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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Design and Technology: Systems and Control Technology *Specification*

SCT1

Mark Scheme

2006 examination – June series

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.

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.

Low mark range
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.

Mid 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.

High 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.

SCT1

Question 1

(a) Any suitable circuit diagram of a transistor or/relay transistor transducer driver including:

Transistor	*1 mark*	
Base protection resistor	*1 mark*	
Solenoid	*1 mark*	
Protection diode	*1 mark*	
If candidates indicated the use of a low-power solenoid, not requiring a transistor to switch it	*3 marks*	**max 4 marks**

(b) Time = 6.2s

Correct answer	*3 marks*	
Correct unit	*1 mark*	**4 marks**

(c)

(i)	Correct sketch of an 8 pin DIL IC Package	*2 marks*	
(ii)	Method of identifying pin 1	*1 mark*	
(iii)	Correct pin numbering	*1 mark*	**4 marks**

(d) Any suitable PCB layout highlighting the location of the following:

555 Timer including identification of pin 1	*1 mark*	
R1	*1 mark*	
C1	*1 mark*	
Pull-up resistor	*1 mark*	
Push switch	*1 mark*	
R3	*1 mark*	
LED	*1 mark*	
Power supply connections	*1 mark*	
Quality of sketch	*2 mark*	**max 8 marks**

(e)

(i) Any five valid points relating to the physical and working properties of the material. e.g. light weight, good visual appearance, good corrosion resistance, can be easily cast, easy to machine, etc. *5 marks*

(ii) Any five valid points relating to the physical and working properties of the material. e.g. very tough material, can be made into large sheets, heatproof, acid/alkali resistant, non-conductor, etc. *5 marks*

(iii) Any five valid points relating to the physical and working properties of the material. e.g. cheaper than solid timber, available in large sheets, stable in use, easily machined, take fixings well, plastic coating makes it wipe clean, moisture proof, etc. *5 marks*

(iv) Any five valid points relating to the physical and working properties of the material. e.g. tough and durable material, self-coloured, waterproof, heat-resistant to hot water, good visual appeal, can be vacuum formed, etc. *5 marks* **20 marks**

40 marks

Question 2

(a) (i) Any valid description of an open loop control system highlighting the lack of a feedback loop *2 marks*

Example of an open loop control system
e.g. non-inverting amplifier *1 mark*

(ii) Any valid description of a closed loop control system highlighting the inclusion of a feedback loop *2 marks*

Example of a closed loop control system
e.g. central heating system with thermostat *1 mark* **6 marks**

(b) Any six valid points briefly discussed, or three points discussed in greater depth for each prototyping system

e.g. Breadboard
Requires 'real' components
Time consuming to wire up complex circuits
Faultfinding can be difficult on large circuits
Relatively low-cost method prototyping
Gives an indication of the size of the finished circuit
Gives a better idea of what the end product will look like

e.g. Circuit Simulation Software
Does not require the purchase of 'real' components
Requires expensive computer hardware to operate
Faultfinding easier to undertake than on Breadboard
Simulation of components only as good as the parameters built into the Software *2 x 6 marks* **12 marks**

(c) Any five valid points briefly discussed, or two points discussed in greater depth, with examples for two forms of ICT modelling

e.g. 3D CAD modelling for architecture
Spreadsheets for modelling costing of projects, etc. *2 x 5 marks* **10 marks**

28 marks

Question 3

(a) Any valid answer highlighting

Requirement for 15:1 gear ratio and calculations determine the need for a compound gearbox made from 8T/40T and 8T/24T gears *6 marks*
Indication of requirement for an idler gear *2 marks*
Quality of annotated sketch *2 marks* **10 marks**

(b) Suitable sketch of worm and wormwheel, either pictorial or using symbolic representation *2 marks*
Indication of worm = 1 tooth *1 mark*
Indication of wormwheel = 15 teeth *1 mark* **4 marks**

(c) Any two valid methods of transmitting rotary motion through 90°
e.g. bevel gears, mitre gears, pulley and (round) belt, etc. *2 x 2 marks*
Quality of sketches *2 x 1 mark* **6 marks**

(d) Any three valid advantages and/or disadvantages for each of the two methods *2 x 3 marks*

e.g.
Belt and pulley systems cannot transmit the same torque that gear can
Belts and pulleys can stretch and slip, gears will not
Changing speeds with belts and pulley is generally easier than gears
Belt and pulley systems are generally cheaper than gears
Belt and pulley systems are easier for transferring motion over large distances
Belt and pulley systems do not require the same level of lubrication as gears

Example of use of belt and pulley, e.g. ink-jet printer *1 mark*
Example of use of gears, e.g. car gearbox *1 mark* **8 marks**

28 marks

Question 4

(a) Any suitable circuit diagram including the following

Suitable connection of astable circuit output to clock input	*1 mark*	
LEDs connected to output pins	*4 marks*	
Suitable connection of push switch (and resistor) to stop count e.g. to enable pin on decade counter or to reset or power on astable	*3 marks*	
Suitable connection of reset pin	*1 mark*	
Suitable connection of power supply	*2 marks*	
Quality of circuit diagram	*1 mark*	**12 marks**

(b) Simplistic answer giving basic outline of PCB production but lacking detail and correct sequences *1 – 2 marks*

Good answer giving detail of the process and an indication of the correct sequence of operations *3 – 5 marks*

Excellent answer giving in-depth detail of PCB production with correct use of technical terminology and a logical sequence of operations *6 – 8 marks*

Answers should include some or all of the following observations

Transfers

Select transfers, clean copper-clad board, rub-down transfers onto board, etch board, wash board, remove transfers, drill board

Photo-etch

Create PCB mask, print onto translucent paper, use UV box, develop image, wash board, etch board, wash board, drill board

Milling

Create PCB CAD design, convert to CNC file, attach copper-clad board to bed of miller, set Z offsets for end of mill cutter and drill, fit end mill, run programme to mill away unwanted copper, fit drill, run programme to drill component holes **max 8 marks**

(c) Any four valid health and safety risks along with control measures

e.g.
UV light is dangerous to eyes – ensure UV box is shut during use
Developer is caustic – wear gloves and goggles
Etchant is corrosive – wear gloves and goggles
PCB swarf from drilling is an irritant to eyes – wear goggles
Solder fumes are an irritant – ensure fume extraction, etc. *4 x 2 marks* **8 marks**

28 marks

Paper Total 96 Marks