Version 1.0

GCE 2004
June Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Design and Technology: Systems and Control Technology
(Subject Code 5556 Unit 1)

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

The answers given in the following mark schemes are neither exhaustive nor exclusive. Candidates whose answers do not appear directly on the mark scheme, but who have demonstrated knowledge, understanding, or skills relevant to the question will receive appropriate credit for their answers.

Further copies of this Mark Scheme are available from:

Publications Department, Aldon House, 39, Heald Grove, Rusholme, Manchester, M14 4NA
Tel: 0161 953 1170

or

download from the AQA website: www.aqa.org.uk

Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee, registered in England and Wales 3644723 and a registered charity number 1073334. Registered address AQA, Devas Street, Manchester, M15 6EX. Dr Michael Cresswell Director General

ASSESSMENT AND QUALIFICATIONS ALLIANCE

GENERAL CERTIFICATE OF EDUCATION

Design and Technology: Systems and Control Technology: Unit 1

Summer Examination 2004

Quality of Written Communication

The following marks are allocated to the quality of the candidate's written communication. Make a separate assessment of the candidate's overall ability as demonstrated across the paper using the criteria given below.

Performance Criteria	Marks
The candidate will express complex ideas extremely clearly and fluently. Sentences and paragraphs will follow on from one another smoothly and logically. Arguments will be consistently relevant and well structured. There will be few, if any, errors of grammar, punctuation and spelling.	4
The candidate will express moderately complex ideas clearly and reasonably fluently, through well-lined sentences and paragraphs. Arguments will be generally relevant and well structured. There may be occasional errors of grammar, punctuation and spelling.	3
The candidate will express straightforward ideas clearly, if not always fluently. Sentences and paragraphs may not always be well connected. Arguments may sometimes stray from the point or be weakly presented. There may be some errors of grammar, punctuation and spelling, but not such as to suggest a weakness in these areas.	2
The candidate will express simple ideas clearly, but may be imprecise and awkward in dealing with complex or subtle concepts. Arguments may be of doubtful relevance or obscurely presented. Errors in grammar, punctuation and spelling may be noticeable and intrusive, suggesting weaknesses in these areas.	1

NB This mark scheme is intended as a guide to the type of answer expected but is not intended to be exhaustive or prescriptive. If candidates offer other answers which are equally valid **they must be given full credit.**

Many responses at this level are assessed according to the **quality** of the work rather than the number of points included. The following level descriptors are intended to be a guide when assessing the quality of a candidate's response.

The candidate has a basic but possibly confused grasp of the issues.
Few correct examples are given to illustrate points made. Description may be unclear.

(low mark range)

The candidate has some knowledge but there will be less clarity of understanding.
Some correct examples given to illustrate points made. Description better but unclear or confused in parts.

(mid mark range)

The candidate has a thorough understanding of the issues and has provided relevant examples to support the knowledge shown. This candidate's answer shows clear evidence of understanding.

(high mark range)

Question 1

(a) Any suitable electro-mechanical interface to produce a pulse every complete revolution of the shaft. (3 marks)

E.g. Micro switch and actuator, Reed switch and Magnet, Slotted opto-switch. Quality of sketch. (1 mark)

Circuit diagram of an input switching circuit that will give a negative-going pulse. (3 marks)

Quality of diagram. (1 mark)

(b) Any suitable systems or circuit diagram of a three digit counter.

Full marks can only be gained by inclusion of the following details:
Representation of three suitable seven-segment decoder/driver ICs. (2 marks)
Inclusion of suitable de-bounced input to the CLOCK input. (2 marks)
Correct wiring of CARRY OUT's to CLOCK's of cascaded ICs. (2 marks)
Suitable wiring of RESET's on ICs. (2 marks)
Seven-segment decoded outputs connected to display. (2 marks)
Suitable power supply connections to displays and IC. (1 mark)
Quality of diagram. (1 mark)

(c) Rotary Velocity of Driver Pulley x Diameter of Driver Pulley = Rotary Velocity of Driven Pulley x Diameter of Driven Pulley.
2000 x 30 – R.V. Driven Pulley x 100. (2 marks)
R.V. Driven Pulley = (2000 x 30) / 100. (1 mark)
R.V. Driven Pulley = 60000 / 100. (1 mark)
R.V. Driven Pulley = 600 rpm. (2 marks)

(d) Annotated sketch of any suitable method.
E.g. Stepped Cone Pulleys, Gearbox, etc. (3 marks)
Quality of Sketch. (1 mark)
Reference to method of slackening belt or changing the gears. (2 marks)
Reference to safety issues. E.g. Guarding moving parts, stopping motor before changing speed etc. (2 marks)

(e) Annotated sketch of any suitable bearing. (3 marks)
Quality of sketch. (1 mark)

(f) Any valid material. E.g. Nylon, PTFE, Hardened steel etc. (2 marks)

Total 40 marks

Question 2

(a) (i) Any valid definition (2 marks)

(ii) Any valid definition (2 marks)

(b) (i) Any six valid responses briefly made, or three points made in greater depth (6 marks)

E.g.
Natural timber has a grain requiring care in the design and manufacture of items.
Natural timber typically costs more than manufactured boards.
Manufactured boards are available in large sheets.
Manufactured boards are stable in use.
Manufactured boards are suitable for CNC routing and cutting.
Manufactured boards can have decorative laminates applied.

(ii) Any suitable material (1 mark)

(iii) Any suitable material (1 mark)

(c) (i) Any six valid responses briefly made, or three points made in greater depth. (6 marks)

E.g.
Plastic components are lighter than metal.
Plastic components do not need protection from corrosion.
Plastic components can be produced in colours that match the car body.
Plastic components can be formed into more complex shapes than metal.
Plastic components do not have the strength of metal.
Plastic components have greater elastic properties than metal components.

(ii) Any suitable material. (1 mark)

(iii) Any suitable material. (1 mark)

(d) Any four valid comments, briefly made or two comments discussed in greater depth for each of the two chosen smart materials. (2 x 4 marks)

Total 28 marks

Question 3

(a) (i) Any three valid points, with explanation together with the description of a suitable use for each of the two methods. (2 x 8 marks)

E.g.
Electrical: Motors, Servos, Solenoids, Relays, Electromagnets, etc.

Application: Door locks, Ventilator controls, etc.

Mechanical: Cam & Follower, Crank & Slider, Rack & Pinion etc.

Application: Motor vehicle engines, Sewing machines etc.

(ii) Any suitable method of generating a reciprocating stroke length of 40mm with a mechanical system. (6 marks)

E.g. Crank and Slider or Cam and Follower.
Full marks can only be gained for highlighting:
Con-rod pivot point at 20mm from centre of rotation to crank (crank & slider).
Difference between TDC and BDC equals 40mm (cam & follower).

Quality of sketch(s). (2 marks)

(b) Any suitable methods of converting reciprocating to oscillating motion. (3 marks)

Clarity of sketch. 1 mark)

Total 28 marks

Question 4

(a) Any suitable systems diagram of an alarm circuit.

Full marks can only be gained by outlining:

A suitable input for motion sensing.	(2 marks)
A suitable latch or bistable.	(2 marks)
A suitable alarm output with transducer driver.	(2 marks)
A suitable method of reset.	(2 marks)
Quality of diagram.	(2 marks)

(b) Suitable annotated sketch(s) and explanation of chosen process including identification of a suitable plastic.

E.g. Injection moulding:

Hopper storing plastic granules.	(1 mark)
Granule transport mechanism.	(1 mark)
Granule heating area.	(1 mark)
Transport mechanism acting as ram when sufficient plastic heated.	(1 mark)
Two part mould with cavity for plastic.	(1 mark)
Plastic forced into mould through gate.	(1 mark)
Mould splits to release component once plastic cooled.	(1 mark)
Clarity of sketch(s)	(2 marks)
Identification of suitable plastic	(1 mark)

E.g. Vacuum forming:

Mould to have draw angle on all sides.	(1 mark)
Mould placed on platen/platen lowered.	(1 mark)
Plastic sheet clamped in place ensuring airtight seal.	(1 mark)
Plastic sheet heated until it becomes flexible.	(1 mark)
Heater removed/platen raised.	(1 mark)
Air removed from under plastic sheet allowing shape to form.	(1 mark)
Mould removed from forming once plastic cools	(1 mark)
Clarity of sketch(s)	(2 marks)
Identification of suitable plastic	(1 mark)

(c) Any four valid considerations with explanation. (4 x 2 marks)

E.g.
Mass Production:
The design, tooling and setting-up costs can be spread over many items.
The selling price can be less than batch or one-off production.
Low selling price of mass produced items will lead to increased sales.
If production rates match sales rates there will be no storage costs. Etc.

Batch Production:
Production can be tailored to demand.
Assembly lines can be used to produce a range of different products.
Changeover costs will be incurred as assembly lines have to be re-tooled.
Storage costs will be incurred as batches of products are used or sold.
Etc.

Total 28 marks