-SQA-SCOTTISH QUALIFICATIONS AUTHORITY

HIGHER NATIONAL UNIT SPECIFICATION

GENERAL INFORMATION

-Unit Number- **7481997**

-Superclass- **RB**

-Title- **INTRODUCTORY MATHEMATICS FOR ENGINEERING**

-DESCRIPTION-

GENERAL COMPETENCE FOR UNIT: Developing mathematical skills necessary to achieve advanced awards in engineering through the use and application of fundamental mathematical techniques.

OUTCOMES

1. apply standard algebraic techniques to solve equations and to manipulate expressions occurring in engineering theory;

2. analyse trigonometric functions and their graphs;

3. differentiate and integrate simple functions.

CREDIT VALUE: 1 HN Credit

ACCESS STATEMENT: Access is at the discretion of the centre. However, it would be beneficial if the candidate had skills in mathematics as evidenced by possession of National Certificate Module 7180331 Core Mathematics 4 or SCE Standard Grade Mathematics at 2, or an equivalent level of experience.

For further information contact: Committee and Administration Unit, SQA, Hanover House, 24 Douglas Street, Glasgow G2 7NQ.

Additional copies of this unit may be purchased from SQA (Sales and Despatch section). At the time of publication, the cost is £1.50 (minimum order (£5.00).

HIGHER NATIONAL UNIT SPECIFICATION

STATEMENT OF STANDARDS

UNIT NUMBER: 7481997

UNIT TITLE: INTRODUCTORY MATHEMATICS FOR ENGINEERING

Acceptable performance in this unit will be the satisfactory achievement of the standards set out in this part of the specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

OUTCOME

1. APPLY STANDARD ALGEBRAIC TECHNIQUES TO SOLVE EQUATIONS AND TO MANIPULATE EXPRESSIONS OCCURRING IN ENGINEERING THEORY

PERFORMANCE CRITERIA

(a) The numerical evaluation of expressions is correct.
(b) The solution of equations is correct.
(c) The simplification of algebraic expressions is correct.
(d) The changing of the subject of a formula is correct.

RANGE STATEMENT

Expressions: exponential; logarithmic.

Equations: simultaneous linear equations in two unknowns; quadratic equations.

Algebraic expressions: brackets; fractions; indices.

EVIDENCE REQUIREMENTS

Written evidence of at least two correct solutions for each performance criterion and covering the range.

OUTCOME

2. ANALYSE TRIGONOMETRIC FUNCTIONS AND THEIR GRAPHS

PERFORMANCE CRITERIA

(a) The analysis of trigonometric functions and their graphs in terms of amplitude, phase and period is correct.
(b) The solution of simple trigonometric equations is correct.

RANGE STATEMENT

Trigonometric functions and equations: phase angle; multiple angle.

EVIDENCE REQUIREMENTS

Written evidence of at least two correct solutions for each performance criterion and covering the range. At least one of the correct solutions for Performance Criterion (b) must have angles specified in radians, and one must have angles specified in degrees.

OUTCOME

3. DIFFERENTIATE AND INTEGRATE SIMPLE FUNCTIONS

PERFORMANCE CRITERIA

(a) The differentiation of standard functions is correct.
(b) The definite integration of standard functions is correct.

RANGE STATEMENT

Standard functions: ax^n;$(ax + b)^n$;sin(ax + b); cos(*ax* + *b*);

(for integration, the index of the power $\neq$-1)

EVIDENCE REQUIREMENTS

Written evidence of at least 4 correct solutions for each performance criteria.

MERIT A candidate who achieves all performance criteria for all outcomes will be awarded a pass. A pass with merit may be awarded to a candidate who demonstrates superior performance throughout the unit in each of the following aspects:

- consistently high level of accuracy
- outstanding skills of analysis
- consistently logical presentation of work

- Evidence which satisfies the criteria for merit may be generated by either:

- solving the problem to a level beyond that defined as pass

or

- where this is not possible, including in the assessment a further section which would allow the candidate to demonstrate skills which satisfy the criteria for merit.

ASSESSMENT

In order to achieve this unit, candidates are required to present sufficient evidence that they have met all the performance criteria for each outcome within the range specified. Details of these requirements are given for each outcome. The assessment instruments used should follow the general guidance offered by the SQA assessment model and an integrative approach to assessment is encouraged. (See references at the end of support notes).

Accurate records should be made of the assessment instruments used showing how evidence is generated for each outcome and giving marking schemes and/or checklists, etc. Records of candidates' achievements should be kept. These records will be available for external verification.

SPECIAL NEEDS

Proposals to modify outcomes, range statements or agreed assessment arrangements should be discussed in the first place with the external verifier.

HIGHER NATIONAL UNIT SPECIFICATION

SUPPORT NOTES

UNIT NUMBER: 7481997

UNIT TITLE: INTRODUCTORY MATHEMATICS FOR ENGINEERING

SUPPORT NOTES: This part of the unit specification is offered as guidance. None of the sections of the support notes is mandatory.

NOTIONAL DESIGN LENGTH: SQA allocates a notional design length to a unit on the basis of time estimated for achievement of the stated standards by a candidate whose starting point is as described in the access statement. The notional design length for this unit is 40 hours. The use of notional design length for programme design and timetabling is advisory only.

PURPOSE This unit is designed to enable candidates to achieve the fundamental mathematical skills necessary to embark on more advanced mathematics units within Higher National Engineering Awards.

CONTENT/CONTEXT Computer packages may be used to enhance the delivery of any outcome.

Corresponding to outcomes:

1. Use of calculator. Scientific notation. Evaluation of formulae

   eg $V_r = V_0 \exp\left(-\frac{t}{CR}\right)$ or $Z = \sqrt{R^2 + \left(2\pi f L - \frac{1}{2\pi fc}\right)^2}$

   Linear and quadratic equations. Simultaneous linear equations in two unknowns. Factorisation, indices.

   Changing subject of formulae, eg $V^2 = u^2 + 2as$ to a.

2. Degrees and radians. Graphs of sin x, cos x and tan x. Effects on these of changes in amplitude, phase and period.

   Solution of simple trigonometric equations eg 10 sin 100πt = - 8.3.

3. The idea of a derivative. Rate of change. Differentiation of simple functions ax^n, $(ax + b)^n$, sin(ax + b), cos(ax + b)

   Integration, definite and indefinite, of simple functions

   ax^n $(n \neq -1)$, $(ax + b)^n$ $(n \neq -1)$, sin (ax + b), cos(ax + b)

ASSESSMENT PROCEDURES Centres may use the Instruments of Assessment which are considered by tutors/trainers to be most appropriate. Examples of Instruments of Assessment which could be used are illustrated by the exemplars. Assessment should be undertaken without the aid of computer packages.

EXEMPLARS

Outcome 1 - Algebra

PC(a) (i) The current i in a circuit is described by the law

$i = i_o(1 - e^{-20t})$ where i_o is equilibrium current and t is time in seconds.

Find the value of i in Amperes if i_o = 2.5 and t = 0.08

(ii) Evaluate $T = 2CR\ln\left(\frac{V_{dd}}{V_{dd} - V_1}\right)$

when $C = 10^{-8}F, \quad R = 120\Omega, \quad V_{dd} = 12V, \quad V_1 = 5.5V$

PC(b) (i) Find the **positive** solution of the quadratic equation

$0.2z^2 - 0.34z - 0.18 = 0$

(ii) Solve the simultaneous equations

$14i_1 - 13i_2 = 34$
$14i_2 - 13i_1 = -33.5$

PC(c) (i) Simplify $\left(\frac{0.1e^{-0.1t}}{e^{-0.2t}}\right)^{-2}$ leaving your answer with **positive** indices.

(ii) Express the following sum as a single fraction

$\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

PC(d) Change the subject of the formula.

(i) $v^2 = u^2 - 2as \quad to \quad a$

(ii) $i_1^2 R_1 = i_2^2 R_2 \quad to \quad i_2$

Outcome 2 - Trigonometry

PC(a) (i) Figure 1 shows the graph of a sine function (y is a function of θ and θ is measured in degrees). For the function shown, state:

(a) the period;
(b) the amplitude;
(c) the phase shift from the Sine function y = 5 sin2θ;
(d) the equation

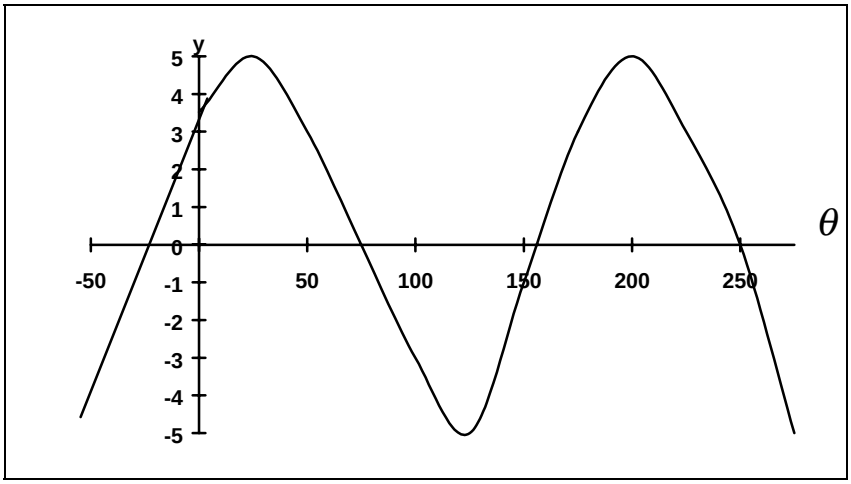

Figure 1

(ii) For the function y = 10 sin (2x - π/3), state:

(a) the period;
(b) the amplitude;
(c) the phase shift.

PC(b) Find **all** of the solutions of

(i) 8.2tan(α - 0.2) = -11.6 for $0 \le \alpha \le 2\pi$ (α is in radians)

(ii) 0.02sin(θ/2) = 0.0025 for $0 \le \theta \angle 360$ (θ is in degrees)

Outcome 3 - Calculus

PC(a) Differentiate each function with respect to its independent variable

(i) $f(x) = (x^2 + 1)(2x - 5)$

(ii) $y(x) = \sqrt{3x + 1}$

(iii) $i(t) = 50\sin\left(20\pi t + \frac{\pi}{6}\right)$

(iv) $f(t) = 100\cos\left(50\pi t - \frac{\pi}{3}\right)$

PC(b)

(i) Evaluate $\int_1^2 (2x + 1)^4 \, dx$

(ii) Evaluate $\int_2^4 (2x - 3)(x + 2) \, dx$

(iii) Evaluate $\int_{-0.001}^{0.001} 50\cos(50\pi t) dt$

(iv) Evaluate $\int_0^{\frac{\pi}{2}} 5\sin(2t - \frac{\pi}{6})$

PROGRESSION Candidates may progress to more advanced mathematics units within Higher National awards, such as 7481987 Mathematics for Engineering and 7481594 Calculus 1 for Engineering.

REFERENCES

1. Guide to unit writing.
2. For a fuller discussion on assessment issues, please refer to SQA's Guide to Assessment.
3. Information for centres on SQA's operating procedures is contained in SQA's Guide to Procedures.
4. For details of other SQA publications, please consult SQA's publications list.

HIGHER NATIONAL MATHEMATICS GRID FOR ELECTRICAL/MECHANICAL ENGINEERING