 1	Level 2	Level 3	Level 4
	Solve straightforward problems in a narrow range of familiar contexts using very simple numeracy skills.	Solve problems in a selected number of predictable contexts using numeracy skills	Solve problems in a broad range of largely predictable contexts by selecting a wide range of standard numeracy skills.	Solve problems in a broad range of varied contexts by selecting a wide range of standard skills and some advanced numeracy skills with justification.
Number and Algebra	• Calculate with whole numbers, fractions and simple decimals *(GCNU101A)* • Calculate simple ratios with whole numbers *(GCNU102A)*	• Calculate with numbers expressed in various forms *(GCNU201A)* • Apply simple formulas, linear equations in one unknown and linear inequalities in one unknown in everyday contexts *(GCNU202A)* • Calculate percentages and percentage changes *(GCNU203A)* • Solve rates and ratios problems *(GCNU204A)* • Solve simultaneous linear equations in two unknowns *(GCNU205A)*	• Solve problems using functions of one variable, quadratic equations in one unknown and quadratic inequalities in one unknown *(GCNU301A)* • Solve problems of variations *(GCNU302A)* • Solve problems related to exponential and logarithmic functions *(GCNU303A)* • Solve problems on arithmetic and geometric sequences *(GCNU304A)*	• Solve linear programming problems in two dimensions *(GCNU401A)* • Solve problems using complex numbers *(GCNU402A)* • Solve physical problems using vectors *(GCNU403A)* • Solve problems using Boolean algebra *(GCNU404A)* • Solve systems of linear equations using determinants and matrices *(GCNU405A)* • Solve financial problems using mathematical methods *(GCNU406A)* • Plan activities using flow charts and critical path analysis *(GCNU407A)* • Solve optimization problems using network analysis *(GCNU408A)*

	Level 1	Level 2	Level 3	Level 4
Descriptors / **Skills**	Solve straightforward problems in a narrow range of familiar contexts using very simple numeracy skills.	Solve problems in a selected number of predictable contexts using numeracy skills	Solve problems in a broad range of largely predictable contexts by selecting a wide range of standard numeracy skills.	Solve problems in a broad range of varied contexts by selecting a wide range of standard skills and some advanced numeracy skills with justification.
Measures, Shape and Space	• Measure various quantities using equipment in everyday contexts *(GCNU103A)* • Calculate measures of common 2-D figures and 3-D solids *(GCNU104A)*	• Estimate measures and amounts *(GCNU206A)* • Solve simple mensuration problems*(GCNU207A)* • Calculate lengths of sides and angles in right-angled triangles *(GCNU208A)* • Work with rectilinear figures *(GCNU209A)* • Solve simple problems in coordinate geometry *(GCNU210A)*	• Solve problems involving symmetry, transformation, congruence and similarity about 2-D figures and 3-D solids *(GCNU305A)* • Model periodical data using sinusoidal functions *(GCNU306A)* • Calculate lengths of sides and angles in 2-dimensional problems *(GCNU307A)*	• Calculate lengths of sides and angles in 3-dimensional problems *(GCNU409A)*

	Level 1	**Level 2**	**Level 3**	**Level 4**
Descriptors / **Skills**	Solve straightforward problems in a narrow range of familiar contexts using very simple numeracy skills.	Solve problems in a selected number of predictable contexts using numeracy skills	Solve problems in a broad range of largely predictable contexts by selecting a wide range of standard numeracy skills.	Solve problems in a broad range of varied contexts by selecting a wide range of standard skills and some advanced numeracy skills with justification.
Data Handling	• Read and construct very simple tables, diagrams, charts and line graphs *(GCNU105A)* • Collect and organize data for simple calculations *(GCNU106A)*	• Construct and use statistical graphs *(GCNU211A)* • Calculate means, medians, modes and ranges of grouped and ungrouped data *(GCNU212A)*	• Select appropriate methods to present data and interpret the results *(GCNU308A)* • Compare data sets using measures of central tendency and measures of dispersion *(GCNU309A)* • Discuss various matters and issues related to conducting a statistical survey *(GCNU310A)* • Solve problems involving uncertainty using basic principles of probability *(GCNU311A)* • Calculate and interpret index numbers *(GCNU312A)* • Identify components of a time series and make forecasts *(GCNU313A)* • Solve counting problems using permutations and combinations *(GCNU314A)*	• Solve problems involving uncertainty using discrete probability distributions *(GCNU410A)* • Solve problems involving uncertainty using normal probability density functions *(GCNU411A)* • Devise statistical quality control plans *(GCNU412A)* • Estimate population parameters from a random sample *(GCNU413A)* • Make decisions by performing hypothesis testing on means or proportions for one-sample and two-sample problems *(GCNU414A)* • Investigate the relationships between two quantitative variables *(GCNU415A)* • Make decisions using decision theory *(GCNU416A)*
Calculus	Nil	Nil	• Solve problems on rates of change, curve sketching and optimization using differentiation *(GCNU315A)* • Solve problems using integration *(GCNU316A)*	• Solve non-linear equations and approximate definite integrals using numerical methods *(GCNU417A)* • Solve first-order ordinary differential equations and second-order ordinary linear differential equations with constant coefficients *(GCNU418A)*

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Calculate with whole numbers, fractions and simple decimals**
Unit Code	GCNU101A
Level	1
Credit	3

Elements of Competency	**Performance Criteria**
1 Communicate using non-negative numbers	1.1 Use non-negative numbers to describe practical situations **Range** ● May include but is not limited to money, lengths and time 1.2 Express non-negative numbers in figures and words **Range** ● May include but is not limited to cheque writing and invoice issuing 1.3 Perform inter-conversion of non-negative numbers expressed in different forms **Range** ● Forms include non-negative numbers in words or in figures, fractions and simple decimals 1.4 Compare non-negative numbers, in the same form or in different forms, in everyday contexts **Range** ● Include the use of inequality signs $>$, $\geq$, $<$ and $\leq$
2 Perform calculations with non-negative numbers	2.1 Add and subtract with non-negative whole numbers, non-negative fractions and simple non-negative decimals in practical situations

		Range ● Calculations may include but are not limited to money, lengths and time 2.2 Multiply and divide non-negative fractions and simple non-negative decimals by positive whole numbers in practical situations **Range** ● Calculations may include but are not limited to money, lengths and time ● Include rounding off	
3	Use calculators to perform basic calculations with non-negative numbers	3.1 Perform basic arithmetic operations using calculators **Range** ● Processes include addition, subtraction, multiplication and division of non-negative numbers (exclude the case when the divisor is zero) ● Other operations may include but are not limited to squaring and finding square roots	

Unit Range

This unit covers basic arithmetic operations with non-negative numbers applicable to all industries.   Examples of application may include calculating hourly wages, total sales amount and car park fee.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing.   Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected.   The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators where necessary.

Special Notes

Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title   Calculate simple ratios with whole numbers

Unit Code   GCNU102A

Level   1

Credit   2

Elements of Competency	Performance Criteria
1 Recognize the meaning of ratios	1.1 Express two quantities as a ratio
	1.2 Find the other quantity from a ratio $a:b$ given the value of either a or b
	Range • a and b are positive whole numbers
2 Solve problems using simple ratios with positive whole numbers	2.1 Calculate the amount of components in a mixture of two components given the ratio of mixing
	2.2 Calculate the actual distance between two points on a scale drawing given a scale
	2.3 Find the scale of a map or a floor plan given the actual distance between two points on a scale drawing

Unit Range

This unit covers basic calculations associated with simple ratios with positive whole numbers and scale drawings. The unit is intended to apply to most industries. Examples of application may include working out the amount of gold in an alloy and finding the actual perimeter of a room from a floor plan.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

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4   Learners may use calculators where necessary.

Special Notes
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Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Measure various quantities using equipment in everyday contexts**
Unit Code	GCNU103A
Level	1
Credit	3

Elements of Competency	Performance Criteria
1 Use measurement equipment to measure quantities	1.1 Select appropriate tools and devices to measure different quantities **Range** ● The quantities to be measured may include but not limited to length, distance, mass, weight, time, temperature, area, volume, capacity and angles ● The measurement tasks should involve a range of units and scales 1.2 Change the reading of a measurement from one metric units to another **Range** ● Include conversion between units such as cm, m and km 1.3 Measure quantities to an appropriate degree of accuracy
2 Perform calculations based on readings from measuring equipment	2.1 Carry out arithmetic operations from readings obtained from measuring equipment **Range** ● Addition, subtraction, multiplication and division
3 Recognize the approximate nature of measurements	3.1 Recognize errors incurred in the actual measurement of objects in everyday contexts

4	Identify methods of reducing errors in measurements	4.1	Identify methods of reducing errors in measuring lengths of line segments
			Range • Include keeping a correct eye position when taking readings from a ruler
		4.2	Identify methods of reducing errors in measuring lengths of curves
			Range • Include using an inelastic string
		4.3	Identify methods of reducing errors in measuring sizes of small objects
			Range • Include accumulating a large number of such objects for measurement followed by estimating the quantity corresponding to one single object by using division
		4.4	Identify methods of reducing errors in measuring areas of irregular shapes
			Range • Include using graph papers with smaller squares

Unit Range

This unit covers the skills of using measuring equipment to measure and calculate quantities based on readings from measuring equipment. Most industries may find this unit useful. Examples of application may include measuring the amount of bleaching agent to be used and the external diameters of water pipes.

Assessment Guidelines

1 The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2 Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing. Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3 All assessment activities should be valid, reliable and practical, with the focus on outcomes

to ensure that sufficient evidence of the performance criteria set in the specification is collected.   The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators where necessary.

Special Notes
Practical applications in everyday and vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title   **Calculate measures of common 2-D figures and 3-D solids**

Unit Code   GCNU104A

Level   1

Credit   3

Elements of Competency	Performance Criteria
1 Calculate perimeters of common 2-D figures	1.1 Calculate perimeters of common 2-D figures from given measurements **Range** ● May include but is not limited to triangles, quadrilaterals and polygons 1.2 Calculate perimeters of common 2-D figures using formulas expressed in words **Range** ● May include but is not limited to squares, rectangles and their composites
2 Calculate areas of common 2-D figures	2.1 Calculate areas of common 2-D figures using formulas expressed in words **Range** ● Include triangles, squares, rectangles, trapeziums, parallelograms and their composites
3 Calculate volumes of cuboids	3.1 Calculate volumes of cubes and cuboids using formulas expressed in words

Unit Range

This unit covers calculations of perimeters and areas of common 2-D figures and volumes of cuboids.   Most industries will find this unit applicable.   Examples of application may include finding the amount of carpet needed to furnish a room and the cost of materials needed to fence a garden.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing.   Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected.   The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

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Special Notes
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Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title   **Read and construct very simple tables, diagrams, charts and line graphs**

Unit Code   GCNU105A
Level   1
Credit   3

Elements of Competency	Performance Criteria
1 Read and use very simple tables, diagrams, charts, and line graphs	1.1 Read and use very simple tables **Range** ● May include but is not limited to time tables, frequency tables and bus fare tables ● Include simple calculations using data from the tables 1.2 Read and use very simple diagrams and charts **Range** ● Include pictograms and bar charts ● Include simple calculations using data from diagrams and charts 1.3 Read and use line graphs **Range** ● Include broken-line graphs ● Include predicting a trend from line graphs ● Include simple calculations using data from line graphs
2 Present information using very simple tables, diagrams, charts and line graphs	2.1 Construct very simple tables, diagrams, charts and line graphs **Range** ● Include tables, diagrams, charts and line graphs listed in 1.1, 1.2 and 1.3

Unit Range

It is applicable to industries which require reading and construction of very simple tables, diagrams, charts and line graphs. It may be applied to a workplace of familiar contexts. Examples of application may include reading out the correct fare from a fare table and constructing a bar-chart showing the number of workers late for the day.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing. Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected. The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators and computer software where necessary.

Special Notes

Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title **Collect and organize data for simple calculations**

Unit Code GCNU106A

Level 1

Credit 2

Elements of Competency	Performance Criteria
1 Collect and organize data	1.1 Collect and record data **Range** ● May include but is not limited to previous information, questionnaires, direct observations, experiments and interviews ● Exclude the design of forms and tables for recording data 1.2 Organize data **Range** ● Tallying and grouping
2 Summarize data	2.1 Calculate the average and range for up to ten items

Unit Range

It is applicable to most industries which require data collection.   People credited with this unit are able to collect, organize and summarize data.   Examples of application may include recording the number of patients attending a clinic in a week and organizing the data in groups.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing.   Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected.   The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators and computer software where necessary.

Special Notes

Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Calculate with numbers expressed in various forms**
Unit Code	GCNU201A
Level	2
Credit	3

Elements of Competency	Performance Criteria
1 Recognize directed numbers	1.1 Identify the uses of positive numbers, negative numbers and zero 1.2 Compare directed numbers on a number line
2 Perform calculations with directed numbers	2.1 Perform addition, subtraction, multiplication and division of directed numbers **Range** ● At most three operations in each expression
3 Convert numbers expressed in different forms	3.1 Express numbers in various numeral systems **Range** ● May include but not limited to binary, decimal, hexadecimal system and their inter-conversion ● Inter-conversion between different measurement units of the same quantity is expected 3.2 Express very large or very small numbers using scientific notation
4 Use a calculator to perform calculations of numbers expressed in different forms	4.1 Perform basic operations of numbers expressed in different forms using calculators **Range** ● Addition, subtraction, multiplication, division and square of directed numbers ● Square root of positive numbers

Unit Range

This unit covers the skills to perform calculations with numbers expressed in different forms and use a calculator to perform basic calculations.   This unit is applicable to work positions of most trades.   Examples of application may include calculations with profit and loss as well as temperature above and below zero degrees Celsius.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing.   Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected.   The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators where necessary.

Special Notes

1   Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

2   Competence in Unit GCNU101A, *Perform calculations with whole numbers, fractions and simple decimals* is assumed.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Apply simple formulas, linear equations in one unknown and linear inequalities in one unknown in everyday contexts**
Unit Code	GCNU202A
Level	2
Credit	4

Elements of Competency	Performance Criteria

1 Recognize the uses of algebraic language	1.1 Use letters to represent numbers
	
	1.2 Translate word phrases into algebraic expressions and vice versa
	
	1.3 Manipulate simple polynomials
	
	     Range
	     ● Combination of like terms, addition, subtraction and multiplications of simple polynomials

2 Evaluate formulas	2.1 Form a formula connecting two or more variables
	
	2.2 Evaluate formulas by substitution
	
	2.3 Perform change of subject in simple formulas
	
	     Range
	     ● Exclude formulas involving the radical sign, exponential functions or trigonometric functions

3 Form and use simple linear equations in one unknown and solve problems	3.1 Identify unknowns in problems 3.2 Choose letters to represent unknowns 3.3 Form simple linear equations in one unknown according to information given in problems 3.4 Solve simple linear equations in one unknown correctly according to context

		Range ● Include techniques of transposing terms, removing brackets and manipulating fractions containing unknowns	
4	Solve linear inequalities in one unknown in practical contexts	4.1	Identify unknowns in problems
		4.2	Choose letters to represent unknowns
		4.3	Form simple linear inequalities in one unknown according to information given in problems
		4.4	Solve inequalities according to context **Range** ● Include techniques of transposing terms, removing brackets and manipulating fractions containing unknowns

Unit Range

Application of this unit will be found in the field of work where knowledge of formulas, linear equations in one unknown and linear inequalities in one unknown is required. It is useful in most trades and industries. Examples of application may include finding the voltage across a load and calculating simple interest with given principal and interest rate.

Assessment Guidelines

1 The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2 Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing. Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3 All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected. The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4 Learners may use calculators where necessary.

Special Notes

Practical applications in everyday and vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Calculate percentages and percentage changes**
Unit Code	GCNU203A
Level	2
Credit	3

Elements of Competency	Performance Criteria

1 Solve simple percentage problems	1.1 Represent a number as a percentage
	
	     Range
	     ● Include converting decimals or fractions to percentages and vice-versa
	
	1.2 Express a number as a percentage of another number
	
	1.3 Solve simple problems where percentages are given

2 Calculate percentage changes	2.1 Calculate percentage changes by using formulas expressed in words 2.2 Solve simple problems where percentage changes are given
3 Solve simple selling problems	3.1 Recognize the terms discount, profit and loss 3.2 Calculate profit or loss per cents by formulas 3.3 Solve simple problems where profit or loss per cents are given

Unit Range

This unit covers basic calculations of percentages and percentage changes in the field of work of all industries. It finds applications to solving problems such as calculating discount, interest, profit, loss, tax and error.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as

written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2 Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing. Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3 All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected. The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4 Learners may use calculators where necessary.

Special Notes
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Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Solve rates and ratios problems**
Unit Code	GCNU204A
Level	2
Credit	2

Elements of Competency	Performance Criteria
1 Solve rates and ratios problems	1.1 Distinguish between the terms rates and ratio 1.2 Solve rates problems 1.3 Solve simple problems involving ratios **Range** • Recognize the notations of $a:b$ (or $\dfrac{a}{b}$) and $a:b:c$ • Divide a quantity in a given ratio • Determine $a:b:c$ from $a:b$ and $b:c$

Unit Range

This unit covers basic calculations associated with rates or ratios. It finds applications in solving problems of wages, speed, currency exchange, gear ratios, gross profit ratios and many others.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing. Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes

to ensure that sufficient evidence of the performance criteria set in the specification is collected.   The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators where necessary.

Special Notes

1   Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

2   Competence in Unit GCNU102A, *Carry out calculations involving simple ratios with whole numbers* is assumed.

Generic (Foundation Competencies)

Unit of Competency for Numeracy

Unit Title	**Solve simultaneous linear equations in two unknowns**
Unit Code	GCNU205A
Level	2
Credit	2

Elements of Competency	**Performance criteria**
1 Formulate simultaneous linear equations	1.1 Formulate simultaneous equations from practical contexts
2 Formulate and solve simultaneous linear equations algebraically	2.1 Solve simultaneous linear equations in two unknowns algebraically **Range** - Limited to equations having a unique solution with integral coefficients and constant terms - Include the methods of substitution and elimination
3 Recognize the representation of straight lines and their intersection on the x-y plane	3.1 Represent points on the x-y plane 3.2 Represent a straight line on the x-y plane given the equation of the straight line 3.3 Locate the intersection of two straight lines
4 Solve simultaneous linear equations graphically	4.1 Plot graphs of linear equations in two variables 4.2 Solve simultaneous linear equations in two unknowns graphically **Range** Limited to equations having a unique solution with integral coefficients and constant terms 4.3 Recognize the condition for no solution and infinitely many solutions

Unit Range

This unit covers some methods of solving simultaneous linear equations in two unknowns. Examples of application include break-even analysis and calculating currents in circuits. Disciplines of finance control, engineering and physical science may find this unit useful.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing.   Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected.   The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators where necessary.

Special Notes

1   Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

2   Competence in Unit GCNU202A, *Apply simple formulas, linear equations in one unknown and linear inequalities in one unknown in everyday contexts* is assumed.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Estimate measures and amounts**
Unit Code	GCNU206A
Level	2
Credit	3

Elements of Competency	Performance Criteria

1 Solve problems using numerical estimation	1.1 Identify the needs of numerical estimation
	
	1.2 Apply the methods of numerical estimation to solve problems given the level of accuracy required
	
	    Range
	    ● Methods of numerical estimation limited to rounding off, front-end, compatible numbers and clustering
	
	1.3 Calculate the maximum error of a measurement given the level of accuracy
	
	1.4 Estimate amounts from formulas

2 Apply the strategies of estimation	2.1 Identify the estimation strategies in solving problems of numerical estimation
	
	    Range
	    ● Strategies of numerical estimation limited to benchmarking and decomposition-recomposition

3 Estimate measures on scale drawings	3.1 Estimate the actual distance between two points on a scale drawing given the actual distance between two other points on the same drawing 3.2 Estimate the actual area given measures on a scale drawing

Unit Range

This unit covers the problems of estimation involving formulas and measurements. Application of this unit will be found in the field of work where estimation of values is required. It is

useful in workplace of both business and engineering sectors. Examples of application may include preparing a budget estimation and finding the actual distance between two attractions on a tourist map.

Assessment Guidelines

1.   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2.   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing. Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3.   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected. The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4.   Learners may use calculators where necessary.

Special Notes

Practical applications in everyday and vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Solve simple mensuration problems**
Unit Code	GCNU207A
Level	2
Credit	3

Elements of Competency	Performance Criteria
1 Calculate circumferences and areas of circles	1.1 Calculate circumferences and areas of circles using formulas
2 Calculate arc lengths and areas of sectors	2.1 Calculate arc lengths and areas of sectors using formulas **Range** ● Limited to the formulas in degrees
3 Calculate surface areas of common solids	3.1 Calculate surface areas of rectangular based solids **Range** ● Include cubes, cuboids and their composites 3.2 Calculate surface areas of cylinders, spheres, right circular cones, pyramids and prisms by using formulas
4 Calculate volumes of common solids	4.1 Calculate volumes of cylinders, spheres, circular cones, pyramids and prisms by using formulas 4.2 Calculate volumes of composite solids in 3.1

Unit Range

Application of this unit will be found in the field of work where solving simple mensuration problems is required. It is useful in workplace of both business and engineering sectors. Examples of application may include working out the circumference of a circular fountain in the garden and finding the capacity of a conical shape container.

Assessment Guidelines

1 The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project

work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing.   Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected.   The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators where necessary.

Special Notes

1   Practical applications in everyday and vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

2   Competence in Unit GCNU104A, *Calculate measures of common 2-D figures and 3-D solids* is assumed.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Calculate lengths of sides and angles in right-angled triangles**
Unit Code	GCNU208A
Level	2
Credit	3

Elements of Competency	Performance Criteria
1 Solve problems using Pythagoras' Theorem	1.1 Find unknowns in right-angled triangles using Pythagoras' Theorem 1.2 Solve problems using the converse of Pythagoras' Theorem
2 Solve problems of right-angled triangles using trigonometric ratios	2.1 Find lengths and angles in right-angled triangles using trigonometric ratios **Range** ● Trigonometric ratios limited to sine, cosine, and tangent ● Limited to 2-D problems ● Problems may include but are not limited to gradients, angles of elevation, angles of depression and bearings

Unit Range

Application of this unit can be found in the field of work where solving problems of right-angled triangles is required. Industries such as design, animation, surveying and navigation may find this unit useful. Examples of application may include finding the gradient according to contours and determining the height of a hill.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing.   Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected.   The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators where necessary.

Special Notes
Practical applications in everyday and vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Work with rectilinear figures**
Unit Code	GCNU209A
Level	2
Credit	2

Elements of Competency	**Performance Criteria**

1 Solve simple geometric problems using angle properties associated with intersecting lines and parallel lines	1.1 Solve problems involving angle properties associated with intersecting lines
	
	   Range
	   ● Angles at a point, adjacent angles on a straight line and vertically opposite angles
	
	1.2 Solve problems involving angle properties associated with parallel lines
	
	   Range
	   ● Corresponding angles, alternate angles and interior angles on the same side

2 Solve simple geometric problems using properties of triangles and convex polygons	2.1 Solve simple geometric problems using properties of triangles
	
	   Range
	   ● Sum of interior angles, sum of exterior angles, base angles of isosceles triangles and angles of equilateral triangles
	
	2.2 Solve simple geometric problems using properties of polygons
	
	   Range
	   ● Sum of interior angles and sum of exterior angles
	
	2.3 Solve simple geometric problems using properties of parallelograms
	
	   Range

	● Include opposite angles, opposite sides and diagonals of parallelograms

Unit Range

This unit is intended to be applied to workplaces where knowledge of geometric properties of rectilinear figures is required. It is expected the disciplines of architecture, animation, design, survey and navigation will find this unit useful. Examples of application may include tessellating floor tiles, finding the unknown angle in a planar drawing and designing animation characters.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing. Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected. The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators where necessary.

Special Notes

Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

Generic (Foundation Competencies)

Unit of Competency for Numeracy

Unit Title	**Solve simple problems in coordinate geometry**
Unit Code	GCNU210A
Level	2
Credit	2

Elements of Competency	Performance Criteria
1 Solve simple problems in coordinate geometry	1.1 Represent points with coordinates on an *x-y* plane
	1.2 Calculate the mid-point of two given points
	1.3 Calculate the distance between two given points on an *x-y* plane
	1.4 Find the slope of a line segment from two given points or from an equation of a straight line
	1.5 Find the intercepts of a straight line from its equation
	1.6 Recognize the conditions for parallel lines and perpendicular lines
	1.7 Find the equations of straight lines from various given conditions
	Range ● Limited to two-point form, point-slope form, general form, slope-intercept form and intercept form

Unit Range

This unit covers the area of solving simple problems in coordinate geometry. Workplace requiring working with graphs will find this unit useful. Examples of application may include finding the midway position, in latitudes and longitudes, of two cities and determining the relation between the price and demand of a commodity.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as

written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing.   Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected.   The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators where necessary.

Special Notes
Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Construct and use statistical graphs**
Unit Code	GCNU211A
Level	2
Credit	3

Elements of Competency	Performance Criteria
1 Construct and use statistical graphs	1.1 Construct and use composite bar charts, pie charts, histograms and scatter diagrams **Range** ● Include calculations using data from charts or diagrams 1.2 Construct and use frequency curves/polygons, cumulative frequency curves/polygons and broken-line graphs **Range** ● Include calculations using data from the graphs

Unit Range

This unit covers the construction and use of statistical graphs.   It is applicable to most trades and industries.   Examples of application may include constructing a pie chart showing the distribution of books in a library and finding the maximum daily rainfall of a city from a bar chart.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing.   Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected.   The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators and computer software where necessary.

Special Notes
1   Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

2   Competence in Unit GCNU105A, *Communicate information using very simple tables, diagrams, charts and line graphs* is assumed.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Calculate means, medians, modes and ranges of grouped and ungrouped data**
Unit Code	GCNU212A
Level	2
Credit	2

Elements of Competency	Performance Criteria
1 Calculate means, medians, modes and ranges of grouped and ungrouped data	1.1 Calculate means (including weighted mean), medians, modes and ranges for ungrouped data
	1.2 Calculate means for grouped data
	1.3 Read medians from a cumulative frequency curve/polygon for grouped data
	1.4 Determine modal classes for grouped data
	1.5 Calculate ranges for grouped data

Unit Range

This unit covers the calculations of means, medians, modes and ranges.   It provides a sound foundation for choosing statistics and solving problems in everyday contexts.   It is applicable to most trades and industries.   Examples of application may include finding the average expense of a tourist in Hong Kong, finding the median income of a working person and working out the range of marks in an examination.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing.   Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected.   The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators and computer software where necessary.

Special Notes

Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Solve problems using functions of one variable, quadratic equations in one unknown and quadratic inequalities in one unknown**
Unit Code	GCNU301A
Level	3
Credit	3

Elements of Competency	Performance Criteria
1 Solve problems involving quadratic equations in one unknown	1.1 Formulate quadratic equations in one unknown in practical contexts 1.2 Solve quadratic equations in one unknown using the factor method, the quadratic formula and the graphical method **Range** ● Graphical method limited to using the graph of $y = ax^2 + bx + c$ to solve the equation $ax^2 + bx + c = 0$ ● Examine the solutions of an equation and reject irrelevant roots ● Exclude the algebra of complex numbers
2 Recognize the conditions for the nature of roots of a quadratic equation	2.1 Determine the nature of roots of a quadratic equation in one unknown **Range** ● Either from graphs or discriminants
3 Recognize the properties of functions of one variable	3.1 Identify the properties of functions of one variable 3.2 Use the notation of for a function of one variable 3.3 Sketch and interpret the graphs of some common functions of one variable **Range**

		● Limited to constant functions, linear functions, quadratic functions and sinusoidal functions
4	Solve problems involving quadratic inequalities in one unknown	4.1 Formulate quadratic inequalities in one unknown in practical contexts
		4.2 Solve quadratic inequalities in one unknown using either the algebraic or the graphical method

Unit Range

This unit is useful in the fields of work where knowledge of functions, quadratic equations and quadratic inequalities is required. Examples of application may include distance-time travel functions, finding profit/loss and solving projectile problems.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing. Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected. The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators where necessary.

Special Notes

1   Practical applications in everyday and vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

2   Competence in Unit GCNU202A, *Apply simple formulas, linear equations in one unknown and linear inequalities in one unknown in everyday contexts* is assumed.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	Solve problems of variations
Unit Code	GCNU302A
Level	3
Credit	2

Elements of Competency	Performance Criteria
1 Solve problems involving direct and inverse variations	1.1 Recognize the algebraic representations of direct and inverse variations 1.2 Sketch the graphs of direct and inverse variations 1.3 Solve practical problems using direct and inverse variations **Range** ● May include but is not limited to supply and demand function, Hooke's law, Boyle's law and Ohm's law
2 Solve problems involving joint and partial variations	2.1 Recognize the algebraic representations of various joint and partial variations **Range** ● May include but is not limited to $V = \pi r^2 h$, $z = k\dfrac{x}{y}$, $y = k_1 + k_2 x$ and $y = k_1 + \dfrac{k_2}{x}$. 2.2 Solve practical problems using joint and partial variations **Range** ● May include but is not limited to unit cost of products, monthly wages and monthly bill of telephone calls

Unit Range

This unit is intended to be applied to workplaces where knowledge of variations is required. It is useful in disciplines such as physical sciences and business accounting. Examples of application may include estimating time for completing a job for a given number of workers and finding unit selling price.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing. Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected. The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators where necessary.

Special Notes

1   Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

2   Competence in Unit GCNU205A, *Solve simultaneous linear equations in two unknowns* is assumed.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Solve problems related to simple exponential and logarithmic functions**
Unit Code	GCNU303A
Level	3
Credit	3

Elements of Competency	Performance Criteria
1 Solve problems using exponential functions	1.1 Use the laws of rational indices to evaluate simple expressions with rational indices 1.2 Recognize the graphs of exponential functions 1.3 Solve simple exponential equations

2 Solve problems using logarithmic functions	2.1 Evaluate expression involving logarithms
	
	    Range
	    ● Include change of base
	
	2.2 Solve exponential equations in the forms $y = ae^x$ and $y = ax^b$

Unit Range

This unit finds application in the field of work where knowledge of exponential functions and logarithmic functions is required. This is especially useful in the disciplines of design, social science, physical science and engineering where solution of problems like constructing spiral curves, population growth, charging or discharging of capacitors and measuring decibel are required.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing.   Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected.   The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators where necessary.

Special Notes
Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Solve problems on arithmetic and geometric sequences**
Unit Code	GCNU304A
Level	3
Credit	3

Elements of Competency	Performance Criteria
1 Perform calculations on arithmetic sequences	1.1 Find the general term of an arithmetic sequence
	1.2 Find the common difference of an arithmetic sequence
	1.3 Insert (an) arithmetic mean(s) between two given terms of an arithmetic sequence
	1.4 Calculate the sum of the first n terms of an arithmetic sequence
	1.5 Solve problems on arithmetic sequence
	Range
	● May include but is not limited to seat arrangement in a theatre, piling of objects and patterns in practical contexts
2 Perform calculations on geometric sequences	2.1 Find the general term of a geometric sequence
	2.2 Find the common ratio of a geometric sequence
	2.3 Insert (a) geometric mean(s) between two given terms of a geometric sequence
	2.4 Calculate the sum of the first n terms of a geometric sequence
	2.5 Calculate the sum to infinity of a geometric sequence when the absolute value of the common ratio is less than one

	2.6 Solve problems on geometric sequences
	Range ● May include but is not limited to compound interest calculations, depreciation and patterns in practical contexts

Unit Range

Application of this unit will be found in the field of work where calculations of change with patterns, growth, depreciation, inflation, deflation and compound interest are required. It is useful for sectors such as finance, business accounting and education.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing. Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected. The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators where necessary.

Special Notes

Practical applications in everyday and vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Solve problems involving symmetry, transformation, congruence and similarity about 2-D figures and 3-D solids**
Unit Code	GCNU305A
Level	3
Credit	4

Elements of Competency	Performance Criteria
1 Solve simple problems involving symmetry in 2-D figures and 3-D solids	1.1 Determine the number of axes of symmetry in a 2-D figure 1.2 Draw the axes of symmetry for a 2-D figure 1.3 Determine the order of rotational symmetry in a 2-D figure 1.4 Locate the centre of rotation for a 2-D figure 1.5 Determine the planes of reflectional symmetries of cubes and tetrahedron 1.6 Determine the axes of rotational symmetries of cubes and tetrahedron
2 Solve simple problems involving transformation in 2-D figures	2.1 State the single transformation involved in comparing an object and its image 2.2 Identify the image of a figure after a single transformation 2.3 Recognize the effect on the size and shape of a 2-D figure under a single transformation
3 Solve simple geometric problems involving congruence in triangles	3.1 Identify the meaning of congruent triangles 3.2 Identify the conditions for two triangles to be congruent

		Range
		● Three sides equal; two sides and the included angle equal; two angles and the included side equal; and two right-angled triangles with equal hypotenuses and another pair of equal sides
4	Solve simple geometric problems involving similar triangles	4.1 Identify the meaning of similar triangles 4.2 Identify the conditions for two triangles to be similar 4.3 Solve problems of magnification of triangles
5	Solve problems involving similar solids	5.1 Distinguish among formulas for lengths, areas, volumes by considering dimensions 5.2 Solve problems using the relationships between sides and surface areas/volumes of similar solids

Unit Range

This unit is intended to be applied to workplaces where knowledge of symmetry, transformation, congruence and similarity about 2-D figures and 3-D solids is required. Examples of application may include drawing floor plans and making models of buildings. It is expected that the disciplines of architecture, animation, design, survey and navigation will find this unit useful.

Assessment Guidelines

1 The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2 Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing. Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3 All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected. The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4 Learners may use calculators where necessary.

Special Notes

1 Practical applications in vocational contexts should be emphasized in teaching and

learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

2 Competence in Unit GCNU209A, *Solve problems involving properties of rectilinear figures* is assumed.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Model periodic data using sinusoidal functions**
Unit Code	GCNU306A
Level	3
Credit	3

Elements of Competency	Performance Criteria
1 Sketch graphs of sinusoidal functions	1.1 Recognize the features of the graphs of sinusoidal functions **Range** ● Include angles expressed in both radians and degrees ● Limited to sine and cosine functions ● Features include amplitude, period, frequency and intercepts
2 Solve trigonometric equations	2.1 Solve simple trigonometric equations in the form of $a \sin \theta = b$ or $a \cos \theta = b$ in the interval $0°$ to $360°$. **Range** ● Include the graphical method and the analytical method
3 Add two waves of same frequency	3.1 Express $A \sin \omega t + B \cos \omega t$ in the form $R \sin(\omega t + \phi)$, $\phi \geq 0$

Unit Range

Disciplines of engineering, design, architecture and finance control will find this unit applicable. Examples of application may include calculating alternating current, oscillatory wave forms and seasonal-fluctuation effects.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project

work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing.   Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected.   The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators where necessary.

Special Notes
1   Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

2   Competence in Unit GCNU208A, *Calculate lengths of sides and angles in right-angled triangles* is assumed.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	Calculate lengths of sides and angles in 2-dimensional problems
Unit Code	GCNU307A
Level	3
Credit	2

Elements of Competency	Performance Criteria
1 Calculate lengths of sides and angles in 2-dimensional problems using the sine formula	1.1 Recognize the conditions for applying the sine formula to solve a 2-D problem 1.2 Find lengths of sides and angles of triangles using the sine formula **Range** ● May include but is not limited to gradients, angles of elevation, angles of depression, bearings
2 Calculate lengths of sides and angles in 2-dimensional problems using the cosine formula	2.1 Recognize the conditions for applying the cosine formula to solve a 2-D problem 2.2 Find lengths of sides and angles of triangles using the cosine formula **Range** ● May include but is not limited to gradients, angles of elevation, angles of depression, bearings

Unit Range

This unit finds application in the field of work where the skills of solving triangles are required. Examples of application may include finding lengths of sides of triangular plots in land surveys and calculating navigation routes. This unit is especially useful in the disciplines of design, engineering, survey and navigation.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone

or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing. Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected. The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators where necessary.

Special Notes
1   Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

2   Competence in Unit GCNU208A, *Calculate lengths of sides and angles in right-angled triangles* is assumed.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Select appropriate methods to present data and interpret the results**
Unit Code	GCNU308A
Level	3
Credit	3

Elements of Competency	Performance Criteria

1 Select appropriate methods to present data	1.1 Distinguish between quantitative and qualitative data
	
	1.2 Choose appropriate statistical graphs to present a given set of data
	
	     Range
	     ● May include but is not limited to pictograms, bar charts, pie charts, histograms, scatter diagrams, frequency curves/polygons, cumulative frequency curves/polygons and broken-line graphs

2 Interpret the results of presentations	2.1 Interpret statistical graphs
	
	     Range
	     ● May use words such as trend, increasing, decreasing, rising and falling in interpreting line graphs
	     ● May use words such as the highest and the lowest in interpreting bar charts
	     ● Include finding percentiles, quartiles and median from cumulative frequency curves/polygons
	
	2.2 Identify sources of deception in misleading graphs and their accompanying statements

Unit Range

It is applicable to most industries where interpreting statistical presentations and writing reports in workplace are essential. People credited with this unit are able to select appropriate methods to present data and interpret the results. Examples of application may include presenting

annual sales of an organization and doing subsequent analysis.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing.   Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected.   The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators where necessary.

Special Notes

1   Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

2   Competence in Unit 211A, *Construct and use statistical graphs* is assumed.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Compare data sets using measures of central tendency and measures of dispersion**
Unit Code	GCNU309A
Level	3
Credit	3

Elements of Competency	Performance Criteria
1 Compare data sets using measures of central tendency	1.1 Compare two data sets with given means, medians and modes
	1.2 Discuss the relative merits of different measures of central tendency for a given situation
	1.3 Explore the effect of changing data on the central tendency in various situations
	Range
	● May include but is not limited to removal of a certain item from the data set, adding a common constant to the whole set of data and insertion of zero in the data set
	1.4 Identify sources of deception in cases of misuse of averages
2 Compare data sets using measures of dispersion	2.1 Recognize ranges, inter-quartile ranges and standard deviations as measures of dispersion for data sets
	2.2 Find inter-quartile ranges from cumulative frequency curves/polygons
	2.3 Construct and use box-and-whisker diagrams to compare the distributions of different data sets
	2.4 Compare the dispersions of two data sets using appropriate measures
	2.5 Explore the effect of changing data on dispersion in

	various situations
	Range ● May include but is not limited to adding a common constant to each item of the set of data and multiplying each item of the set of data by a common constant

Unit Range

This unit covers comparing of data sets using measures of central tendency and measures of dispersion. It is applicable to most industries where writing report using statistical data is essential. Examples of application may include comparing the average volume of production and stability of two production lines.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing. Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected. The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators and computer software where necessary.

Special Notes

1   Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

2   Competence in Unit 212A, *Calculate means, medians, modes and ranges of grouped and ungrouped data* is assumed.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Discuss various matters and issues related to conducting a statistical survey**
Unit Code	GCNU310A
Level	3
Credit	3

Elements of Competency	Performance Criteria

1 Recognize different data collection methods	1.1 Distinguish between primary and secondary data sources
	
	1.2 Identify the advantages and disadvantages of different types of data collection methods
	
	   Range
	   ● Methods may include but is not limited to postal questionnaire, on-line questionnaire, personal interview, telephone interview, direct observation, and experiment
	
	1.3 Recognize the basic principles in designing questionnaires
	
	   Range
	   ● May include but is not limited to brevity, simplicity, avoid ambiguity, avoid leading questions, avoid personal questions
	
	1.4 Design a simple questionnaire with at least five questions

2 Recognize different sampling methods	2.1 Recognize the difference between probability and non-probability sampling 2.2 Identify the advantages and disadvantages of different types of probability sampling methods **Range**

	• May include but is not limited to simple random sampling, stratified sampling and systematic sampling

Unit Range

It is applicable to industries which require data collection. People credited with this unit are able to participate in conducting a statistical survey. Examples of application may include conducting a small scale survey on habits of using mobile phone or surfing the web.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing. Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected. The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

Special Notes

Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Solve problems involving uncertainty using basic principles of probability**
Unit Code	GCNU311A
Level	3
Credit	2

Elements of Competency	Performance Criteria
1 Determine probabilities of simple events	1.1 Calculate the empirical probabilities 1.2 Calculate the theoretical probabilities by listing 1.3 Recognize the meaning of expectation

2 Solve problems involving uncertainty using probability	2.1 Apply addition and multiplication laws to solve problems
	
	     Range
	    ● Exclude the use of permutation and combination
	
	2.2 Recognize the concept and notation of conditional probability
	
	     Range
	    ● May include but is not limited to the use of tree diagrams
	    ● Exclude the use of Bayes' Theorem

Unit Range

This unit can be applied to many industries in business, services and engineering sectors where problems involving uncertainty are encountered. Examples of application may include doing acceptance sampling and feasibility studies.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project

work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing.   Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected.   The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators and computer software where necessary.

Special Notes
Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title   Calculate and interpret index numbers

Unit Code   GCNU312A

Level   3

Credit   2

Elements of Competency	Performance Criteria
1 Recognize the uses of index numbers	1.1 Describe the use of commonly used index numbers such as Hang Seng Index and Consumer Price Index 1.2 Identify the importance of selecting an appropriate base period
2 Calculate index numbers	2.1 Calculate index numbers by various methods **Range** • Include Laspeyres and Paasche indices 2.2 Recognize the limitations of index numbers

Unit Range

This unit covers some methods of calculating index numbers. It applies to business, finance and government sectors. It is useful for showing trends and measuring changes in time series variables. Examples of application may include interpreting stock market indices and using Consumer Price Index.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing. Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected.   The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators and computer software where necessary.

Special Notes

Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Identify components of a time series and make forecasts**
Unit Code	GCNU313A
Level	3
Credit	2

Elements of Competency	Performance Criteria
1 Recognize basic time series models	1.1 Identify components of a time series **Range** ● Include trend, seasonal variation, cyclical variation and irregular variation 1.2 Recognize additive and multiplicative models for time series
2 Decompose a time series into its components using additive and multiplicative models	2.1 Estimate the linear trend curve by the freehand method 2.2 Smooth non-linear trend using moving averages 2.3 Calculate the seasonal indices 2.4 Deseasonalize the time series 2.5 Make forecasts for the time series

Unit Range

It is applicable to many industries such as business, finance and manufacturing which require an analysis of time series. Examples of application may include analyzing the annual production of toys, analyzing the daily closing price of a share in the stock market and making weather forecast using the hourly temperature of a city. This unit is useful for analysing current decisions, forecasting and planning future operations.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations,

observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing.   Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected.   The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators and computer software where necessary.

Special Notes
Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Solve counting problems using permutations and combinations**
Unit Code	GCNU314A
Level	3
Credit	2

Elements of Competency	Performance Criteria
1 Recognize basic counting principles	1.1 Recognize the addition rule and multiplication rule in counting principles **Range** ● Include the inclusion-exclusion principle
2. Solve counting problems on permutation	2.1 Recognize the meaning and notation of $n!$ 2.2 Recognize the meaning and notations of permutation **Range** ● Notations may include but are not limited to P_r^n, $_nP_r$ and $P(n,r)$ 1.1 Solve problems on the permutation of distinct objects without repetition **Range** ● Exclude circular permutation
3. Solve counting problems on combination	3.1 Recognize the meaning and notations of combination **Range** ● Notations may include but are not limited to C_r^n, $_nC_r$, $\binom{n}{r}$ and $C(n,r)$

	3.2 Solve problems on the combination of distinct objects without repetition

Unit Range

This unit can be applied to many industries in business, services, Information Technology and engineering sectors where counting problems are encountered.   Examples of application may include comparing different algorithms and designing combination locks.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing.   Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected.   The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators and computer software where necessary.

Special Notes

Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Solve problems on rates of change, curve sketching and optimization using differentiation**
Unit Code	GCNU315A
Level	3
Credit	5

Elements of Competency	Performance Criteria
1 Differentiate elementary functions	1.1 Differentiate polynomial, rational, trigonometric, exponential and logarithmic functions **Range** ● Include composite functions, parametric functions, inverse functions and implicit functions ● Include finding the second derivatives of explicit functions ● Exclude differentiation from first principles
2 Solve problems on rates of change	2.1 Solve problems on rates of change using differentiation **Range** ● May include but is not limited to calculating velocity, acceleration, gradient and marginal profit
3 Solve curve sketching and optimisation problems **Range** ● Limited to functions that are differentiable in the intervals under consideration	3.1 Determine whether a function is increasing or decreasing 3.2 Find the maximum/minimum value(s) of a function using differentiation **Range** ● Include the first and second derivative tests 3.3 Solve optimization problems

	Range • Include local and global extreme values

Unit Range

This unit covers basic skills in using differentiation. It is applicable to many industries in business and engineering sectors in which solving rate problems and/or finding maximum/minimum is required. Examples of application include calculating sales rate and maximum power loading in a circuit.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing. Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected. The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators and computer software where necessary.

Special Notes

1   Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

2   Competence in Unit GCNU210A, *Solve simple problems in coordinate geometry* and Unit GCNU301A, *Solve problems using functions of one variable , quadratic equations in one unknown and quadratic inequalities in one unknown* is assumed.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	Solve problems using integration
Unit Code	GCNU316A
Level	3
Credit	3

Elements of Competency	Performance Criteria

2 Find indefinite Integrals	.1 Recognize indefinite integration as the reverse process of differentiation
	
	.2 Find indefinite integrals of some common functions
	
	      Range
	      ● Polynomial functions, rational functions, trigonometric functions, exponential functions and logarithmic functions
	
	.3 Solve problems involving indefinite integrals such as equations of curves, velocity and displacement

3 Evaluate definite integrals	3.1 Recognize the Fundamental Theorem of Calculus $$\int_a^b f(x)dx = F(b) - F(a) \quad \text{where} \frac{d}{dx}F(x) = f(x)$$ 3.2 Evaluate definite integrals of some common functions as stated in 1.1 using 2.1

3 Solve problems using definite integrals	3.1 Solve problems on area between curves
	
	      Range
	      ● Integration techniques could be applied to about either the *x*-axis or the *y*-axis
	
	3.2 Solve problems on volumes of solids of revolution
	
	      Range

	● Limited to revolutions about the coordinate axes

Unit Range

This unit can be applied to many industries in business and engineering sectors.   Examples of application may include finding root mean square values, moments of a force, centroids, radius of gyration, revenue and average cost.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing.   Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected.   The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators and computer software where necessary.

Special Notes

1   Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

2   Competence in Unit GCNU315A, *Solve problems on rates of change, curve sketching and optimization using differentiation* is assumed.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Solve linear programming problems in two dimensions**
Unit Code	GCNU401A
Level	4
Credit	3

Elements of Competency	Performance Criteria
1 Solve linear programming problems in two dimensions	1.1 Model real and simulated situations as linear programming problems **Range** • Determine the linear function to be maximised/minimised • Express all constraints as linear inequalities 1.2 Represent graphs of linear inequalities in two unknowns 1.3 Solve systems of linear inequalities in two unknowns 1.4 Determine the feasible region 1.5 Obtain and interpret the optimal solution **Range** • Include no feasible solution, unbounded solution and multiple solutions
2 Perform sensitivity analysis on linear programming problems	2.1 Determine the effect of varying parameters on linear programming problems **Range** • Changes include objective function coefficients, constant terms of constraints, adding or deleting a constraint

Unit Range

This unit may be applied to industries which require allocating a finite set of resources in an optimal way. Examples of application may include finding the amount of fertilizers required in providing sufficient nutrients, preparing airline flight crew scheduling, designing telecommunication networks and making investment portfolio selection.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing. Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected. The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators and computer software where necessary.

Special Notes

1   Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

2   Competence in Unit GCNU202A, *Apply simple formulas, linear equations in one unknown and linear inequalities in one unknown in everyday contexts* is assumed.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Solve problems using complex numbers**
Unit Code	GCNU402A
Level	4
Credit	3

Elements of Competency	Performance Criteria
1 Recognize basic properties of complex numbers	1.1 Recognize the notation for $\sqrt{-1}$ **Range** • Either i or j can be used to stand for $\sqrt{-1}$ 1.2 Reduce powers of j to $\pm j$ or ± 1 1.3 Recognize that complex numbers are expressible in the form (real part) $+ j$ (imaginary part) 1.4 Recognize equal complex numbers 1.5 Represent a complex number on an Argand diagram
2 Carry out basic operations on complex numbers	2.1 Perform arithmetic operations on complex numbers in rectangular form 2.2 Convert complex numbers from rectangular form to polar form and vice versa **Range** • Polar form expressed as $r(\cos\theta + j\sin\theta)$ or $r\angle\theta$ or $re^{j\theta}$ 2.3 Perform arithmetic operations on complex number in polar form 2.4 Find the conjugate of a complex number
3 Solve quadratic equations with real coefficients in one unknown using complex	3.1 Find the unreal roots of quadratic equations with real coefficients in one unknown

	numbers	**Range** ● May include but is not limited to finding zeros and poles in control systems
4	Solve AC circuit problems using complex numbers	4.1 Represent sinusoidal currents and voltages as complex numbers 4.2 Calculate quantities in AC circuits **Range** ● May include but not limited to current, voltage, impedance and power

Unit Range

This unit covers methods in solving AC circuits problems using complex numbers and can be applied to most engineering fields which require basic knowledge in AC circuits.   Examples of application may include calculating current, voltage, impedance and power factor in A.C. circuits.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing.   Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected.   The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators where necessary.

Special Notes

Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	Solve physical problems using vectors
Unit Code	GCNU403A
Level	4
Credit	4

Elements of Competency	Performance Criteria
1 Recognize basic properties of vectors	1.1 Classify physical quantities as vectors and scalars 1.2 Represent a vector geometrically by a directed line segment 1.3 Use appropriate notations to represent vectors and their magnitudes **Range** • Vector notation may include but is not limited to $\overrightarrow{AB}$ and $\vec{a}$ • Magnitude notation may include but is not limited to $\left\|\overrightarrow{AB}\right\|$ and $\|\vec{a}\|$ 1.4 Recognize equal vectors, parallel vectors and unit vectors **Range** • Unit vectors include $\vec{i}$, $\vec{j}$ and $\vec{k}$ • Use the notation $\hat{a}$ for unit vector
2 Solve physical problems using basic operations of vectors	2.1 Solve physical problems using vector addition **Range** • Include the triangle law and the parallelogram law • Problems may include but not limited to resultant force and resultant velocity 2.2 Solve physical problems using vector subtraction **Range**

	• Problems may include but not limited to relative velocity 2.3 Calculate the scalar multiple of a vector 2.4 Resolve a vector into its components
3 Solve physical problems using dot product and cross product of vectors	3.1 Solve physical problems using the dot product of two vectors **Range** • Problems may include but not limited to work done, projections and angle between two vectors 3.2 Solve physical problems using the cross product of two vectors **Range** • Problems may include but not limited to moment of a force about a point and areas of parallelograms 3.3 Calculate and interpret the triple products **Range** • Includes both $\vec{a}\times\vec{b}\times\vec{c}$ and $\vec{a}\cdot(\vec{b}\times\vec{c})$ • Problems may include but not limited to volume of parallelepiped and moment of force about a line

Unit Range

This unit provides the basics of vector manipulation. Disciplines of physical science and engineering will find this unit useful. Examples of application may include calculating work done in pushing a cart and shear moments on a window frame.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing. Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected.   The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators where necessary.

Special Notes

Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	Solve problems using Boolean algebra
Unit Code	GCNU404A
Level	4
Credit	2

Elements of Competency	Performance Criteria
1 Solve problems using propositional calculus	1.1 Translate between natural language and logical symbols **Range** ● Include logical symbols for AND, OR and NOT 1.2 Construct truth tables
2 Solve problems using sets and relations	2.1 Calculate unions, intersections, differences and Cartesian products of simple sets 2.2 Use Venn diagrams to represent sets 2.3 Use sets in counting problems 2.4 Use different methods to represent relations **Range** ● Include methods of listing, tabulation, direct graph and zero-one matrix 2.5 Determine the reflexive , symmetric and transitive properties of a relation on a set

Unit Range

This unit may be applied to fields such as information technology and electronic engineering. Examples of application may include designing automatic control devices and multiple-output logic-circuits.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing. Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected. The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators where necessary.

Special Notes

Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Solve systems of linear equations using determinants and matrices**
Unit Code	GCNU405A
Level	4
Credit	4

Elements of Competency	Performance Criteria

1 Perform basic operations of matrices and determinants	1.1 Evaluate determinants
	
	1.2 Perform basic operations of matrices
	
	    Range
	    ● Include addition, subtraction, scalar multiplication, matrix multiplication, inverse and transpose

2 Solve systems of linear equations	2.1 Solve system of linear equations by Cramer's rule, inverse matrices and Gaussian elimination
	
	    Range
	    ● Include the cases: unique solution, no solution and infinitely many solutions
	
	2.2 Find eigenvalues and eigenvectors of matrices
	
	    Range
	    ● May include but is not limited to vibration analysis

Unit Range

This unit may be applied to workplaces which require solving systems of linear equations. Industries such as business administration, finance control and engineering will find this unit useful. Examples of application may include preparing production scheduling, monitoring traffic flow, doing cost analysis, allocating resources and decoding messages.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone

or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing.   Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected.   The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators and computer software where necessary.   Manual calculations are restricted to $m \times n$ matrices where $1 \leq m \leq 3$, $1 \leq n \leq 3$ and system of linear equations in two or three unknowns.

Special Notes
1   Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

2   Competence in Unit GCNU205A, *Solve simultaneous linear equations in two unknowns* is assumed.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title   Solve financial problems using mathematical methods

Unit Code   GCNU406A

Level   4

Credit   3

Elements of Competency	Performance criteria
1 Solve problems of present value	1.1 Calculate the present value of a future amount using the present value formula or discounting tables
	1.2 Calculate the present value of a future sum using the summation of a finite numbers of terms of a geometric sequence
	1.3 Calculate the present value of an interest-bearing debt by using the formula $PV = \dfrac{P(1+i)^n}{(1+j)^n}$
2 Calculate the net present value of a project	2.1 Calculate the net present value of a project given the inflows and outflows in a defined period of time
	2.2 Interpret the significance of the net present value of a project
3 Solve problems of annuities	3.1 Calculate the accrued amount of an invested annuity
	3.2 Calculate the net present value of an annuity using the method of a schedule or the summation of finite terms of a geometric sequence
	3.3 Calculate the payment of each instalment of an amortized debt using the method of a schedule or the summation of finite terms of a geometric sequence

Unit Range

Application of this unit will be found in the field of work where knowledge of interest calculation and payment by installments is required. Examples of application may include finding the internal rate of return of an investment project and analyzing an amortization schedule. Disciplines of accounting, finance and general business administration will find this unit useful.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing. Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected. The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators where necessary.

Special Notes

1   Practical applications in everyday and vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

2   Competence in Unit GCNU304A, *Solve problems on arithmetic and geometric sequences* is assumed.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Plan activities using flow charts and critical path analysis**
Unit Code	GCNU407A
Level	4
Credit	3

Elements of Competency	Performance Criteria
1 Plan activities using flow charts	1.1 Recognize basic flow chart symbols **Range** ● Include process and decision 1.2 Represent an activity by a series of tasks using flow charts
2 Plan projects using critical path analysis	2.1 Draw a network to represent the inter-relationship between various activities of a project 2.2 Calculate the earliest start time, the latest start time, the earliest finishing time and the latest finishing time for an activity 2.3 Find the slack (float) for an activity 2.4 Identify the critical path of a project 2.5 Determine the minimum project time 2.6 Draw the Gantt chart for a project

Unit Range

It is applicable to industries where project management is required.   Areas of applications may include business administration, marketing, manufacturing, construction, civil engineering, building services and software engineering, etc.   Examples of application include calculating the earliest finishing time and the latest finishing time for a construction project.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing.   Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected.   The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators where necessary.

Special Notes

Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	Solve optimization problems using network analysis
Unit Code	GCNU408A
Level	4
Credit	3

Elements of Competency	Performance Criteria

1 Solve optimization problems using networks	1.1 Use networks to represent information
	
	1.2 Solve shortest path problems
	
	    Range
	    • Include Dijkstra's algorithm
	
	1.3 Solve minimal spanning tree problems
	
	    Range
	    • Include the Greedy algorithm

Unit Range

This unit provides some methods in solving problems of scheduling, network routing and computer engineering. Disciplines of logistics, general business administration, telecom networking and engineering will find this unit useful.   Examples of application may include analyzing possible solutions of a transport problem and finding the shortest path of a flight plan.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing. Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes

to ensure that sufficient evidence of the performance criteria set in the specification is collected.   The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators and computer software where necessary.

Special Notes
Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Calculate lengths of sides and angles in 3-dimensional problems**
Unit Code	GCNU409A
Level	4
Credit	2

Elements of Competency	Performance Criteria
1 Calculate lengths of sides in 3-dimensional problems	1.1 Find the lengths of sides in 3-dimensional problems **Range** ● Include using Pythagoras' theorem, the sine formula and the cosine formula ● May include but is not limited to lengths of line segments on an inclined plane and length of projection of an edge on a plane
2 Calculate angles in 3-dimensional problems	2.1 Find the angles in 3-dimensional problems **Range** ● Include using the sine formula and the cosine formula ● Include problems on angle between two intersecting lines, angle between a line and a plane, and angle between two planes

Unit Range

This unit is intended to be applied to workplaces where knowledge of 3-dimensional solids is required. It is expected the disciplines of architecture, animation, design, survey and navigation will find this unit useful. Examples of application may include calculating the angle of inclination of the apex of a mountain and the distance of an aircraft from a ground station.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project

work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing.   Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected.   The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators where necessary.

Special Notes

1   Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

2   Competence in GCNU307A, *Calculate lengths of sides and angles in 2-dimensional problems* is assumed.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Solve problems involving uncertainty using discrete probability distributions**
Unit Code	GCNU410A
Level	4
Credit	3

Elements of Competency	Performance Criteria
1 Recognize the concept of discrete random variables	1.1 Represent distributions by tables, graphs and mathematical formulas 1.2 Calculate expectation $E(X)$ and variance $Var(X)$ for distributions **Range** • Include the formulas $E(aX+b)=aX+b$ and $Var(aX+b)=a^2Var(X)$
2 Solve problems using discrete probability distributions	2.1 Recognize the meaning and properties of binomial, geometric and Poisson distributions **Range** • Include the formulas for mean and variance of binomial , geometric and Poisson distributions 2.2 Calculate binomial, geometric and Poisson probabilities **Range** • Exclude using the binomial distribution table

Unit Range

Examples of application may include acceptance sampling and feasibility studies. People credited with this unit are able to solve problems involving uncertainty using discrete probability distributions. Examples of application may include calculating the employee turnover rate, the expected number of defects in a box of products.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing.   Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected.   The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators where necessary.

Special Notes

1   Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

2   Competence in Unit GCNU311A, *Solve problems involving uncertainty using basic principles of probability* is assumed.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Solve problems involving uncertainty using normal probability density functions**
Unit Code	GCNU411A
Level	4
Credit	3

Elements of Competency	Performance Criteria
1 Use the normal distribution table to find probabilities	1.1 Recognize elementary properties of normal distribution, its mean μ and variance σ^2, and the notation $N(\mu, \sigma^2)$ **Range** • Properties include the shape and symmetry of a normal curve for which the mean, mode and median are all equal; the dispersion can be determined by the value σ and that the area under the curve is 1 1.2 Standardize a normal variable 1.3 Use the normal distribution table to find the area under the standard normal curve
2 Solve problems using normal probability density function	2.1 Evaluate the values of $P(X > x_1)$ or $P(X < x_2)$ or $P(x_1 < X < x_2)$ given the values of x_1, x_2 or vice versa **Range** • Include linear combinations of independent normal variables 2.2 Use normal distribution to approximate other distributions **Range** • Limited to either binomial or Poisson

	distributions

Unit Range

This unit covers the skills of using the normal distribution in various fields. The unit finds its applications in disciplines of physical science, behavioral science, quality assurance, production and engineering. Work sectors ranging from production engineering in factories to general business administration would require the skills in this unit for calculating, analyzing, monitoring and making decision. Examples of application may include finding the expected percentage of products reaching a given standard range.

Assessment Guidelines

1 The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

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3 All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected. The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4 Learners may use calculators and computer software where necessary.

Special Notes

1 Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

2 Competence in Unit GCNU410A, *Solve problems involving uncertainty using discrete probability distributions* is assumed.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Devise statistical quality control plans**
Unit Code	GCNU412A
Level	4
Credit	3

	Elements of Competency	Performance criteria
1	Recognize the importance of quality control	1.1 Identify the needs of quality control in various industries
2	Construct control charts	2.1 Construct control charts for attributes **Range** ● Limited to p-chart, c-chart and u-chart 2.2 Construct control charts for variables **Range** ● Limited to $\overline{X}$-chart and R-chart
3	Interpret control charts	3.1 Identify and analyze non-random patterns from control charts **Range** ● Limited to p-chart, c-chart, u-chart, $\overline{X}$-chart and R-chart 3.2 Justify any remedies to be carried out
4	Solve quality control problems using sampling plans	4.1 Construct and apply the operating characteristic curve to practical work environment 4.2 Identify the advantages and disadvantages of common sampling plans **Range** ● Limited to simple, double, multiple and

	sequential sampling plans
	4.3 Select and justify the sampling plan to be used in a given practical situation
	Range ● Limited to simple, double, multiple and sequential sampling plans

Unit Range

It is applicable to the collation and interpretation of statistical data in the context of statistical quality control. Disciplines such as production engineering, catering services, general management and general business administration will find this unit useful. Examples of application may include constructing a control chart for a toy production line and monitoring the quality of incoming goods in a department store.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing. Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected. The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators and computer software where necessary.

Special notes

1   Practical applications in everyday and vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

2   Competence in Unit GCNU411A, *Solve problems involving uncertainty using normal probability density functions* is assumed.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Estimate population parameters from a random sample**
Unit Code	GCNU413A
Level	4
Credit	4

Elements of Competency	Performance Criteria
1 Demonstrate that sample statistics have sampling distributions	1.1 Recognize the meaning of samples and population 1.2 Recognize the sampling distribution of sample mean **Range** • Include finding the mean and variance of the sample mean given the population mean and variance • Include the Central Limit Theorem
2 Estimate population parameters from a random sample	2.1 Find point estimates for population parameters 2.2 Determine confidence intervals for population means **Range** • Include a normal population with known variance, a population with unknown variance where the sample size is sufficiently large and a normal population with unknown variance where the sample size is small 2.3 Determine confidence intervals for population proportions **Range** • Limited to a random sample of size n, where n is sufficiently large, drawn from a Bernoulli distribution, in which the proportion of success is p

Unit Range

This unit covers the area of estimating population parameters from a random sample. Disciplines of marketing, education and statistics will find this unit useful. Examples of application may include estimating the proportion of smoking adults and the mean mark in an examination.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

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3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected. The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators and computer software where necessary.

Special Notes

1   Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

2   Competence in Unit GCNU411A, *Solve problems involving uncertainty using normal probability density functions* is assumed.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Make decisions by performing hypothesis testing on means or proportions for one-sample and two-sample problems**
Unit Code	GCNU414A
Level	4
Credit	5

Elements of Competency	Performance Criteria

1 Carry out hypothesis testing on means or proportions for one-sample and two- sample problems
 	
Range
• Limited to problems involving the use of normal distributions and t distributions
	1.1 Determine the null and alternative hypotheses
	
	1.2 Calculate the test statistic
	
	1.3 Set up the criterion for rejecting the null hypothesis
	
	    Range
	    • Include critical value, level of significance and p-value
	
	1.4 Draw conclusions from test results
	
	1.5 Recognize possible errors in hypothesis testing
	
	    Range
	    • Type I and Type II errors

Unit Range

Applications of this unit may include acceptance sampling and feasibility studies. People credited with this unit are able to make decisions by performing hypothesis testing on means or proportions for one-sample and two-sample problems. Examples of application may include determing whether a noise level falls outside the tolerance limit.

Assessment Guidelines

1 The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning

diaries/logs.

2 Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing. Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3 All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected. The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4 Learners may use calculators and computer software where necessary.

Special Notes
1 Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

2 Competence in Unit GCNU411A, *Solve problems involving uncertainty using normal probability density functions* is assumed.

	Elements of Competency		Performance Criteria
1	Explore relationships between two quantitative variables using graphical methods	1.1	Draw scatter diagrams for a given set of data
		1.2	Draw the best fit lines or curves for a given set of data
2	Investigate the linear relationship between two quantitative variables	2.1	Calculate and interpret correlation coefficients for a pair of quantitative variables **Range** • Include product-moment correlation coefficient and Spearman's coefficient of rank correlation
		2.2	Calculate the equation of regression line for a pair of quantitative variables
		2.3	Make predictions based on the regression line

Unit Title — Investigate the relationship between two quantitative variables

Unit Code — GCNU415A

Level — 4

Credit — 3

Unit Range

People credited with this unit are able to investigate the relationship between two quantitative variables. The unit is applicable to sectors of general business administration, servicing, production and engineering. Examples of application may include exploring the relationships between government subsidy and employment vacancies or predicting the stock market indices in the next 6 months.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project

work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing. Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected. The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators and computer software where necessary.

Special Notes
Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	**Make decisions using decision theory**
Unit Code	GCNU416A
Level	4
Credit	2

Elements of Competency	Performance Criteria
1 Represent information in a decision problem	1.1 Represent information in a decision problem as a payoff table 1.2 Represent information in a decision problem as a decision tree

2 Make decisions under different environments using decision theory	2.1 Recognize various measures of decision maker's desirability
	
	    Range
	    • Include monetary values and utility values
	
	2.2 Make decisions under certainty
	
	2.3 Make decisions under uncertainty
	
	    Range
	    • Include the optimistic, the pessimistic, the equally likely and the minimax regret decision criteria
	
	2.4 Make decisions under risk
	
	    Range
	    • Include expected monetary value and expected opportunity loss decision criteria
	    • Include the calculation of expected value of perfect information and the expected value of sample information

Unit Range

This unit can be applied to many industries in business, services and engineering sectors where problems of decision making are encountered.   Examples of application may include deciding which portfolio of investment to be selected and estimating the amount of money to spend on market research.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing.   Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected.   The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators and computer software where necessary.

Special Notes

1   Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

2   Competence in Unit GCNU311A, *Solve problems involving uncertainty using basic principles of probability* is assumed.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	Solve non-linear equations and approximate definite integrals using numerical methods
Unit Code	GCNU417A
Level	4
Credit	2

Elements of Competency	Performance Criteria

1 Solve non-linear equations using numerical methods	1.1 Obtain an approximate location of the roots of non-linear equations $f(x) = 0$
	
	Range
	    ■ Either by testing the signs of $f(x)$ at various points or using the graphical method
	
	1.2 Solve non-linear equations using one of the following methods: bisection, false position, Netwon's method, the secant method and fixed-point iteration.
	
	Range
	    ■ Include the case of divergence

2. Approximate definite integrals using numerical methods	2.1 Evaluate definite integrals using the trapezoidal rule or Simpson's rule **Range** ● Exclude error estimation

Unit Range

This unit covers the basics of solving algebraic equations and problems of integration using numerical method. Disciplines of physical science and engineering will find this unit useful. Examples of application may include finding the interest rate in amortization and working out the area of a plot of land.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone

or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing.   Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected.   The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators and computer software where necessary.

Special Notes
1   Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

2   Competence in Unit GCNU315A *Solve problems on rates of change, curve sketching and optimization using differentiation* and Unit GCNU316A, *Solve problems using integration* is assumed.

Generic (Foundation) Competencies

Unit of Competency for Numeracy

Unit Title	Solve first-order ordinary differential equations and second-order ordinary linear differential equations with constant coefficients
Unit Code	GCNU418A
Level	4
Credit	3

Elements of Competency	Performance Criteria
1 Solve first-order ordinary differential equations	1.1 Solve first-order ordinary differential equations which are solvable by the method of separation of variables 1.2 Solve first-order ordinary differential equations which are solvable by the method of integrating factors 1.3 Interpret the solutions
2 Solve second-order linear ordinary differential equations with constant coefficients	2.1 Solve second-order linear homogeneous ordinary differential equations with constant coefficients by using the method of auxiliary equations **Range** • The nature of the roots of the auxiliary equations include: two distinct real roots; two equal real roots; no real roots. 2.2 Solve second-order linear non-homogeneous ordinary differential equations with constant coefficients $$a\frac{d^2y}{dx^2}+b\frac{dy}{dx}+cy=f(x)$$ by finding the complementary function from the auxiliary equation and the particular integral by the method of undetermined coefficients **Range**

	• $f(x)$ may include but is not limited to $ax^2 + bx + c$, Ae^{px} and $A\cos px + B\sin px$

Unit Range

Examples of application of this unit may include working out pricing strategy for goods, estimating population growth, finding amount of chemicals in a solution at any time, the rate of spread of diseases, solving mechanical oscillation problems and solving circuit problems. The disciplines of general business administration, physical science and engineering will find this unit useful.

Assessment Guidelines

1   The competencies covered by this unit can be demonstrated by an individual working alone or as part of a team to the assessor/examiner in a combination of appropriate forms, such as written assignments, written tests, on-line tests, skill tests, hands-on demonstrations, observations in the workplace by verified/qualified assessors, oral presentations, project work, portfolios of workplace activities, case studies, simulations, role-plays and learning diaries/logs.

2   Where possible knowledge should be tested in practical and applied contexts with a minimum of written testing. Institutions, in-house trainers and/or assessors should provide industry-specific contexts for the assessment of the skills and knowledge.

3   All assessment activities should be valid, reliable and practical, with the focus on outcomes to ensure that sufficient evidence of the performance criteria set in the specification is collected. The contexts of activities should be as close to work situations as possible and the performance criteria should be open to those concerned.

4   Learners may use calculators and computer software where necessary.

Special Notes

1   Practical applications in vocational contexts should be emphasized in teaching and learning as far as possible in order to relate skills and techniques acquired to an actual work environment.

2   Competence in Unit GCNU316A, *Solve problems using integration* is assumed.

A POINT TO NOTE FOR NUMERACY STRAND

In 'Range' statements alongside 'Performance Criteria' and the 'Elements of Competency' concerned

- The clause 'may include but is/are not limited to item A, item B and item C' is frequently used to ensure that the range is not too restricted.   In this case, A, B and C are examples that can be included in the range.

- The clause 'include A, B and C' means A, B and C must be included in the range.