SCOTTISH QUALIFICATIONS AUTHORITY

TECHNOLOGICAL STUDIES
Higher

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SCOTTISH QUALIFICATIONS AUTHORITY

NOTE OF CHANGES TO ARRANGEMENTS
THIRD EDITION PUBLISHED ON CD-ROM DECEMBER 1999

COURSE TITLE: Technological Studies (Higher)

COURSE NUMBER: C036 12

National Course Specification

Course Details: Core skills statements expanded

National Unit Specification

All Units: Core skills statements expanded

SCOTTISH QUALIFICATIONS AUTHORITY

National Course Specification

TECHNOLOGICAL STUDIES (HIGHER)

COURSE NUMBER C036 12

COURSE STRUCTURE

This course has four mandatory units as follows:

D186 12	***Applied Electronics (Higher)***	***1 credit (40 hours)***
D187 12	***Systems and Control (Higher)***	***1 credit (40 hours)***
D190 12	***Structures and Materials (Higher)***	***0.5 credit (20 hours)***
D191 12	***Case Study Report (Higher)***	***0.5 credit (20 hours)***

All courses include 40 hours of teaching and learning activity over and above the notional 120 hours assigned to the component units of the course. This may be used for induction, extending the range of learning and teaching approaches, support, consolidation, integration of learning and preparation for external assessment.

It is suggested that delivery of course units are approached in the following order but a unit need not necessarily be completed before commencing the next unit:

- Applied Electronics (Higher)
- Systems and Control (Higher)
- Structures and Materials (Higher)
- Case Study Report (Higher).

This order will ensure that concepts are encountered at an appropriate stage of the course and can be reviewed, reinforced and further developed through application within later units.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates will normally be expected to have attained one of the following:

- Standard Grade Technological Studies at grade 1 or 2
- Intermediate 2 Technological Studies.

Administrative Information

Publication date: December 1999

Source: Scottish Qualifications Authority

Version: 03

Centres may wish to consider, at their own discretion, qualifications in other related subjects such as Computing Studies or Physics at Standard Grade Credit level and Higher Grade or equivalent clusters of NQ units at Intermediate 2 or above.

It is recommended that candidates should have achieved Credit level at Standard Grade in Mathematics or have demonstrated competency in equivalent NC units.

CORE SKILLS

This course gives automatic certification of the following:

Complete core skills for the course	Problem Solving	H
	Numeracy	H
	IT	Int 2
Additional core skills components for the course	None	

For information about the automatic certification of core skills for any individual unit in this course, please refer to the general information section at the beginning of the unit.

Additional information about core skills is published in *Automatic Certification of Core Skills in National Qualifications* (SQA, 1999).

National Course Specification: course details

COURSE Technological Studies (Higher)

RATIONALE

The rationale for Technological Studies at Higher has been developed from that contained in previous *Arrangements in Technological Studies (1990).* In line with the systems approach, and applying this methodology to the learning process, the depth of treatment of topics introduced at Standard Grade is developed further. For example, in electronics, the level of understanding is developed from a sub systems base to a study at component base level. In a similar manner, topics such as structures, materials, and programmable systems are treated in a more formal manner, thus developing a depth of knowledge and understanding appropriate to Higher level.

This Higher course will build on and develop the knowledge gained from the Standard Grade and or Intermediate 2 courses, with greater depth of treatment being applied to individual topics. The level of mathematics required in the analysis of problems, and the degree of integration of concepts, which candidates will require, will further expand each candidate's abilities in a manner commensurate with modern technology.

To ensure that the course remains relevant to the industrial and commercial fields, it is important that every opportunity is taken to expose candidates to real applications of technological systems and to reflect actual technological practice. To reinforce this approach, candidates are required to access information from data booklets and data sheets.

A feature of any technological course is that candidates are not only required to process information and to develop understanding of concepts but, in addition, they are required to demonstrate capability in applying concepts to the solution of practical problems. This will be a permeating aspect of this course.

The unit called Case Study Report will offer candidates the opportunity to analyse a given solution to a stated problem set in an industrial/commercial context. This will allow them to review knowledge and understanding acquired through course work. In doing so, candidates will be required to demonstrate communication skills through the production of a report and to develop analytical skills in investigating the development of a solution to a problem.

Any course in technology would be seen to fail if it did not take into account the wider issues faced by technologists and engineers in considering the effects of technological change. The Scottish CCC document *Technology Education in Scottish Schools* identifies technological capability as consisting of four elements:

- technological perspective
- technological confidence
- technological sensitivity
- technological creativity.

While the elements of perspective, confidence and creativity are clearly encompassed within the assessable aspects of the course, the importance of technological sensitivity should be recognised and given due consideration.

Within the context of the course, adequate time should be set aside to consider the social, economic and environmental issues of technologically driven change and the impact of these issues on society.

As a trading nation, it is important that the significant role played by manufacturing industry in the generation of employment and the creation of wealth is widely recognised. To maintain and improve the economic standing of the country among the other industrialised nations, there is a continued need to attract young people of the highest ability into the technology and technology-related professions. Higher Technological Studies provides candidates with the opportunity to experience the challenge of modern technology at first hand and, in so doing, seeks to develop positive attitudes to, and a continuing interest in, careers within technology.

Course aims:

Candidates having completed the Higher course in Technological Studies should be able to:

- develop an appreciation of selected key issues in technology, such as the environment, the contexts in which these key issues may be viewed and the constraints within which solutions or designs must be achieved
- instil a knowledge of physical principles and of technology and commercial methodologies, and to apply them to solving problems or meeting specifications
- encourage development of each candidate's communication and presentation skills
- inculcate a receptive attitude towards technological progress and its demands
- foster the ability to seek out, research, analyse and apply such information as is necessary for the aims above
- foster technologically sensitive attitudes.

COURSE CONTENT

There are benefits to be gained by taking the course in Technological Studies rather than studying the individual units.

When units are studied as part of a course, opportunities exist for candidates to experience a range of integrated problems. Such problems may require solutions that extend beyond the boundaries of the discrete units.

Apart from the Case Study Report, all of the course content will be subject to sampling in the external assessment. A data booklet will be available for reference in work during the course and in the external examination.

A description of the content and outcomes of each of the four units which comprise the course follows.

Applied Electronics (Higher)

Outcomes

1 Design and construct electronic systems to meet given specifications.

2 Design and construct electronic systems, based on operational amplifiers, to meet given specifications.

3 Design and construct combinational logic systems to meet given specifications.

Content

Principles of the voltage divider. Examples of potentiometer, fixed voltage divider. Use of variable resistors and analogue input transducers (LDR, thermistor, strain gauge) in voltage dividers.

Use input transducer characteristics from the data booklet to design a voltage divider to meet a given specification.

The n-p-n transistor as a switch (common emitter mode); switching circuits using transistors and voltage dividers. The need for circuit protection and associated techniques.

Current gain of an n-p-n transistor.

Calculations based on the load being connected to the collector. All calculations assume that the transistor is at the point of 'saturation' (assume $I_e \simeq I_c$).

Use of Darlington Pair and associated calculations.

Push-pull driver circuit - use of the p-n-p/n-p-n configuration to provide negative and positive output voltages. (No calculations are required on p-n-p transistors.)

The *n-channel* MOSFET (in enhancement mode) as a switch and as an output driver. Simple switching circuit with MOSFET and voltage divider.

Calculations associated with MOSFETs for a given gate voltage. Use of a relay in a transistor circuit to switch a separate (high voltage or high current) circuit.

Use of computer simulation to evaluate electronic systems. Constructing electronic systems to meet given specifications.

Introduction to the use of a 741 IC as a building block for a range of op-amp configurations; pin-out diagram for a 741 IC.

Basic theory of operational amplifiers as devices for amplifying voltage signals.

Relationships between input voltages (to inverting and non-inverting inputs) and output voltage for different op-amp configurations. Calculations involving input voltage, output voltage and gain.

Op-amp configurations: inverting, non-inverting, comparator, difference amplifier, summing amplifier, voltage follower. Basic theory of operation and use. Use of data booklet in selection and representation of op-amp configurations.

Use of computer simulation to evaluate electronic systems, based on op-amps.

Construction of electronic systems, based on op-amps, to meet given specifications.

Logic functions and their associated truth tables: AND, OR, NOT, NAND, NOR. Use of NAND based equivalents.

Truth tables - maximum of three inputs. Development of Boolean expressions from truth tables or circuit specifications.

Construction of truth tables for combinational logic diagrams. Production of combinational logic diagrams from truth tables using any gates or NAND based equivalents.

Construction of truth tables and logic diagrams from written specifications.

Use of data sheets in selecting logic ICs. Graphical representation of solutions to combinational logic problems.

Use of logic ICs and pin-out diagrams. Comparison of TTL and CMOS families of ICs (in terms of operational characteristics).

Use of computer simulation (and construction) to evaluate combinational logic systems.

Systems and Control (Higher)

Outcomes

1 Analyse and describe the operation of control systems.

2 Analyse the design of closed loop analogue control systems.

3 Develop a control sequence and use it to control a mechatronic system, by means of a microcontroller.

4 Develop a monitoring system based on a microcontroller, and evaluate its performance.

Content

Principles of operation of control systems.

Open loop control; closed loop control: digital, analogue.

Graphical representation: system diagrams, block diagrams, detailed control diagrams, flowcharts.

Examples of closed loop analogue control systems, to include proportional, positional, push-pull.

Application of op-amp configurations to control systems.

Graphical representation of circuit elements such as voltage dividers, op-amps and output transducers.

Evaluation of control systems.

Introduction to microcontrollers including RAM, ROM, ALU, EEPROM, bus, clock. Advantages and applications of microcontrollers. Comparison with hard-wired alternatives.

Binary and decimal systems of counting; conversion from one number system to the other.

Signal conditioning.

A–D conversion; the need for A–D conversion in microcontroller systems.

Simple A–D and D-A calculations.

Creating input signals to a microcontroller from analogue and digital devices.

Control routines: systems with up to 4 inputs and 4 outputs.

Use of flowcharts as the basis of a structured, top-down approach to programming.

Writing control programs in a high level language, such as PBASIC; inputs, outputs, loops and time delays.

Setting up loops; looping through a sequence or program 'N' times and looping continuously.

Controlling a motor by a microcontroller using pulse-width modulation: 'soft start'; speed; position.

Stepper motor control; structure and operation of stepper motors; applications; data sheets on coil energising; control problems involving stepper motors – position and speed control; reversing a stepper motor.

Data logging; applications of data logging; microcontroller based data logging systems; manipulation and presentation of recorded data.

Multiplexing.

Structures and Materials (Higher)

Outcomes

1 Apply the conditions of static equilibrium in solving problems on concurrent force and non-concurrent force systems.

2 Apply the conditions of static equilibrium in solving problems on simple framed structure systems.

3 Use and interpret data from a tensile test in studying properties of materials.

4 Produce a specification for a structural component.

Content

Coplanar force systems - conditions for static equilibrium.

Resolution of inclined forces into horizontal and vertical components.

Use of free body diagrams to represent force systems.

Analytical solutions to problems on force systems. (No graphical solutions in tests and examinations.)

Principle of moments; moments problems with inclined forces; hinge and roller reactions; simple beam problems, finding unknown forces and reactions; overall conditions for static equilibrium: $\Sigma F_h = O$, $\Sigma F_v = O$, $\Sigma M = O$

Practical applications of statics.

Introduction to framed structures; nodal analysis only; members in compression/tension; redundant members; hinge and roller reactions; (analytical methods only in tests and examinations.)

Common properties of materials — elasticity, ductility, plasticity, hardness, brittleness; common engineering materials — ferrous/non-ferrous metals, thermoplastic and thermosetting plastics.

Elastic and plastic behaviour of materials; common applications in engineering design.

Behaviour of material under load; typical graphs for a tensile test.

Direct stress, direct strain and Young's Modulus; use of Young's Modulus and ultimate stress values from the data booklet.

Load/extension graphs and stress/strain graphs for mild steel, copper, aluminium and cast iron. Comparison of UTS, ductility and Young's Modulus.

Factor of safety — based on safe working stress and ultimate stress (or loads) — reasons for factor of safety.

Case Study Report (Higher)

Outcomes

1 Analyse the development of an existing solution to a given problem.

2 Produce a report.

Content

This will depend on the nature of the case study selected by the candidate. The depth of treatment should be similar to that described in the other units of the Higher Technological Studies course.

ASSESSMENT

To gain the award of the course, the candidate must pass all the unit assessments as well as the external assessment. The external assessment will provide the basis for grading attainment in the course award.

When the units are taken as component parts of a course, candidates will have the opportunity to achieve levels beyond that required to attain each of the unit outcomes. This attainment may, where appropriate, be recorded and used to contribute towards course estimates, and to provide evidence for appeals. Additional details are provided, where appropriate, with the exemplar assessment materials. Further information on the key principles of assessment is provided in the paper, *Assessment*, published by HSDU in May 1996.

DETAILS OF INSTRUMENTS FOR EXTERNAL ASSESSMENT

There will be one written examination paper, with a time allocation of 3 hours.

The paper will comprise two parts, as follows:

Section A (60 marks)
Six to eight short-answer questions will be set on the knowledge and understanding of discrete aspects of the course. Candidates should attempt **all** questions in this section.

Section B (40 marks)
Three extended-answer questions will be set. Candidates should attempt **two** questions from this section.

These questions will test knowledge, understanding and the ability to deal with integrated course content.

Candidates may be required to extract information from a data booklet supplied by the awarding body. This will include technical details such as the PBASIC instruction set, formulae and tabulated data.

National Course Specification: course details (cont)

COURSE Technological Studies (Higher)

GRADE DESCRIPTIONS

The descriptions below are of expected performance at grade C and at grade A. They are intended to assist candidates, teachers, lecturers and users of the certificate, and to help establish standards when question papers are being set. The grade of an award will be based on the total score obtained in the examination.

Grade C

In order to obtain a Grade C, the candidate should be able to:

- use appropriate knowledge, understanding and skills acquired through the study of the component units of this course
- demonstrate the ability to integrate skills acquired in component units to solve problems of a theoretical nature
- apply knowledge and understanding to solve problems presented in less familiar contexts.

Grade A

In order to obtain a Grade A, the candidate should be able to:

- use knowledge, understanding and skills at a depth of treatment beyond that required for the component units
- demonstrate the ability to integrate skills acquired in component units to solve more complex problems of a theoretical nature
- apply knowledge and understanding to solve complex and sometimes unstructured problems presented in a variety of contexts.

APPROACHES TO LEARNING AND TEACHING

Where appropriate, arrangements should be made to ensure that there will be no artificial barriers to learning and assessment. The nature of a candidate's special needs should be taken into account when planning learning experiences and selecting assessment instruments. Alternative arrangements should be made as necessary.

Detailed subject guides may give further advice and information on:

- support materials for each course
- appropriate learning and teaching approaches
- core skills as they relate to the subject
- assessment
- appropriate access for candidates with special educational needs.

Approaches to learning and teaching for Applied Electronics (Higher)

This unit should be the first presented in the course. It deals with concepts which are applied in other units and thus offers opportunities for integration of content.

The purpose of the unit is to develop the sub-systems based level of understanding of analogue and digital electronics introduced at Standard Grade and Intermediate 2. Candidates are required to develop an understanding of the function and operation of electronic devices and apply quantitative analysis to verify the operation of electronic systems.

Each outcome has been structured to address a body of knowledge that will enable candidates to analyse electronic systems. Candidates will apply this knowledge in simulating, constructing and evaluating electronic systems to given specifications.

The main topics of study are transistors, operational amplifiers and combinational logic. Candidates are required to carry out practical activities in circuit construction and simulation. In addition to this, aspects of technological sensitivity that relate to Applied Electronics will be discussed.

Candidates should have some previous experience in handling simple potential divider and transistor-driver circuits before taking Outcome 1.

Candidates would be expected to select an appropriate sensor, use a data sheet to find sensor resistance at a specified physical property level and make calculations to determine the passive resistor value to enable a potential divider to be constructed. Candidates would also be expected to select a transistor based output driver and appropriate output devices. The need for component protection using a diode should be understood.

The work covered by candidates in overtaking Outcome 2 should be structured to develop a basic knowledge of, and competence in, handling op-amps. The control of gain using feedback and input resistance should be applied to the range of op-amp configurations and typical applications.

The work undertaken by candidates in overtaking Outcome 3 should build on previous experience in building simple combinational logic systems based on two-input gates. The basic operational characteristics of CMOS and TTL logic ICs should be discussed and candidates should be sufficiently aware of these to suggest a specific family of devices for a particular application. Standard layout and interpretation of truth tables should be covered. Using the resulting expression, candidates would be expected to construct a logic diagram using standard gates, which would then be converted into an equivalent NAND-based circuit. The advantages in using a single gate based solution should be understood.

Approaches to learning and teaching for Systems and Control (Higher)

The purpose of this unit is to develop the understanding of control concepts and control systems developed at Standard Grade and Intermediate 2.

The outcomes have been structured to address a body of knowledge that will enable candidates to analyse control systems and develop control sequences. Candidates will apply this knowledge in using a high level programming language (PBASIC) to control mechatronic devices and monitoring systems.

Data logging should be used as a means of monitoring the operation of a system. The understanding of electronic systems developed in the Applied Electronics (Higher) unit should be reinforced through application within this unit.

Outcomes 1–4 could be overtaken in the context of assignments which bring industrial/domestic perspectives to the applications of control systems.

It is anticipated that candidates will be familiar with the concepts of open loop and closed loop control. Systems representation and the use of block diagrams should be revised and the concept of a system boundary should be developed. Candidates should become familiar with the standard representation of closed loop control systems and the concept of negative feedback.

Candidates would benefit from undertaking a series of problem solving activities. Analogue closed loop control could be considered, using an automatic temperature-control system, based on a comparator op-amp, and using a thermistor to provide a feedback signal. Proportional closed loop control could be introduced through the evaluation of a servo-system applied to positional control. A potentiometer could be used to provide a feedback signal to a difference amplifier based control system. In a similar manner, speed control applications could be considered, using a tachogenerator to provide feedback.

It is anticipated that candidates will have prior experience of developing simple control programs, using high-level languages and constructing and interpreting simple flowcharts.

Candidates should become familiar with the basic layout and operation of a microcontroller system. Programs will be developed using a high-level language (PBASIC).

Candidates should be capable of interfacing mechatronic devices with the BASIC Stamp microcontroller, eg bit testing, setting loops and generating sub-procedures.

Typical applications could involve controlling electro-mechanical devices, speed control of d.c. motors and stepper motors and positional control of motors.

From a given specification, candidates would be required to construct a flowchart, develop a control sequence, and use it to control a mechatronic system.

Candidates should become familiar with the need for and applications of data-logging systems and are required to use a dedicated data-logging system based on the Stamp microcontroller to record and analyse the data produced. The importance of frequency of sampling in a monitoring system should be appreciated.

Candidates should record voltage signals, produced by sensors. These signals could be processed through a multiplexer and A-D converter into a form suitable for a microcontroller. Candidates should develop a program to enable the microcontroller to monitor and record the data for specified conditions. The data could be presented in both tabular and graphical form.

Approaches to learning and teaching for Structures and Materials (Higher)

Although candidates may have been introduced to the concept of static equilibrium, the depth of treatment is likely to have been mainly qualitative. The purpose of this unit at Higher level is to establish a clear understanding of the concept of equilibrium and its application in solving problems involving concurrent and non-concurrent force systems.

Candidates will undertake a series of graded problems dealing with the three conditions of static equilibrium. Candidates are required to analyse force systems, resolve inclined forces into horizontal and vertical components and represent force systems in free body diagrams.

In structural systems, candidates will consider the effects of both external and internal forces. Problems on framed structures will be solved using the nodal analysis method only. Calculations and the use of graphical and tabulated data are applied to establish a specification for a structural component.

Problems should be set in a structural/civil engineering context. The magnitude of the loading applied to framed structures should, where possible, reflect engineering practice.

Candidates should interpret data from tensile tests for a number of common materials, draw graphs and carry out relevant calculations.

Candidates are expected to interpret data in selecting appropriate materials for a component and to carry out related calculations. In selecting materials, candidates must take account of the effects of operational environment on the component.

Approaches to learning and teaching for the Case Study Report

The purpose of this unit is to provide candidates with the opportunity to investigate the development of an existing solution to a problem.

It is recommended that candidates complete at least one other unit of the course before starting the case study.

A typical case study could involve candidates in interpreting a given specification to analyse a problem in systems terms. The sub-systems could be electronic, programmable, control, or structural. Candidates would be expected to research the ideas developed for solutions to each sub-system. Methods of testing, calculations and results achieved could be included in the Case Study Report. Candidates should give due emphasis to the social, environmental and economic effects. An evaluation of the effectiveness of the solution in meeting the specification should be produced.

Possible sources of information for the Case Study Report are: CD-ROM, Internet access, audio/visual material, library access, company literature and direct industrial contact.

SPECIAL NEEDS

This course specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative outcomes for units. For information on these, please refer to the SQA document *Guidance on Special Assessment and Certification Arrangements for Candidates with Special Needs/Candidates whose First Language is not English* (SQA, 1998).

SUBJECT GUIDES

A Subject Guide to accompany the Arrangements document has been produced by the Higher Still Development Unit (HSDU) in partnership with the Scottish Consultative Council on the Curriculum (SCCC) and Scottish Further Education Unit (SFEU). The Guide provides further advice and information about:

- support materials for each course
- learning and teaching approaches in addition to the information provided in the Arrangements document
- assessment
- ensuring appropriate access for candidates with special educational needs.

The Subject Guide is intended to support the information contained in the Arrangements document. The SQA Arrangements documents contain the standards against which candidates are assessed.

SCOTTISH QUALIFICATIONS AUTHORITY

National Unit Specification: general information

UNIT Applied Electronics (Higher)

NUMBER D186 12

COURSE Technological Studies (Higher)

SUMMARY

This unit is designed to enable candidates to develop the level of understanding of analogue and digital electronics introduced at Standard Grade and Intermediate 2.

OUTCOMES

1 Design and construct electronic systems to meet given specifications.
2 Design and construct electronic systems, based on operational amplifiers, to meet given specifications.
3 Design and construct combinational logic systems to meet given specifications.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates will normally be expected to have attained one of the following:

- Standard Grade Technological Studies at grade 1 or 2
- Intermediate 2 Technological Studies or equivalent NC units.

CREDIT VALUE

1 credit at Higher.

Administrative Information

Superclass: XL

Publication date: December 1999

Source: Scottish Qualifications Authority

Version: 03

National Unit Specification: general information (cont)

UNIT Applied Electronics (Higher)

CORE SKILLS

This unit gives automatic certification of the following:

Complete core skills for the unit	Problem Solving	H
	Numeracy	H
Additional core skills components for the unit	None	

Additional information about core skills is published in *Automatic Certification of Core Skills in National Qualifications* (SQA, 1999).

National Unit Specification: statement of standards

UNIT Applied Electronics (Higher)

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

OUTCOME 1

Design and construct electronic systems to meet given specifications.

Performance criteria

(a) Components and sub systems are identified correctly, for given electronic systems.
(b) The operation of electronic sub systems is explained clearly.
(c) Calculations to verify the operation of sub systems are carried out correctly.
(d) An electronic system is evaluated correctly against a given specification, using computer simulation.
(e) An electronic system is constructed to meet a given specification.

Note on range for the outcome

Components: LDR, thermistor fixed resistor, variable resistor, strain gauge, bi-polar and MOSFET transistors, motor, relay, diode.

Electronic systems (including the following sub-systems):
input – potential divider
process – MOSFET, bi-polar configuration
output – any appropriate output.

Evidence requirements

Written and graphical evidence for PCs (a) to (c). Performance evidence for PCs (d) and (e).

OUTCOME 2

Design and construct electronic systems, based on operational amplifiers, to meet given specifications.

Performance criteria

(a) In selecting operational amplifier configurations from a data booklet, information is interpreted correctly and the configurations are represented graphically.
(b) The operation of electronic systems, based on operational amplifiers, is explained clearly.
(c) Calculations relating to operational amplifier based systems are carried out correctly.
(d) An operational amplifier system is evaluated correctly against a given specification, using computer simulation.
(e) An operational amplifier system is constructed to meet a given specification.

Note on range for the outcome

Operational amplifier configurations: non-inverting, inverting, difference and summing amplifiers, comparator, voltage follower.
Calculations: input voltage, output voltage, supply voltage, feedback resistance, input resistance, gain.

Evidence requirements

Written and graphical evidence for PCs (a) to (c). Performance evidence for PCs (d) and (e).

OUTCOME 3

Design and construct combinational logic systems to meet given specifications.

Performance criteria

(a) The operational characteristics of common integrated circuit logic families are described correctly.
(b) Data sheets are interpreted correctly in the selection of integrated circuits.
(c) Solutions to logic problems are developed successfully using truth tables, Boolean expressions, common logic gate diagrams and NAND-based equivalents.
(d) The graphical representation used in designing solutions to logic problems is in accordance with the data booklet.
(e) A logic circuit is evaluated correctly against a given specification, using computer simulation.
(f) A logic circuit is constructed to meet a given specification.

Evidence requirements

Written and graphical evidence for PCs (a) to (d). Performance evidence for PCs (e) and (f).

National Unit Specification: support notes

UNIT Applied Electronics (Higher)

This part of the unit specification is offered as guidance. The support notes are not mandatory.

While the time allocated to this unit is at the discretion of the centre, the notional design length is 40 hours.

A data booklet will be issued by SQA for use in connection with this unit.

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

Guidance for each outcome is given below.

Outcome 1

Principles of the voltage divider. Examples of potentiometer, fixed voltage divider. Use of variable resistors and analogue input transducers (LDR, thermistor, strain gauge) in voltage dividers.

Use input transducer characteristics from the data booklet to design a voltage divider to meet a given specification.

The n-p-n transistor as a switch (common emitter mode; switching circuits using transistors and voltage dividers. The need for circuit protection and associated techniques.

Current gain of an n-p-n transistor.

Calculations based on the load being connected to the collector. All calculations assume that the transistor is at the point of 'saturation' (assume $I_e \simeq I_c$).

Use of Darlington Pair and associated calculations.

Push-pull driver circuit – use of the p-n-p/n-p-n configuration to provide negative and positive output voltages. (No calculations are required on p-n-p transistors.)

The *n-channel* MOSFET (in enhancement mode) as a switch and as an output driver. Simple switching circuit with MOSFET and voltage divider.

Calculations associated with MOSFETs for a given gate voltage. Use of a relay in a transistor circuit to switch a separate (high voltage or high current) circuit.

Use of computer simulation to evaluate electronic systems. Constructing electronic systems to meet given specifications.

Outcome 2

Introduction to the use of a 741 IC as a building block for a range of op-amp configurations; pin-out diagram for a 741 IC.

Basic theory of operational amplifiers as devices for amplifying voltage signals.

Relationships between input voltages (to inverting and non-inverting inputs) and output voltage for different op-amp configurations. Calculations involving input voltage, output voltage and gain.

National Unit Specification: support notes (cont)

UNIT Applied Electronics (Higher)

Outcome 2 (cont)	Op-amp configurations: inverting, non-inverting, comparator, difference amplifier, summing amplifier, voltage follower. Basic theory of operation and use. Use of data booklet in selection and representation of op-amp configurations. Use of computer simulation to evaluate electronic systems, based on op-amps. Construction of electronic systems, based on op-amps, to meet given specifications.
Outcome 3	Logic functions and their associated truth tables: AND, OR, NOT, NAND, NOR. Use of NAND based equivalents. Truth tables – maximum of three inputs. Development of Boolean expressions from truth tables or circuit specifications. Construction of truth tables for combinational logic diagrams. Production of combinational logic diagrams from truth tables using any gates or NAND based equivalents. Construction of truth tables and logic diagrams from written specifications. Use of data sheets in selecting logic ICs. Graphical representations of solutions to combinational logic problems. Use of logic ICs and pin-out diagrams. Comparison of TTL and CMOS families of ICs (in terms of operational characteristics). Use of computer simulation (and construction) to evaluate combinational logic systems.

Candidates are required to develop an understanding of the function and operation of electronic devices and to carry out calculations to verify the operation of electronic systems. The main areas of study are the potential divider, transistor driver, operational amplifier and combinational logic. In addition, candidates are required to develop practical capabilities in simulating and constructing electronic systems.

National Unit Specification: support notes (cont)

UNIT Applied Electronics (Higher)

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Where appropriate, opportunities should be taken to ensure that learning and teaching is contextualised in industrial/commercial applications. Candidates are expected to design and construct systems to meet given specifications. Such systems should be based on transistor control and operational amplifier and combinational logic applications.

This unit deals with concepts which are applied in other units and thus offers opportunities for integration of content. In presenting this unit, teachers and lecturers should ensure that there is a balance between direct teaching and practical activities.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

National Assessment Bank materials have been created specifically to assess knowledge and understanding for each outcome. Assessments can take place either at the completion of an outcome or as an end of unit test. Centres must ensure that tests are conducted under appropriate conditions. Candidates should be allowed to use the Technological Studies data booklet. Candidates should be issued with clean copies of this booklet for use during tests.

All three outcomes require candidates to simulate, construct and evaluate systems to given specifications. It is the responsibility of the centre to ensure that evidence of candidate performance is recorded in an appropriate way. All evidence of performance must be retained by the centre. The assessment of this unit is subject to central moderation by the SQA.

Candidates generate evidence by means of their response to written tests, proficiency in practical activities and systems evaluation.

In order to gain success in the written test for an outcome, each candidate must achieve at least the cut-off score for that outcome. In order to succeed in practical activities, the candidate must simulate, construct and evaluate a system to meet a given specification. Evidence of performance must be recorded in an appropriate manner. Simulation and construction performance must be observed directly. Candidates' evaluation of a system can be in the form of either a written or oral report. Details should be recorded of the particular system(s) dealt with by each candidate.

SPECIAL NEEDS

This unit specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative outcomes for units. For information on these, please refer to the SQA document *Guidance on Special Assessment and Certification Arrangements for Candidates with Special Needs/Candidates whose First Language is not English* (SQA, 1998).

SCOTTISH QUALIFICATIONS AUTHORITY

National Unit Specification: general information

UNIT Systems and Control (Higher)

NUMBER D187 12

COURSE Technological Studies (Higher)

SUMMARY

This unit is designed to enable candidates to apply the principles of control to mechatronic systems and to monitor and record data from a system.

OUTCOMES

1 Analyse and describe the operation of control systems.
2 Analyse the design of closed loop analogue control systems.
3 Develop a control sequence and use it to control a mechatronic system, by means of a microcontroller.
4 Develop a monitoring system based on a microcontroller, and evaluate its performance.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates will normally be expected to have attained one of the following:

- Standard Grade Technological Studies at grade 1 or 2
- Intermediate 2 Technological Studies or equivalent NC modules.

CREDIT VALUE

1 credit at Higher.

Administrative Information

Superclass: VE

Publication date: December 1999

Source: Scottish Qualifications Authority

Version: 03

National Unit Specification: general information (cont)

UNIT Systems and Control (Higher)

CORE SKILLS

This unit gives automatic certification of the following:

Complete core skills for the unit	Problem Solving	H
Additional core skills components for the unit	Using Number	H

Additional information about core skills is published in *Automatic Certification of Core Skills in National Qualifications* (SQA, 1999).

National Unit Specification: statement of standards

UNIT Systems and Control (Higher)

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

OUTCOME 1

Analyse and describe the operation of control systems.

Performance criteria

(a) The type of control applied to a system is identified correctly.
(b) The operation of a control system is described clearly.
(c) The use of graphical representation is appropriate in analysing the design of a control system.

Evidence requirements

Written and graphical evidence showing that the candidate can analyse and describe the operation of given control systems and represent systems graphically, on a minimum of two occasions (one open loop, one closed loop).

OUTCOME 2

Analyse the design of closed loop analogue control systems.

Performance criteria

(a) The type of closed loop analogue control applied to a system is identified correctly.
(b) The operational amplifier configuration for a specified analogue control system is selected correctly.
(c) Analogue control systems are represented correctly using block diagrams and circuit diagrams.
(d) The operation of a specified analogue control system is evaluated correctly, either by construction or computer simulation.

Evidence requirements

Written and graphical evidence for PCs (a) to (c). Performance evidence for PC (d).

National Unit Specification: statement of standards (cont)

UNIT Systems and Control (Higher)

OUTCOME 3

Develop a control sequence and use it to control a mechatronic system, by means of a microcontroller.

Performance criteria

(a) The operation and architecture of a microcontroller are described correctly.
(b) The need for and operation of interfacing devices are described clearly.
(c) A specified control sequence is represented correctly by a flowchart, using symbols from a data booklet.
(d) A specified control sequence is developed successfully in a high level programming language.
(e) A control sequence, written in a high level programming language, is used successfully to control a mechatronic system.
(f) Interfacing devices required to provide control of a mechatronic system, are used correctly.

Evidence requirements

Written and graphical evidence for PCs (a) to (d). Performance evidence for PCs (e) and (f).

OUTCOME 4

Develop a monitoring system, based on a microcontroller, and evaluate its performance.

Performance criteria

(a) The need for and operation of processing sub systems are described clearly.
(b) Calculations to determine the specified operation of a signal processing sub system are carried out correctly.
(c) The importance of sampling frequency in a monitoring system is explained correctly.
(d) A program is developed successfully, in a high level language, to enable a microcontroller to monitor and record data for specified conditions.
(e) A software based microcontroller system is used successfully to monitor specified conditions.
(f) Data from a microcontroller based monitoring system are recorded and evaluated correctly.

Evidence requirements

Written and graphical evidence for PCs (a) to (c). Performance evidence for PC (d) to (f).

National Unit Specification: support notes

UNIT Systems and Control (Higher)

This part of the unit specification is offered as guidance. The support notes are not mandatory.

While the time allocated to this unit is at the discretion of the centre, the notional design length is 40 hours.

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

Prior work in Applied Electronics (H) is assumed. Guidance for each outcome is listed below.

Outcome 1	Principles of operation of control systems. Open loop control; closed loop control: digital, analogue. Graphical representation: system diagrams, block diagrams, detailed control diagrams, flowcharts.
Outcome 2	Examples of closed loop analogue control systems, to include proportional, positional, push-pull. Application of op-amp configurations to control systems. Graphical representation of circuit elements such as voltage dividers, op-amps and output transducers. Evaluation of control systems.
Outcome 3	Introduction to microcontrollers including RAM, ROM, ALU, EEPROM, bus, clock. Advantages and applications of microcontrollers. Comparison with hard-wired alternatives. Binary and decimal systems of counting; conversion from one number system to the other. Creating input signals to a microcontroller from analogue and digital devices. Control routines: systems with up to 4 inputs and 4 outputs. Use of flowcharts as the basis of a structured, top-down approach to programming. Writing control programs in a high level language, such as PBASIC; inputs, outputs, loops and time delays. Setting up loops; looping through a sequence or program 'N' times and looping continuously. Controlling a motor by a microcontroller using pulse-width modulation: 'soft start'; speed; position. Stepper motor control; structure and operation of stepper motors; applications; data sheets on coil energising; control problems involving stepper motors – position and speed control; reversing a stepper motor.

National Unit Specification: support notes (cont)

UNIT Systems and Control (Higher)

Outcome 4	Signal conditioning. A-D conversion; the need for A-D conversion in microcontroller systems. Simple A-D and D-A calculations. Data logging; applications of data logging; microcontroller based data logging systems; manipulation and presentation of recorded data. Multiplexing.

Candidates are required to develop an understanding of closed loop analogue control systems and of the function and operation of microcontroller control and monitoring systems.

Candidates are also required to develop a program to control the operation of a mechatronic system.

Understanding of electronic systems developed in the Applied Electronics (Higher) unit should be reinforced through application within this unit.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Every opportunity should be taken to ensure that the learning and teaching contexts are of an industrial nature and are seen to be relevant by the candidate. Candidates are expected to develop control sequences to control mechatronic systems and to monitor and record data from systems. An example is the design of a temperature control and monitoring system used in an office block. This allows sensing circuits, signal conditioning and data logging to be used in an integrated assignment.

In presenting courses, teachers and lecturers should ensure that there is a balance between direct teaching and candidate-centred activities.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

National Assessment Bank materials have been created specifically to assess knowledge and understanding for each outcome. Assessments can take place either at the completion of an outcome or as an end of unit test. Centres must ensure that tests are conducted under appropriate conditions. Candidates should be allowed to use the Technological Studies data booklet. Candidates should be issued with clean copies of this booklet for use during tests.

Outcomes 2, 3 and 4 require candidates to carry out practical activities. It is the responsibility of the centre to ensure that evidence of candidate performance is recorded in an appropriate way. All evidence of performance must be retained by the centre. The assessment of this unit is subject to central moderation by the SQA.

Candidates generate evidence by means of their response to written tests, proficiency in practical activities and systems evaluation.

National Unit Specification: support notes (cont)

UNIT Systems and Control (Higher)

In order to gain success in the written test for an outcome, each candidate must achieve at least the cut-off score for that outcome. Success in each of the practical activities must be observed by the teacher or lecturer. The practical activities are based on construction or simulation of analogue closed loop systems, control of mechatronic device systems based on microcontrollers, and monitoring and recording of data based on microcontrollers. Evidence of performance must be recorded in an appropriate manner. Simulation and construction performance must be observed directly. Candidates' evaluation of a system can be in the form of either a written or oral report. Details should be recorded of the particular system(s) dealt with by each candidate.

SPECIAL NEEDS

This unit specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative outcomes for units. For information on these, please refer to the SQA document *Guidance on Special Assessment and Certification Arrangements for Candidates with Special Needs/Candidates whose First Language is not English* (SQA, 1998).

SCOTTISH QUALIFICATIONS AUTHORITY

National Unit Specification: general information

UNIT Structures and Materials (Higher)

NUMBER D190 12

COURSE Technological Studies (Higher)

SUMMARY

This unit is designed to enable candidates to apply the principles of static equilibrium to structural systems and calculate the effect of loading on individual members.

OUTCOMES

1 Apply the conditions of static equilibrium in solving problems on concurrent force and non-concurrent force systems.
2 Apply the conditions of static equilibrium in solving problems on simple framed structure systems.
3 Use and interpret data from a tensile test in studying properties of materials.
4 Produce a specification for a structural component.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates will normally be expected to have attained one of the following:

- Standard Grade Technological Studies at grade 1 or 2
- Technological Studies Intermediate 2 or equivalent NC units

CREDIT VALUE

0.5 credit at Higher.

Administrative Information

Superclass: RC

Publication date: December 1999

Source: Scottish Qualifications Authority

Version: 03

National Unit Specification: general information (cont)

UNIT Structures and Materials (Higher)

CORE SKILLS

This unit gives automatic certification of the following:

Complete core skills for the unit	None	
Core skills components for the unit	Using Graphical Information	H

Additional information about core skills is published in *Automatic Certification of Core Skills in National Qualifications* (SQA, 1999).

National Unit Specification: statement of standards

UNIT Structures and Materials (Higher)

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

OUTCOME 1

Apply the conditions of static equilibrium in solving problems on concurrent force and non-concurrent force systems.

Performance criteria

(a) The conditions of static equilibrium are applied correctly to co-planar force systems.
(b) Force systems are represented correctly using free-body diagrams.
(c) Forces are resolved correctly into horizontal and vertical components.
(d) The principle of moments is applied correctly.
(e) Analytical solutions to force system problems are correct.

Evidence requirements

Written and graphical evidence for PCs (a) to (e), including solutions to problems on concurrent and non-concurrent force systems.

OUTCOME 2

Apply the conditions of static equilibrium in solving problems on simple framed structure systems.

Performance criteria

(a) The conditions of static equilibrium are applied correctly to framed structures.
(b) Calculations to determine the magnitude and direction of support reactions are carried out correctly.
(c) The nodal analysis method of solving simple framed structure problems is applied correctly.
(d) The magnitude and nature of forces in frame members are evaluated correctly.

Evidence requirements

Written and graphical evidence for PCs (a) to (d).

National Unit Specification: statement of standards (cont)

UNIT Structures and Materials (Higher)

OUTCOME 3

Use and interpret data from a tensile test in studying properties of materials.

Performance criteria

(a) Using data from a tensile test, a load-extension graph is plotted correctly, to appropriate scales.
(b) The effects of progressive loading on a test piece are described clearly.
(c) Calculations to determine Young's Modulus, yield stress and ultimate stress for a test piece are carried out correctly.
(d) Characteristics of a stress/strain graph are stated clearly.
(e) The properties of a material are interpreted correctly from the test data.

Evidence requirements

Written and graphical evidence for PCs (a) to (e).

OUTCOME 4

Produce a specification for a structural component.

Performance criteria

(a) The design criteria for a component are interpreted correctly.
(b) Tabulated and graphical data are used correctly in selecting a material for a component.
(c) Calculations to determine a specification for a component are applied correctly.
(d) The effects of the operational environment on a structural component are stated clearly.

Evidence requirements

Written and graphical evidence for PCs (a) to (d).

National Unit Specification: support notes

UNIT Structures and Materials (Higher)

This part of the unit specification is offered as guidance. The support notes are not mandatory.

While the time allocated to this unit is at the discretion of the centre, the notional design length is 20 hours.

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

Guidance for each outcome is listed below.

Outcome 1

Coplanar force systems – conditions for static equilibrium.

Resolution of inclined forces into horizontal and vertical components.

Use of free body diagrams to represent force systems.

Analytical solutions to problems on force systems. (No graphical solutions in tests and examinations.)

Principle of moments; moments problems with inclined forces; hinge and roller reactions; simple beam problems, finding unknown forces and reactions; overall conditions for static equilibrium:
$\Sigma F_h = O$, $\Sigma F_v = O$, $\Sigma M = O$

Practical applications of statics.

Mass, weight and force; force of gravity on 1kg = 9.81N or g = 9.81m/s^2.

Outcome 2

Introduction to framed structures; nodal analysis only; members in compression/tension; redundant members; hinge and roller reactions; (analytical methods only in tests and examinations.)

Outcome 3

Common properties of materials – elasticity, ductility, plasticity, hardness, brittleness; common engineering materials – ferrous/non ferrous metals, thermoplastic and thermosetting plastics.

Elastic and plastic behaviour of materials; common applications in engineering design.

Behaviour of material under load; typical graphs for a tensile test.

Direct stress, direct strain and Young's Modulus; use of Young's Modulus and ultimate stress values from the data booklet.

Load/extension graphs and stress/strain graphs for mild steel, copper, aluminium and cast iron. Comparison of UTS, ductility and Young's Modulus.

Outcome 4

Factor of safety – based on safe working stress and ultimate stress (or loads) – reasons for factor of safety.

Although candidates may have been introduced to the concept of static equilibrium, the depth of treatment at this stage should be qualitative. The purpose of this unit at Higher level is to establish a clear understanding of the concept of equilibrium and its application in solving problems involving concurrent and non-concurrent force systems.

In framed structures and structural components, candidates should consider the effects of both external and internal forces acting on a body. Knowledge about tensile testing is required, as well as the use of related data. Calculations and the use of graphical and tabulated data are applied to establish a specification for a structural component.

Candidates should be able to understand and apply basic equilibrium conditions in the analysis of a force system and be able to use materials data and calculations in designing a structural component.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Every opportunity should be taken to ensure that the learning and teaching contexts are of an industrial nature and are seen as relevant by the candidate. An essential aspect of Structures and Materials is materials testing. Opportunities should be taken to relate content, where possible, to other units of the course. This can be achieved by incorporating structural loading, strain gauges, signal conditioning, data-logging and, perhaps, active control systems into an assignment.

In connection with the Case Study Report, teachers should take the opportunity to discuss and consider the impact of the advances in structures and materials on the economy, the environment and society. Candidates should be encouraged to consult periodicals, magazines, quality newspapers and audio-visual material to gain background knowledge in this area.

In presenting courses, teachers and lecturers should ensure that there is a balance between direct teaching and candidate-centred activities.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Each outcome of this unit must be assessed by a written test. This test should be closed book with the teacher in attendance to ensure examination conditions within the classroom. Candidates should be allowed to use the data booklet.

In order to gain success in the written test for an outcome, the candidate must achieve at least the cut-off score for that outcome. In addition, each candidate has to plot a graph from test data.

SPECIAL NEEDS

This unit specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative outcomes for units. For information on these, please refer to the SQA document *Guidance on Special Assessment and Certification Arrangements for Candidates with Special Needs/Candidates whose First Language is not English* (SQA, 1998).

SCOTTISH QUALIFICATIONS AUTHORITY

National Unit Specification: general information

UNIT Case Study Report

NUMBER D191 12

COURSE Technological Studies (Higher)

SUMMARY

This unit is designed to give the candidate the opportunity to analyse and evaluate an existing product or process, selected from an industrial or commercial context. The unit should provide a logical conclusion to the course and offer opportunity to review and consolidate knowledge and understanding gained earlier.

OUTCOMES

1 Analyse the development of an existing solution to a given problem.
2 Produce a report.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates will normally be expected to have completed the other units of Higher Technological Studies.

CREDIT VALUE

0.5 credit at Higher.

CORE SKILLS

There is no automatic certification of core skills or core skills components in this unit.

Information on the automatic certification of any core skills in this unit is published in *Automatic Certification of Core Skills in National Qualifications* (SQA, 1999).

Administrative Information

Superclass: XA

Publication date: November 1999

Source: Scottish Qualifications Authority

Version: 03

National Unit Specification: statement of standards

UNIT Case Study Report

OUTCOME 1

Analyse the development of an existing solution to a given problem.

Performance criteria

(a) Systems analysis is applied correctly to the problem.
(b) The integration of technology used in the solution is identified clearly.
(c) The textual and/or graphical description of sub-systems is appropriate.
(d) The solution to the problem is evaluated correctly.

Evidence requirements

Written and graphical evidence of the candidate's ability to analyse the solution to a technological problem and investigate the operation of each sub-system. The candidate will be expected to include an account of the problems encountered by the original team/engineer in developing a solution.

OUTCOME 2

Produce a report.

Performance criteria

(a) The sequence of the report is correct.
(b) A brief introduction to the report describes clearly the background to the case study.
(c) The product/process is clearly analysed and described.
(d) Social, environmental and economic effects are stated clearly.
(e) The conclusion to the report is stated clearly.

Evidence requirements

Word processed/written and graphical evidence of the candidate's ability to produce a report of approximately 2000 words in length.

National Unit Specification: support notes

UNIT Case Study Report

This part of the unit specification is offered as guidance. The support notes are not mandatory.

While the time allocated to this unit is at the discretion of the centre, the notional design length is 20 hours.

This unit will develop abilities to analyse a project set in an industrial or commercial context, and to produce a technological report.

GUIDANCE ON THE CONTENT AND THE CONTEXT FOR THIS UNIT

The Case Study Report should provide a logical conclusion to the course and offer the opportunity to consolidate (and possibly extend) knowledge and understanding gained in the other units.

It is envisaged that candidates will be provided with an existing solution to a stated problem set in an industrial or commercial context. The problem will require candidates to carry out research and investigation into how the solution was developed. A report will be produced by the candidate on an individual basis as evidence of the investigative work undertaken.

For this unit, the depth of treatment and range of content should reflect those of the other units in the course.

A typical case study would involve each candidate in interpreting a given specification, to analyse a problem in systems terms. Sub-systems could be electronic, programmable, mechanical or structural. The candidates would be expected to research ideas developed for solutions to each sub-system. Methods of testing and results achieved could be recorded in the Case Study Report. In addition to this, candidates would be expected to examine the social, economic and environmental effects. A critical evaluation should be produced on the effectiveness of the solution in meeting the needs of the problem.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

The instrument of assessment for this unit is the candidate's Case Study Report containing evidence of the work undertaken.

The teacher/lecturer would be expected to keep a record of investigation/research undertaken by the candidate as the report develops. Each performance criterion is assessed on an achieved/not achieved basis.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

This unit will require candidates to carry out research and investigation into a given case study, set in an industrial or commercial context. This could be introduced with the use of CD-ROM, Internet, videos or direct industrial contact. The problem identified will require candidates to carry out research and investigation into the development of the solution. An individual report must be produced by each candidate. The report should be approximately 2000 words in length.

National Unit Specification: support notes (cont)

UNIT Case Study Report

SPECIAL NEEDS

This unit specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative outcomes for units. For information on these, please refer to the SQA document *Guidance on Special Assessment and Certification Arrangements for Candidates with Special Needs/Candidates whose First Language is not English* (SQA, 1998).