TECHNOLOGICAL STUDIES
Advanced Higher

Third edition – published August 2011

NOTES OF CHANGES TO ADVANCED HIGHER ARRANGEMENTS THIRD EDITION AUGUST 2011

COURSE TITLE: Technological Studies (Advanced Higher)

COURSE NUMBER: C036 13

National Course Specification Change in mark allocation for External Assessment

National Unit Specification No change

National Course Specification

TECHNOLOGICAL STUDIES (ADVANCED HIGHER)

COURSE NUMBER C036 13

COURSE STRUCTURE

This course has four mandatory units as follows:

D186 13	***Applied Electronics (Advanced Higher)***	***1 credit (40 hours)***
D187 13	***Systems and Control (Advanced Higher) Structures and***	***1 credit (40 hours)***
D190 13	***Materials (Advanced Higher) Technological***	***0.5 credit (20 hours)***
D192 13	***Studies:Project Enquiry (Advanced 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 is approached in the following order but a unit need not necessarily be completed before commencing the next unit:

Applied Electronics (Advanced Higher)
Systems and Control (Advanced Higher)
Structures and Materials (Advanced Higher)
Technological Studies: Project Enquiry (Advanced 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.

Administrative Information

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National Course Specification: general information (cont)

COURSE Technological Studies (Advanced Higher)

RECOMMENDED ENTRY

Whilst entry is at the discretion of the centre, candidates will normally be expected to have attained Higher Technological Studies.

Centres may wish to consider, at their own discretion, qualifications in other related subjects such as Physics at Higher, or equivalent clusters of NC units at Higher.

It is recommended that candidates should have achieved a C pass in Higher Mathematics or have demonstrated competency in equivalent NC units.

CORE SKILLS

Core Skills for Advanced Higher remain subject to confirmation and details will be available at a later date.

National Course Specification: course details

COURSE Technological Studies (Advanced Higher)

RATIONALE

Advanced Higher Technological Studies could form part of a two-year course incorporating Higher Technological Studies and hence the rationale for the Higher also applies here.

The purpose of Advanced Higher is to allow candidates to expand on the knowledge, understanding and skills gained at Higher level. The course culminates in a Project Enquiry, which affords candidates the opportunity to demonstrate their learning, abilities and interests by investigating the application of technology within an industrial context. This activity has been designed to facilitate consolidation of the course and to better prepare candidates to undertake study in higher or further education or to directly enter careers within the field of technology.

The course aims to:

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

COURSE CONTENT

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

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

With the exception of the Project Enquiry, the external assessment will examine material across the remaining units of the course. 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 (Advanced Higher)

The purpose of this unit is to further develop the understanding of analogue and digital electronics covered at Higher level. Candidates will be required to study applications of electronics. Additional study of analogue electronics will allow candidates to develop a more detailed understanding of a range of processing sub systems and to apply them.

Outcomes

1 Design and construct sequential logic systems to meet given specifications.
2 Design and construct sequential logic control systems to perform specified functions.
3 Design and construct complex analogue electronic systems, based on operational amplifiers, to meet given specifications
4 Investigate Analogue-to-Digital and Digital-to-Analogue converters.

Content

Review aspects of Applied Electronics (Higher).
Sequential logic devices: S–R bistable, D-type and J-K type bistables.
Sequential logic systems: registers, counters, frequency dividers, seven segment displays.
Timing diagram calculations: mark, $T_1 = 0.7(R_1+R_2)C_1$; space, $T_2 = 0.7R_2C$

$$\text{frequency} = \frac{1.44}{(R_1 + 2R_2)C}$$

Elements of a sequential control system: clock, binary counter, decimal decoder, logic array, output driver.
Operational amplifiers: basic integrator used as a ramp generator.
Positive feedback and the Schmitt trigger.
Simple op-amp oscillators and applications (square-wave, saw tooth and sine-wave).
Mark-to-space ratio.
Digital-to-analogue converters (dedicated IC configurations and applications).
Analogue-to-digital converters (dedicated IC configurations and applications).

National Course Specification: course details (cont)

COURSE Technological Studies (Advanced Higher)

Systems and Control (Advanced Higher)

Outcomes

1 Evaluate the operation of microcontrollers.
2 Develop a control sequence and use it to control a mechatronic system, by means of a microcontroller.
3 Develop a control sequence and use it to provide proportional control of a system.

Content

Review aspects of Systems and Control (Higher).
Typical system diagram for microcontroller.
Analogue and digital input and output signals.
Microcontroller types and configurations.

Microcontroller architecture and operation.
Hexadecimal counting system: denary – binary – hexadecimal conversions.
Use of flow charts as the basis of a structured, top-down approach to writing a low level control program.
Writing control programs in a low-level assembly code.
Input transducers: light, temperature, position, moisture.
Output transducers: d.c. motor, stepper motor, solenoid.
Signal-conditioning sub systems: operational amplifier, voltage divider.

Use of flow charts as the basis of a structured, top-down approach to writing a proportional control program.
Writing proportional control programs in a low-level assembly code.
Proportional control of a d.c. motor.

National Course Specification: course details (cont)

COURSE Technological Studies (Advanced Higher)

Structures and Materials (Advanced Higher)

Outcomes

1 Apply the general bending equation in solving problems on idealised beams.
2 Evaluate the distribution of shear force and bending moment in loaded beams.
3 Apply the method of sections in solving problems on complex framed structure systems.

Content

Review aspects of Structures and Materials (H).

Calculations: use of the general bending equation ($\frac{M}{I} \quad \frac{\sigma}{y} \quad \frac{E}{r}$),
second moment of area (for common and simple non-standard sections), deflection, bending stress.
Factors affecting beam design: span, bending moment, Young's modulus, depth of beam.

Load systems to include any number of point loads and uniformly distributed loads.
Beam types: cantilevers, simply supported and fixed beams.
Shear force and bending moment diagrams: including UDLs, point loads and combinations of these.
Loading effects: compression and tension in bending.
Stress distribution diagram: position of maximum stress on the surface of the beam.
Design features: thin-wall webs, flanges, weight reduction along the neutral axis.
Calculations: bending moment, maximum deflection.

Conditions of static equilibrium: forces in the vertical plane; forces in the horizontal plane; moment equilibrium.
Frame structure: complex frameworks.
Support reactions: roller, hinge.
Use of method of sections to determine the magnitude and nature of force in up to three members of a complex framed structural system.

Technological Studies: Project Enquiry (Advanced Higher)

Outcome

1 Evaluate two technological solutions to a problem.

Content

This will be dependent on the nature of the Project Enquiry undertaken by the candidate. The depth of treatment should be similar to that described in the other units of the Advanced Higher Technological Studies course.

National Course Specification: course details (cont)

COURSE Technological Studies (Advanced Higher)

ASSESSMENT

To gain the award of the course, the candidate must pass all of 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*, (HSDU, 1996) and in *Managing Assessment* (HSDU, 1998).

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 (120 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 from this section.

Section B (80 marks)
Three extended-answer questions will be set. Candidates should attempt **two** questions from this section.

These questions will test knowledge, understanding and the extended skills associated with a candidate's 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 instruction set for a low-level assembly code, formulae and tabulated data.

National Course Specification: course details (cont)

COURSE Technological Studies (Advanced 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 the component units to solve more complex problems of a theoretical nature
apply advanced knowledge and understanding to solve complex and sometimes unstructured problems presented in a variety of contexts

APPROACHES TO LEARNING AND TEACHING

Approaches to teaching and learning should reflect the ethos and advanced nature of the course and facilitate appropriate problem solving, technological application and independent learning opportunities. There should be a suitable balance in the teaching approaches used to deliver the units of the course, for example, between teacher led, candidate centred and practical activities. Opportunities to integrate material should be taken wherever relevant.

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 (Advanced 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.

It is recommended that teachers/lecturers review some aspects of the Applied Electronics (Higher) unit.

Candidates are expected to investigate various bistable devices and use these bistables to create counting and shifting registers. Construction and testing of circuits is essential to provide reinforcement of the principles of operation. Candidates are also required to further develop their understanding of analogue circuits and their applications.

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

The purpose of this unit is to augment the understanding of control concepts and control systems attained at Higher.

It is recommended that teachers/lecturers review some aspects of the Systems and Control (Higher) unit.

The outcomes have been structured to address a body of knowledge that will enable candidates to further analyse control systems and develop control sequences. Candidates will apply this knowledge by using a low-level assembly code to write control sequences which control mechatronic devices, and to provide proportional control.

Outcomes 2 and 3 could be overtaken in the context of assignments which bring industrial/domestic perspectives to the applications of proportional control.

Candidates are expected to have a prior understanding of computers and programming in a high-level language and would benefit from undertaking a series of problem solving activities.

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

It is recommended that teachers/lecturers review all aspects of the Structures and Materials (Higher) unit.

Problems will be set in a structural/civil-engineering context. Where loading is applied to structures, it should, where possible, reflect engineering practice.

Candidates will develop an understanding of traverse loads acting on structural members and the resulting deformation which is termed ‘bending’. The method of sections used to determine the magnitude and nature of forces in structural members is a progression from the nodal analysis used at Higher level. Candidates should be posed a variety of problems set in a structural/civil-engineering context.

Approaches to learning and teaching for the Project Enquiry (Advanced Higher)

The purpose of this unit is to provide candidates with the opportunity to evaluate two technological solutions to a problem.

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

A typical Project Enquiry could involve a candidate in researching into two technological solutions to a problem set in an industrial or commercial context. Candidates should give due emphasis to the social, environmental and economic effects of the solutions. An evaluation of the selected solutions is required, from a technological perspective.

The project should be negotiated with the teacher/lecturer to ensure suitability. It will be the responsibility of the candidate to plan out the project. The role of the teacher/lecturer will be to supervise the research work undertaken and to ensure that the candidate has every opportunity to develop the Project Enquiry.

It is envisaged that the major source of information for the Project Enquiry will be through Internet access, though other sources may include: CD-ROM, technical or trade journals and periodicals, audio-visual material, library access, company literature or 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 document contains the standards against which candidates are assessed.

National Unit Specification: general information

UNIT Applied Electronics (Advanced Higher)

NUMBER D186 13

COURSE Technological Studies (Advanced Higher)

SUMMARY

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

OUTCOMES

1 Design and construct sequential logic systems to meet given specifications.
2 Design and construct sequential logic control systems to perform specified functions.
3 Design and construct complex analogue electronic systems, based on operational amplifiers, to meet given specifications
4 Investigate Analogue-to-Digital and Digital-to-Analogue converters.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates will normally be expected to have attained Higher Technological Studies at grade A, B or C or to have completed equivalent units.

CREDIT VALUE

1 credit at Advanced Higher.

CORE SKILLS

Core Skills for Advanced Higher remain subject to confirmation and details will be available at a later date.

Administrative Information

Superclass: XL

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National Unit Specification: statement of standards

UNIT Applied Electronics (Advanced 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 sequential logic systems to meet given specifications.

Performance criteria

(a) The operation of common sequential logic devices is explained clearly.
(b) The configuration of sequential logic devices used to perform given sequential logic functions is described correctly.
(c) Timing diagrams to verify the operation of sequential logic systems are represented correctly.
(d) A sequential logic system is evaluated correctly to meet a given specification, using computer simulation.
(e) A sequential logic system is constructed to meet a given specification.

Evidence requirements

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

OUTCOME 2

Design and construct sequential logic control systems to perform specified functions.

Performance criteria

(a) The function of the main elements of a sequential logic control system is explained clearly.
(b) The analysis of logic arrays is carried out effectively.
(c) A sequential control system is evaluated correctly to meet a given specification, using computer simulation.
(d) A sequential control system is constructed to meet a given specification.

Evidence requirements

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

National Unit Specification: statement of standards (cont)

UNIT Applied Electronics (Advanced Higher)

OUTCOME 3

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

Performance criteria

(a) The operation of analogue electronic systems is described correctly.
(b) Calculations relating to analogue electronic systems are carried out correctly.
(c) The operation of analogue electronic systems is evaluated correctly to meet given specifications, using computer simulation.
(d) An analogue electronic system is constructed to meet a given specification.

Evidence requirements

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

OUTCOME 4

Investigate Analogue-to-Digital and Digital-to-Analogue converters.

Performance criteria

(a) Simple A-D calculations based on a set reference voltage are carried out correctly.
(b) Simple D-A calculations based on a set reference voltage are carried out correctly.
(c) The function of series and parallel ADCs is explained correctly.

Evidence requirements

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

National Unit Specification: support notes

UNIT Applied Electronics (Advanced 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 listed below.

Outcome 1

Sequential logic devices: S–R bistable, D-type and J–K type bistables.
Sequential logic systems: registers, counters, frequency dividers, seven-segment displays.
Timing diagrams: calculations, mark $T_1 = 0.7(R_1 + R_2)C$; space, $T_2 = 0.7R_2C$.

$$\text{frequency} = \frac{1.44}{(R_1 + 2R_2)C}$$

Outcome 2

Elements of a sequential control system: clock, binary counter, decimal decoder, logic array, output driver.

Outcome 3

Operational amplifiers: basic integrator used as a ramp generator.
Positive feedback and the Schmitt trigger.
Simple op-amp oscillators and applications (square-wave, saw tooth and sine-wave).
Mark-to-space ratio.

Outcome 4

Digital-to-analogue converters (dedicated IC configurations and applications).
Analogue-to-digital converters (dedicated IC configurations and applications).

Candidates are required to develop an understanding of the function and operation of sequential logic systems and complex analogue systems and to carry out calculations to verify the operation of sequential logic systems. The main areas of study are S-R bistable, D-type bistable, J-K bistable, register, counter, integrator, Schmitt trigger, oscillator, and A-D and D-A converters. In addition, candidates are required to develop practical capabilities in simulating and constructing electronic systems.

National Unit Specification: support notes (cont)

UNIT Applied Electronics (Advanced Higher)

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Where appropriate, opportunities 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 design and construct systems to meet given specifications. Such systems should be based on sequential logic systems, sequential logic control systems, complex analogue electronic control systems, and A-D and D-A converters.

This unit deals with concepts that 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 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 Advanced Higher data booklet. Candidates should be issued with clean copies of this booklet for use during tests.

Outcomes 1, 2 and 3 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 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 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. The candidate's evaluation of a system can be in the form of an oral or written 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).*

National Unit Specification: general information

UNIT Systems and Control (Advanced Higher)

NUMBER D187 13

COURSE Technological Studies (Advanced Higher)

SUMMARY

This unit is designed to enable candidates to develop the level of understanding of principles of control of mechatronic systems introduced at Intermediate 2 and Higher.

OUTCOMES

1 Evaluate the operation of microcontrollers.
2 Develop a control sequence and use it to control a mechatronic system, by means of a microcontroller.
3 Develop a control sequence and use it to provide proportional control of a system.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates will normally be expected to have attained Higher Technological Studies at grade A, B or C or to have completed equivalent units.

CREDIT VALUE

1 credit at Advanced Higher.

CORE SKILLS

Core Skills for Advanced Higher remain subject to confirmation and details will be available at a later date.

Administrative Information

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National Unit Specification: statement of standards

UNIT Systems and Control (Advanced 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

Evaluate the operation of microcontrollers.

Performance Criteria

(a) The system diagram of a microcontroller is produced correctly.
(b) The operation of the control process is explained correctly.
(c) The type and configuration of a microcontroller are selected appropriately to meet a given specification.

Evidence requirements

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

OUTCOME 2

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 hardware and software used when developing microcontroller programs in low level assembler code are described correctly.
(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 low level assembler code.
(e) A control sequence, written in low-level assembler code, is used successfully to control a mechatronic system.

Evidence requirements

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

National Unit Specification: statement of standards (cont)

UNIT Systems and Control (Advanced Higher)

OUTCOME 3

Develop a control sequence and use it to provide proportional control of a system.

Performance Criteria

(a) A specification for the proportional control of a system is represented correctly by a flowchart.
(b) A proportional control sequence is developed successfully in low level assembler code, to meet a given specification.
(c) The function of proportional, integral and derivative (PID) control is explained clearly.
(d) A proportional control sequence, written in low-level assembler code, is used successfully to control a mechatronic system.

Evidence requirements

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

National Unit Specification: support notes

UNIT Systems and Control (Advanced 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

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

Outcome 1

Typical system diagram for microcontroller.
Analogue and digital input and output signals.
Microcontroller types and configurations.

Outcome 2

Microcontroller architecture and operation.
Hexadecimal counting system: denary – binary – hexadecimal conversions.
Use of flow charts as the basis of a structured, top-down approach to writing a low-level control program.
Writing control programs in a low-level assembly code.
Input transducers: light, temperature, position, moisture.
Output transducers: d.c. motor, stepper motor, solenoid.
Signal-conditioning sub systems: operational amplifier, voltage divider.

Outcome 3

Use of flow charts as the basis of a structured, top-down approach to writing a proportional control program.
Writing proportional control programs in a low-level assembly code.
Proportional control of a d.c. motor.

Candidates are required to develop an understanding of microcontroller architecture and configurations.

Candidates are also required to develop programs in a low-level assembly code to provide control of a mechatronic system, and also to provide proportional control.

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

National Unit Specification: support notes (cont)

UNIT Systems and Control (Advanced Higher)

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 in low-level assembly code to control mechatronic systems.

Candidates will be expected to have prior understanding of computer programming in a high-level language.

In presenting this unit, teachers and lecturers should ensure that there is a balance between 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 on 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 Advanced Higher data booklet. Candidates should be issued with clean copies of this booklet for use during tests.

Outcomes 2 and 3 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 moderation by the SQA.

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

In order to gain success in the written test for an outcome, each candidate must achieve 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. The candidate's evaluation of a system can be in the form of an oral or written 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).*

National Unit Specification: general information

UNIT Structures and Materials (Advanced Higher)

NUMBER D190 13

COURSE Technological Studies (Advanced Higher)

SUMMARY

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

OUTCOMES

1 Apply the general bending equation in solving problems on idealised beams.
2 Evaluate the distribution of shear force and bending moment in loaded beams.
3 Apply the method of sections in solving problems on complex framed structure systems.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates will normally be expected to have attained Higher Technological Studies at grade A, B or C or to have completed equivalent units.

CREDIT VALUE

0.5 credit at Advanced Higher.

CORE SKILLS

Core Skills for Advanced Higher remain subject to confirmation and details will be available at a later date.

Administrative Information

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National Unit Specification: statement of standards

UNIT Structures and Materials (Advanced 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 general bending equation in solving problems on idealised beams.

Performance criteria

(a) Tabulated and graphical data are used appropriately in selecting materials and common/standard sections, to meet a specification for a simple beam design.
(b) Calculations to determine the specification for a loaded beam are carried out correctly, using the general bending equation.
(c) Calculations to determine the deflection of a loaded beam are carried out correctly.

Evidence requirements

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

OUTCOME 2

Evaluate the distribution of shear force and bending moment in loaded beams.

Performance criteria

(a) Force systems are represented correctly using free body diagrams.
(b) Calculations to determine the magnitude of support reactions are carried out correctly.
(c) Shear force and bending moment diagrams are produced correctly.
(d) Maximum shear force and bending moment in a loaded beam 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 (Advanced Higher)

Outcome 3

Apply the method of sections in solving problems on complex framed structure systems.

Performance criteria

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

Evidence requirements

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

National Unit Specification: support notes

UNIT Structures and Materials (Advanced Higher)

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

Whilst the time allocated to this unit is at the discretion of the centre, the notional design length is 20 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 listed below.

Outcome 1

Calculations: use of the general bending equation ($\frac{M}{I} \quad \frac{\sigma}{y} \quad \frac{E}{r}$), second moment of area (for common and simple non-standard sections), deflection, bending stress.
Factors affecting beam design: span, bending moment, Young's modulus, depth of beam.

Outcome 2

Load systems to include any number of point loads and uniformly distributed loads.
Beam types: cantilevers, simply supported and fixed beams.
Shear force and bending moment diagrams: including UDLs, point loads and combinations of these.
Loading effects: compression and tension in bending.
Stress distribution diagram: position of maximum stress on the surface of the beam.
Design features: thin-wall webs, flanges, weight reduction along the neutral axis.
Calculations: bending moment, maximum deflection.

Outcome 3

Conditions of static equilibrium: forces in the vertical plane, forces in the horizontal plane, moment equilibrium.
Frame structure: complex frameworks.
Support reactions: roller, hinge.
Use of method of sections to determine the magnitude and nature of force in up to three members of a complex framed structural system.

The use of appropriate units and appropriate sign conventions is required throughout this unit.

National Unit Specification: support notes (cont)

UNIT Structures and Materials (Advanced Higher)

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Every opportunity should be taken to ensure that the teaching and learning contexts are of an industrial nature and are seen as relevant by the candidate. Opportunities should be taken where possible to relate content to other units of the course.

In presenting this unit, 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 on 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 Advanced Higher data booklet. Candidates should be issued with clean copies of this booklet for use during tests.

Candidates generate evidence by means of their response to written tests.

In order to gain success in the written test for an outcome, each candidate must achieve the cut-off score for that outcome. The assessment of this unit is subject to moderation by SQA.

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).*

National Unit Specification: general information

UNIT Technological Studies: Project Enquiry (Advanced Higher)

NUMBER D192 13

COURSE Technological Studies (Advanced Higher)

SUMMARY

This unit is designed to provide candidates with the opportunity to analyse and evaluate two valid technological solutions to a problem and should be set in an industrial or commercial context. A detailed report, comparing and contrasting the selected solutions should be produced. The unit also provides a natural conclusion to the course and offers an opportunity to review and consolidate the knowledge and understanding gained from other units of the course.

OUTCOME

1 Evaluate two technological solutions to a problem.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates will normally be expected to have attained Higher Technological Studies at grade A, B or C or to have completed equivalent units.

CREDIT VALUE

0.5 credit at Advanced Higher.

CORE SKILLS

Core Skills for Advanced Higher remain subject to confirmation and details will be available at a later date.

Administrative Information

Superclass: XA

Publication date: April 2000

Source: Scottish Qualifications Authority

Version: 02

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Additional copies of this unit specification can be purchased from the Scottish Qualifications Authority. The cost for each unit specification is £2.50 (minimum order £5).

National Unit Specification: statement of standards

UNIT Technological Studies: Project Enquiry (Advanced 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

Evaluate two technological solutions to a problem.

Performance criteria

(a) A problem situation is identified and described clearly.
(b) Two valid technological solutions to the problem are selected.
(c) A range of information sources is used appropriately to investigate the selected solutions.
(d) With reference to the information gathered, each solution is described and analysed clearly from a technological perspective.
(e) The results of the analysis for each solution are compared and contrasted appropriately.

Evidence requirements

Written and graphical evidence of the candidate's ability to evaluate two technological solutions to a problem in a detailed report of approximately 2,000 - 2,500 words.

National Unit Specification: support notes

UNIT Technological Studies: Project Enquiry (Advanced Higher)

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

Whilst 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 evaluate two technological solutions for a problem set in an industrial or commercial context, and allows the production of a detailed technological report.

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

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

It is envisaged that each candidate will identify two valid technological solutions to a problem set in an industrial or commercial context. The enquiry requires the candidate to carry out research and investigation into the selected solutions. A detailed report will be produced by the candidate as evidence of the evaluative 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 Project Enquiry would involve the candidate in identifying and describing a problem situation, in selecting two valid technological solutions, and in accessing a range of information sources to investigate these solutions. From the information gathered, each solution will be analysed and the results will be compared and contrasted.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

This unit will require each candidate to select two valid technological solutions to a problem set in an industrial or commercial context, and to carry out research and investigation into these solutions. It is envisaged that candidates will use various resources, including Internet, CD-ROM, technical or trade journals and periodicals, videos, or direct industrial contact. Candidates will compare and contrast the selected solutions with reference to the gathered information, and will each produce a written report of approximately 2000-2500 words.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

The instrument of assessment for this unit is the candidate's Project Enquiry report containing evidence of the work undertaken. Candidates generate evidence by means of their written record of work undertaken for each performance criterion. Each performance criterion is assessed on an achieved/not achieved basis. In order to gain success for the outcome, the candidate must achieve the cut-off score for the outcome.
The Project Enquiry report should be retained for evidence purposes. The assessment of this unit is subject to moderation by SQA.

National Unit Specification: support notes (cont)

UNIT Technological Studies: Project Enquiry (Advanced Higher)

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).*