PROTOTYPING CONTROL SYSTEMS USING SYSTEMS ELECTRONICS BOARDS

For this kind of activity you will need;

- A set of systems electronics boards: Alpha system from UNILAB,
- either a voltmeter or a signal tester designed for the kit.

SIGNALS

Before you start to assemble a prototype circuit using the boards, you should have a good idea of the **signals** that will be passing through your system.

You will find a control block diagram helpful here; remember that the **lines** in this diagram show the **signals**, the **blocks** represent things that **change the signals**.

The boards have a large number of electronic sub-systems. Each sub-system has a signal going into it and a signal going out. What the sub-system does to the signal depends on the kind of sub-system it is. There are various sub-systems available;

Input; An electronic circuit receives a signal from the physical world; this requires an input transducer (a **sensor**) to convert a physical signal into an electronic signal.

Process; Electronic signals often need to be processed; this might mean joining signals together in some way or making a signal larger or smaller. There is a wide range of different processes available.

Driver; Electronic signals are usually unable to provide much power. A driver is used to give the signal more power without changing it in any other way. A few process boards do provide powerful signals, these do not need a driver board. A transistor board is an example.

Output; The final electronic signal produced by the circuit needs to be communicated back to the physical world, this requires an output transducer (an **actuator**) to convert it into a physical signal.

A practical implementation of an electronic circuit is likely to need a minimum of 5 sub-system boards;

Power supply	Sensor	Process	Driver	Actuator

ASSEMBLING THE PROTOTYPE

Inputs
Examine the specification and block diagram for your control system and from these write down all of the inputs to the system. This will include all sensors and switches.

When you have finished the prototype of the electronic system, you will need to test that it works in the situation you have designed it for. This means that there may be sensors that will need to be away from the prototype circuit. You should choose input boards for these inputs that allow you to connect remote sensors.

You will need one input or sensor sub-system for each input that your system has; examine the input boards from the electronics kit and select the sub-systems that you need.

Processes
Examine the specification and block diagram for your control system.

Each block in the diagram that has an electronic signal at both its input and output will need at least one process sub-system. Sometimes more than one will be needed.

Select the process sub-systems that you need.

Test the system so far
Connect together the input and process subsystems that you have selected. Check that the signal from the process part is what you want.

Once this part of the circuit is satisfactory continue to the next part.

Drivers and Outputs
Examine the specification and block diagram for your control system and from these write down all of the outputs from the system. For each output, note whether it is a digital or an analogue output.

When you have finished the prototype of the electronic system, you will need to test that it works in the situation you have designed it for. This means that there may be actuators that will need to be away from the prototype circuit. You should choose driver/output boards for these actuators that allow you to connect them remotely.

You will need one driver and output sub-system for each output that your system has: Digital outputs may be best controlled through a relay driver sub-system. Analogue outputs will need an analogue driver.

Examine the output and driver boards from the electronics kit and select the sub-systems that you need.

Test the completed system
Connect together all of the subsystems that you have selected. Check that the circuit behaves in the way you expect.

Now try out the circuit in the control situation that you have designed it for.

When you have a prototype circuit that has been fully tested and shown to be working, you can proceed to the next section.

DESIGNING A MASK FOR A PRINTED CIRCUIT BOARD

Once you have a working circuit, it needs to be turned from a prototype into a printed circuit board (PCB). Traditionally this has needed the following steps;

1. Translate the sub-systems design into a circuit diagram.
2. Translate the circuit diagram into the layout for a PCB mask.
3. Draw out the mask neatly and accurately.

Each of these steps can be quite difficult. The solution to this difficulty is to make use of computer power.

Computer software is available with a set of libraries of PCB masks. Each of these masks corresponds to one of the sub-system boards in the systems electronics kit.

Before you go to the computer make sure that you have a diagram of your prototype circuit with the names of the boards you have used clearly set out.

Producing the PCB mask for your circuit is a matter of setting out the PCB mask for each of your sub-systems, one at a time, in the same order as they are in the prototype;