UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

**Cambridge ICT Starters
On Track**

Scheme of Work

4293
Control for a Purpose
Stage 2 Module

UNIVERSITY *of* CAMBRIDGE
International Examinations

Introduction

This module builds on the Next Steps module, 'Exploring Control', and develops the use of sequences of instructions to control devices. In this module, students will use a control box connected to a computer to write sequences of instructions which will control more than one output device, and will build sequences of events to solve a problem.

Students will need to consider examples of real life control systems, and should evaluate systems – including their own control solutions – identifying limitations. In working on this module, the sequence Plan –Test – Modify is very important. Students should be encouraged to check control sequences for errors, both by 'proof-reading' procedures and trialling them with real input data. Wherever possible, students' experience should be broadened to include control and monitoring applications which may be used in other subject areas – for example, automatic weather stations, datalogging equipment, computerised lathes.

What is Assessed in This Module?

Students will demonstrate how to:

- design a control system
- build a sequence of events to activate multiple devices concurrently
- correct and improve procedures
- evaluate the system, identifying limitations

To Start This Module You Will Need

- a control kit with a computer interface, or computer control simulation software, which allows students to write control procedures. It must include a range of input devices/sensors and output devices; it must be able to handle data from at least two input devices and control at least two output
- optional software suitable for creating system design drawings

Underpinning Knowledge

Before commencing this module it is recommended that students

- can understand procedures
- are able to produce simple diagrams
- can write short explanatory comments about their work

Complements and extends 'Starting Control' and 'Exploring Control'

General Principles and Procedures

The following are further suggestions and considerations:

- this module can be completed without specialist control equipment if suitable control simulation software is used
- using a combined construction and control system will reduce the construction skill demands for the students
- the module is about the use of monitoring and control rather than the ability to build realistic working models, but it may be more enjoyable for students if they can produce a working model
- students will benefit by considering some real life control systems and identifying the stages, e.g. what makes an automatic kettle or water heater or heating system switch on or off? What kind of input devices does the system use? What output devices does it need? What is the sequence of events?
- students will need to think out the sequence of events they need before they try to write procedures

- introduce the use of a flowchart and ask students to construct flowcharts for some 'simple' control systems, such as a lift: what has to happen before a lift can go up or down?
- draw attention to different kinds of input that can be used in automatic processes e.g. a car park entry system might be activated by movement (via a sensor), by a push button, or by a password
- get students to begin by writing simple control sequences and progress to more complex instructions and procedures. e.g. Make a lamp flash or a motor turn, then Make a buzzer sound when the temperature sensor is 'warm', then Make the buzzer sound when the temperature sensor is 'warm' AND a slide switch is 'on', then Write a control sequence for a set of traffic lights or to turn an appliance on and off at set times of the day
- in real systems, safety is a vital feature, so students should be encouraged to check for errors in the procedure and carry out test runs at each stage of recreating and refining a control system. Solutions should include some attempt to consider safety features and or problems but the lists do not need to be exhaustive
- students should also consider when and how an operator might be able to override the control system
- students should be encouraged to work methodically through creation, testing and refining their systems
- try to provide a design brief which makes a range of solutions possible and for which solutions will be within the range of abilities of the students
- complexity of the system is not as important as showing a good development process
- students should be able to write about the purpose of their systems and also make a good evaluation of it. Discussions and practise during lessons will help students to develop this skill
- the Assessment Criteria are about the fitness of the control system for its purpose, not the student's ability to build a model. (If the system is correct but the model falls apart the student should pass, but for a Merit the student should at least have identified the problem and tried to deal with it)
- because working models cannot be transported for moderation, teachers will need to provide sufficient documentary or electronic evidence that the system worked as intended

Learning Objectives	Classroom Ideas	Resources	Notes
Session Plan One			

• recognise control technology in everyday life
 	
• recognise that devices can monitor real-life changes
 	
• recognise that events can be triggered when a change or input occurs
 	
• identify inputs, processes and outputs
	• class activity: list everyday examples of control devices and systems and the events they trigger.
	
	• student task: explore how a number of control systems work, identifying the input, processor and output in each. Students could work in pairs to investigate different systems. Students can use the internet to find information to back up their decisions
	
	• share findings with the class
		• examples of control devices/systems e.g.
		  - movement detector
		  - alarm
		  - television
		• alarms:
		  - fire
		  - burglar
		• sensors e.g.
		  - doors opening automatically
		  - car park barriers
		  - stereo system
		• example control system with system diagram
			• use everyday examples like central heating, street lights, fridge
			
			• events can be triggered by changes in light, temperature, pressure, time, movement, user input, sound
			
			• inputs include: Microphone, Switches, Sensors that detect changes, TV Arial
			
			• processors include: amplifiers, decision making circuits, counters, timers
			
			• outputs include: light bulbs, LEDs, loudspeakers, motors,
			
			• encourage students to consider a wide range of devices

Learning Objectives	Classroom Ideas	Resources	Notes
Session Plan Two			
• identify features of a control system • draw a system diagram • copy a working control model	• teacher demonstration: example control system and system diagram – outlining how the events on the control system translate to a system diagram. (Or flow chart) • student task: copy the system diagram and label the parts. Write an explanation of how the system functions. Identify the input, processes and outputs • students practise by: producing diagrams of other simple systems – they may benefit from working in small groups when the systems are more complex to draw • group task: use control equipment or simulation software to create a copy of the system you have been shown. Test and modify this so that it works correctly	• example of a working control system model. This can be either a control scenario from the web or a control system set up with control equipment or with control simulation equipment. E.g. Control system example of a fish tank: http://www.ictgcse.org.uk/ • example system diagram for the control system being demonstrated • software for creating a system diagram • descriptions of other simple control systems for the students to practise creating as diagrams • control software or control boxes with output and input devices	• flow charts and system diagrams show different features of the same system and using both could confuse students – they will benefit from learning how to do one of these (which best suits the facilities available) first and then being introduced to the other at a later stage • software for creating system diagrams or flow charts can be complex and so care should be taken to limit the features that students need to use and learn • students may need extra support if they are using the drawing tools in MS word for diagrams – these can be difficult to handle • copying an initial system diagram and documenting it will help students practise the software before they have to use it to design a system

Learning Objectives	Classroom Ideas	Resources	Notes
Session Plan Three			

• work systematically
 	
• devise a method for producing a working control system
	• teacher introduces criteria for success in this module: e.g. evidence for working though the 5 phases of development:
	
	  - design
	  - create
	  - test
	  - modify
	  - evaluate
	
	• class discuss for each phase the following:
	
	  - what to I need to produce / do in this phase?
	
	  - what do I need to provide to prove that I have done this stage well?
	
	• record discoveries on a class chart, listing tasks, outcomes and evidence required
		• chart for devising a method	• drawing attention to the 5 phases required for success in the module Learning Objectives: Design, Create, Test, Modify, Evaluate, should help students to focus on having distinct outcomes for each phase
			
			• students will find it easier to produce evidence of each phase if outcomes and evidence required are clearly defined and if they have actually seen good examples of these
			
			• creating a staged method for the whole class to adopt will encourage students to develop good routines which will help them to produce work independently
			
			• the process the students go through is complex, so the design brief doesn't need to be. Using simple examples will make it easier for students to work by themselves

Learning Objectives	Classroom Ideas	Resources	Notes
Session Plan Four			
• use 'class method' to create a control system • design a control system • draw a system diagram • create a control system • test a control system • modify a control system	• students practise by: using the 'class method' devised in the previous session to design (produce diagram), create, test and modify a control system. (Taking care to produce all the evidence required for each stage.) • students user test and evaluate each others systems • group task: students modify their control system based on feedback and user testing • students practise by: creating more and other systems, changing tasks around in their groups so that all students get to work with all aspects of the equipment/software	• class method chart (from previous session) • control software or control boxes with output and input devices • examples of simples design briefs for control systems: some very simple examples to start and building up to more complex briefs	• students can work in groups to create the working system but each student will still need to work independently with the control equipment so that they will be able to create a system at assessment • students should be encouraged to stick to control systems which are easily definable – tackling systems which are too complex will lead to frustration and confidence being lost • encouraging students to adopt a 'class method' will cause them to develop good routines and provide evidence for each stage of their work

Learning Objectives	Classroom Ideas	Resources	Notes
Session Plan Five			

• evaluate a control system	• class discussion:
	
	  - what is meant by 'limitations of the system'?
	
	  - what is meant by a 'comparison to the real-life system'?
	
	  - what sort of comments should we be making?
	
	• class devise an evaluation sheet to use on their finished control systems. This should have space for writing explanatory sentences next to each section they decide to include in the evaluation sheet
	
	• students use the evaluation sheet to evaluate each others work (students can practise on systems they produced in session four)
		• groups completed control systems from previous sessions	• during evaluations and feedback it important that students see this as a positive process by allowing time for discussion and/or modifications to be made
			
			• writing down simple evaluation statements about the work of others will help students to do the same for their own work
			
			• encourage students to make positive comments as well as negative
			
			• avoid students giving marks, percentages or ticks as a means of evaluation
			
			• students will be able to fulfil this evaluation Learning Objective if they can see examples of the sort of statements which are expected of them

Assessment Ideas

To show how the Assessment Idea fully incorporates the Learning Objectives tested, the Assessment Idea is cross-referenced with the Learning Objective table below.

Assessment Idea

Write a sequence of instructions to control a glass house used for growing orchids. The orchids need an environment with balanced temperature and moisture. The system needs to provide for an alarm to notify when increased moisture is needed and control windows that open or shut depending on the temperature.

Create a flow chart or diagram of the system with all the devices labelled. Write a few sentences to explain what each of the devices does and the sequence of events in the system. (1) Create a working model of the system in either control software or using control equipment. (2) Correct and improve your system. Note down and changes you have made and why you made them. (3) Write a brief statement about what you could do to further improve your system and explain what (if any) differences there would be between your model and the real–life greenhouse system. (4)

	Stage 2 Module – Control for a Purpose
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Teachers should retain the following evidence for moderation:

- copy of assessment question
- a photograph, screen grab or other file showing the completed system (or teacher evidence)
- system diagram (or flowchart) of the system design
- students written comments

Resources

Becta - Control and Monitoring Activities
http://curriculum.becta.org.uk/docserver.php?docid=279

D&T Online Electronics Information – provides information on various electronic terms e.g. transducers, switches
http://www.dtonline.org/apps/menu/app?2&1&0

Bad Designs – a site full of bad designs with a section specifically on control devices that are badly designed with improvement suggestions.
http://www.baddesigns.com/

Electronics and Control Technology Unit Plans - unit plans developed for the New Zealand Ministry of Education. Each title contains a unit outline, unit plan, student worksheets, support material, contextual links, and Word files that may be modified by you to suit your class and Technology programme.
http://www.tki.org.nz/r/technology/curriculum/Electrical_unit_e.php
http://www.windmill.co.uk Control Technology Kit

Data Harvest Worksheets for Control and Data Logging
http://www.data-harvest.co.uk/datalogging/ssl_workroom.html

Sherston Online Activities and Resources
http://www2.sherston.com

Flowol - control software with variety of mimics of different scenarios at different levels	Data Harvest	http://www.data-harvest.co.uk/control/flo_software.html
Mission Control V2 - control software	Sherston	http://www2.sherston.com/
SenSci Data Loggers	Valiant	http://www.valiant-technology.com
SmartQ Sensors - range of sensors	Data Harvest	http://www.data-harvest.co.uk/datalogging/smartq.html
Deltronics Junior Serial Interface Pack - comtrol hardware and software pack	Deltronics	http://www.deltronics.co.uk
Junior Control - control software	Deltronics	http://www.deltronics.co.uk
Flow Chart Editor	Deltronics	http://www.deltronics.co.uk
Junior Control Insight - Control Software	Logotron	http://www.logotron.co.uk/catalogue/titles/junior_cinsight/
Control Works - combined control and data collection pacakge	Camboard Technology	http://www.camboard-technology.com/
Virtual Models - control software and worksheets	Deltronics	http://www.deltronics.co.uk