**General Certificate of Education (A-level)
June 2013**

**Design and Technology: SYST3
Systems and Control
Technology**

(Specification 2555)

Unit 3: Design and Manufacture

Final

Mark Scheme

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 events which all examiners participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for standardisation each examiner analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised 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 students' 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.

Section 1

Question 1			
0 1	References made to – type of pollution – atmospheric – gases chemical – visual – sound – industrial waste – heat - etc. Reference to specific effects on environment – land fill – acid rain – global warming – ground and river pollution – smoke – smog – transport – secondary pollution e.g. Power grids – raw material extraction – etc. *Each relevant point (1) with reason (1) mark*	*4 x 5 marks*	Max 20 marks
0 2	Suitable form of lubrication e.g. Oil – grease – graphite – air bearings etc. *Examples of advantages:* Frequency of lubrication required – protective effects – Loadings – amount or type of movement – cooling – contamination – ease of application – accessibility for lubrication - etc *Each type with advantage up to 4 marks*	*2 x 4 marks*	Max 8 marks
Question 2			
0 3	Lack of manufacturing facilities on site – lack of materials – lack of energy required – lack of skilled workforce – Size of components – transport requirements – size of bridge compared to component size – quality of components – selection of correct material for each component – speed of production – etc. *Each point (1) with reason (1) mark*		Max 12 marks
0 4	Relevant piece of anthropometric data *E.g. Thigh length, Arm length, Lower leg, etc.* Supporting Sketch Reason Application of data to adjustment/ design requirements. ***Max 4 x 4 marks***	*1 mark* *1 mark* *1 mark* *1 mark*	Max 16 marks
Question 3			
0 5	Suitable test (1) for the property (1) Appropriate size of sample for test rig *E.g. Long enough and thin enough to provide enough flexibility to be measured by the measurement system chosen* Appropriate method of carrying out test (1) Fair test (2) Identification of data to collect Suitable / accurate method of collecting data *E.g. A method that can accurately differentiate the relatively small variations involved.*	*2 marks* *1 mark* *2 marks* *1 mark* *1 mark*	

	Explanation of data analysis (1) with outcome (2) *E.g. How the data is compared to provide a conclusion and what that conclusion tell us.* **Max 2 x 8 marks**	*2 marks*	Max 16 marks
0 6	Selection of suitable material *E.g. A suitable metal or plastic that can be deformed or machined to provide a gear wheel capable of withstanding the forces that will be applied to it – steel, brass, aluminium, nylon etc.* Selection of suitable process (1) to match material (2) Quality of sketches to aid explanation Explanation of manufacturing process – (each point 1) *E.g. The stages involved - the tools involved – Technical information such as temperatures if relevant – Etc.*	*1 mark* *2 marks* *2 marks* *7 marks*	Max 12 marks

Section 2

Question 4			

0 7	Input switch 1 mark
	PIC shown
	Power requirements shown (1) correct (2)
	8 LED's
	Load resistors on LED's
	Correct interconnections
	    Input switch correctly connected (1)
	    Some components correctly connected (2)
	    Majority of components correctly connected (3)
	    Working Circuit (4)
	
	 Up to 4 marks
		1 mark
		1 mark
		2 marks
		1 mark
		1 mark
			Max 10 marks

0 8	The flowchart can take many forms; therefore marks will be awarded for the percentage of the process performed independent of complexity. Detection of momentary switch push. Switch – method of scanning for input Relevant decision Relevant feedback loop For each LED that illuminates in sequence with a 3 second delay (1 mark) – Each LED must be clearly defined by either Code, label or number – up to 8 marks Suitable end sequence or loop to start	*1 mark* *1 mark* *1 mark*	Max 12 marks
0 9	Explanation (1) with reason (2) for modification Interface components (1) suitable for 240 volts (2) *E.g. Relay, thyrister, triac etc.* Correct connections (1) suitable diagram (1)	*2 marks* *2 marks* *2 marks*	Max 6 marks
Question 5			
1 0	The flowchart can take many forms, therefore marks will be awarded for the percentage of the process performed independent of complexity. The use of analogue or digital systems is acceptable. Input from setting system defined Input from sensing system defined Comparison of inputs Decision temperature is correct Relevant feedback loop Decision temperature is too high Output to cooling system Relevant feedback loop	*1 mark* *1 mark* *1 mark* *1 mark* *1 mark* *1 mark* *1 mark* *1 mark*	

	Decision temperature is too low	*1 mark*	
	Output to cooling system	*1 mark*	
	Relevant feedback loop	*1 mark*	
	Inclusion of delay to reduce constant switching	*1 mark*	**Max 10 marks**
1 1	Suitable sensing system – above (1) below (1) *E.g. Thermister, thermostat, bimetallic strip, expansion of a material operating a switch etc.*	*2 marks*	
	Suitable Temp setting system *E.g. Variable resistor with a scale, keypad with display etc.*	*1 mark*	
	Suitable Heating System *E.g. A system that will have an output rated in kW.*	*1 mark*	
	Suitable Cooling system *E.g. Fans, venting systems, refrigeration systems etc.*	*1 mark*	
	Comparator system - Inputs (1) Outputs (1) correctly connected (1) 3 marks	*3 marks*	

	Description / Explanation / Diagram
	    Basic overview (1)
	    Some important areas covered (2)
	    Most important areas covered (3)
	    Clear explanation of whole process (4)
	
	Up to 4 marks
			Max 12 marks

1 2	Each Specific point (1) with reason (1) Examples: Harder for heat to escape – reduced conduction – reduced convection – less heat required to maintain temperature – less heat required to bring internal temperature to required temperature from cold – fast responses times – reduced size of heating system – reduced heating bills – better heat retention – house will be cooler in hot weather – etc.	*2 marks*	**Max 6 marks**
Question 6			
1 3	Power source identified	*1 mark*	
	Suitable prime mover *E.g. Electric motor, stepper motor, D/A cylinder, S/A cylinder Etc.*	*1 mark*	
	Conversion to linear (1) Reciprocating motion (2)	*2 marks*	
	Capable of continuous operation	*1 mark*	
	Constant Velocity – Forward (1) Reverse (1)	*2 marks*	
	Travel distance limited (1) to 200mm (2) *E.g. Limit switches, throw of crank, profile of cam etc.*	*2 marks*	
	Detailed Explanation – each relevant point (1)	*3 marks*	**Max 12 marks**

1 4	Automatic operation - Sensing (1) – Activation (1) *E.g. A method of sensing the power has been removed then producing a response to activate the rest of the system*	*2 mark*	
	Quality of sketch – Adequate (1) Clear and helpful (2)	*2 marks*	
	Method of stopping shaft - Activation (1) Application (1) *E.g. A suitable prime mover activating a braking system or using induction to stop the rotation of the shaft.*	*2 marks*	
	Explanation – Partial (1) Full (1)	*2 marks*	
	Max 2 x 8 marks		Max 16 marks