Sample Assignment Brief

AQA Level 3 Technical Level Engineering: Mechatronic Engineering
Mechatronic Control Systems

Tutor/Assessor name			
Assignment Title			
Date assignment issued		**Submission Date**	

Task number	**Grading criteria to be evidenced in the task**
Task 1	P1, P2, P3
Task 2	P4, M1, M2, D1
Task 3	P5, P6, P8, P9, P10
Task 4	P7, P11, M4, M6, M7
Task 5	M3, M5, D2, D3

Learner Authentication

I confirm that the work and/or the evidence I have submitted for this assignment is my own. I have referenced any sources in my evidence (such as websites, text books). I understand that if I don't do this, it will be considered as a deliberate deception and action will be taken.

Learner Signature **Date**

Tutor/Assessor Signature **Date**

What Does Royal Mail Engineering Do?

The Royal Mail is the primary postal service of the United Kingdom, delivering millions of letters and parcels every year to households and businesses in every part of the country. To meet this huge demand they employ around 150,000 staff members, run a fleet of over 30,000 vehicles and use a range of automated mail sorting equipment in mail centres and delivery offices in towns and cities all over the UK.

Engineers at the Royal Mail are responsible for the corrective and preventative maintenance of various types of mail sorting machines, and for conducting performance improvement initiatives. The equipment ranges from small, single-operator units which are used to apply cancelling ink to stamps, to large machines requiring numerous operators which process tens of thousands of mailpieces of varying sizes every hour. Each of these machines comprises numerous components, all of which perform tasks essential to the automated and efficient directing of mail. An engineer's job is to ensure all of these components are fully operational before and during designated mail processing hours.

Culler Facer Cancellers (CFCs) at Medway Mail Centre

Flats Sorting Machine (FSM) at Leeds Mail Centre

One of the larger pieces of equipment the Royal Mail uses is the Solystic TOP 2000 Flats Sorting Machine, known as the FSM. This machine processes large mail pieces, such as A4 sized letters and glossy magazines. It is capable of processing 38,000 mailpieces per hour at full capacity, and requires a team of 5 operators. Mailpieces are fed into the machine before being scanned and marked with a barcode for identification. They are then dropped into a plastic tray based on their destination, which is ejected, once full, and travels via conveyor to an exit line, where it is collected and loaded for transportation. For identification purposes, each tray must have a label affixed prior to dispatch containing details about the dispatching and receiving mail facilities as well as the date of dispatch and billing information.

Task Overview

Within this assignment you will research, design, build and test a mechatronic system which will apply labels to a designated slot on a mail tray. The tray identification system and printing functions will not be required. The system designed must consist of both **electronic** and **pneumatic** elements and utilise electronic control systems with either Programmable Logic Controller (PLC) or microcontroller controls.

You must also show an understanding of the characteristics of different control systems, and evaluate the benefits and drawbacks of these with reference to your own final design.

Mail Trays on FSM conveyer at Leeds Mail Centre

LABEL APPLICATOR DESIGN AND CONSTRUCTION

Task 1: PO1 – Research common control system characteristics (P1, P2 and P3)

The first stage of the process is to become fully familiarised with mechatronic systems, the principles of control theory and the different types of sensors contained within a mechatronic system.

Using **sketches or diagrams** for all parts and with written commentaries of operations, you should produce a report based on the examination of the components and function of identified mechatronic systems that includes:

- The identification of **three** mechatronic systems containing multiple sensors, control systems and actuators should be clearly described, and the features which make them mechatronic should be acknowledged (P1)
- An explanation of the principles of control theory on one of your selected mechatronic systems (including open and closed feedback loops, subsystems and the principles of input, process and output) should be in the form of an annotated diagram (P2).
- The identification of a common control system with multiple sensors.
- From this control system, **three** different types of sensor should be selected and their operations outlined (P3).

Mechatronic systems you could consider include:

- industrial robotic systems;
- sorting and packaging systems for factory lines;
- temperature control systems;
- anti-lock brake, traction control or other automobile safety systems.

Task 2: PO1 – Identifying the flow of signals through a mechatronic system (P4, M1, M2 and D1)

The next step to developing your knowledge of mechatronic systems is to demonstrate your awareness of the flow of signals through the system blocks, and how signals vary when affected by variable conditions.

Using **sketches, diagrams and flow charts** with written explanations, identify a common mechatronic system and describe the flow of signals through it. In doing so you should:

- Identify the way in which signals pass through the system, the components involved and the effect of different conditions on the signal (P4)
- Describe the process by which input into a sensor results in a change in output from an actuator in a specified component, and explain how the input signal is modified and used to change the actions of two different actuators (M1).
- Describe in detail the signal conditioning element of the control system, and explain what happens as the signal passes through the controller (M2).

- Identify two key control system components within the mechatronic system and justify why these have been selected for use, and consider whether other components could have been used instead (D1).

Task 3: PO2/PO3 – Designing a mechatronic system (P5, P6, P8, P9 and P10)

In order to construct a suitable mechatronic system for a label applicator, a design must be created, covering both the pneumatic elements and the electronic control system (P5 and P8).

Using suitable **sketches, drawings, diagrams or photographs**, create your design and in doing so you should describe and identify:

- the separate measurement, control and actuation of the pneumatic elements involved;
- the inputs, processes, outputs and signals that operate within the electronic control system, along with any feedback loop;
- how PLCs and microcontrollers are integrated into electrical control systems;
- the function of the PLC or microcontroller within your designed system (P10).

Your design must take into account the characteristics required of an automatic tray labeller. The mail trays which require labelling will arrive on a conveyor and will stop in an identical position on each occasion. A scanner will scan a barcode to identify the box and a printer will print a label based on this information. **Your task is to design a label applicator** which will take the printed label, turn it 90° and affix it into a pre-designated label holder on the front of a mail tray. It must be pushed forward to sit underneath lips at the top and bottom of the holder, as shown below.

Label tray at Leeds Mail Centre

Your design must take into account the needs of different clients, for adjustable heights of reception and placement. You must consider appropriate sensors to use, and to consider how the labelling process will be triggered. Consider which components to use, taking into account cost, functionality and practicality. You should describe the control and output actions of the pneumatic components of the designed system (P6), and use a systems block diagram to describe the electrical components in the control system you have designed (P9). Your design should include as suitable PLC or microcontroller, and you should describe the function of this within your planned system.

Task 4: PO2/PO3 – Building a mechatronic system (P7, P11, M4, M6 and M7)

Next you should construct your designed control system using various suitable methods, working in a safe manner at all times (P7 and P11). You should show a clear step-by-step record of the process taken, using **video or photographic evidence** if appropriate.

In addition to constructing your control system, you should explain how the components you have chosen interact. This should include explanations of how different pneumatic components work together, and of how different electrical components operate together with the PLC or microcontroller (M4, M6 and M7)

You should clearly demonstrate the interdependence of components, and explain how the choice of PLC or microcontroller in the design has affected the selection of other components, for example, in the need to use diodes to protect against the risk of back emf, or the need for resistors to limit current.

Task 5: PO2/PO3 – Testing a completed mechatronic system (M3, M5, D2 and D3)

On completion of the building of your mechatronic control system you should perform a series of appropriate tests to ensure it functions correctly (M3 and M5). You must record the results of the test in an appropriate format to ensure they can be easily interpreted, in a **table** for example. Individual tests should be performed on the pneumatic components and on the electrical components, and function tests on the completed system should be made.

Having obtained results from suitable testing, it is important that you analyse your findings to evaluate the success of your design and construction, and to pinpoint any improvements which could be made to the control system you have constructed (D2). You should consider the constructed control system holistically to suggest specific improvements and justify these logically based on the results of your testing. In addition, you should fully evaluate the control system, covering how well the system meets the given brief and how testing supported any improvements made (D3). This evaluation should consider:

- component selection
- construction
- performance
- ease and cost of maintenance
- how well the system performs specified operations
- the correct size and operation of components
- the expected life of components.

You could produce your evaluation in the form of a **report**, which could include suitable **diagrams and charts**.

Submission Checklist (please insert the items the learner should hand in)	**Confirm submission**
Learner – please confirm that you have proofread your submission	