**282.778 – Mechatronics – Amended Project**

**Aim:**

To build a mechatronic device, integrating actuation, sensing, and control sub-systems.

**Objective/s:**

* To design a mechatronic sub-system that effects extension and contraction of a pneumatic cylinder.
* To design a mechatronic sub-system that measures the extension and contraction of a pneumatic cylinder.
* To integrate your mechatronic actuation, sensor, and control sub-systems in order to eject a part from a hopper with a fixed period between ejection of subsequent parts.

**Description:**

You are required to build a mechatronic device that makes use of your mechatronic actuation and sensing sub-systems, and their respective control interface, to time the ejection of a part from a hopper. The part to be ejected is a tennis ball. You will need to design the hopper, which should hold three tennis balls. The tennis balls will be pre-loaded into the hopper. The time between the balls being ejected is up to you (approximately two to three seconds per ball would be ideal; 20 to 30 seconds per ball not as ideal).

**Constraints:**

* None.

**Resources:**

* A pneumatic cylinder, a solenoid valve, and a relay.
* Three tennis ball (a communal bucket of balls will be available for you to use; however, please be considerate and not take more than you need to use to test your device).

**Method of Assessment:**

* You will be required to demonstrate the controlled extension and contraction of a pneumatic cylinder.
* You will be required to demonstrate the measurement of the pneumatic cylinder’s extension and contraction.
* You will be required to demonstrate the working mechatronic device.
* You will be required to submit a report about the mechatronic device.

A grade out of 100 marks will be given for the demonstration and account for 60% of the project’s final grade.

A grade of 100 marks will be given for the report and account for 40% of the project’s final grade.

This project will be out of a total grade of 100 marks.

**Additional Information:**

This project assesses the following paper learning outcomes:

1. Build a mechatronic sub-system using sensing elements and signal conditioning used within a mechatronic device.
2. Build a mechatronic sub-system using pneumatics and hydraulics.
3. Build a mechatronic sub-system using mechanical and electrical actuators.
4. Integrate mechatronic sub-systems to build a mechatronic device.
5. Configure and use PC and PLC control systems.

This project will account for 65% of the 282.778 Mechatronics paper’s grade.

This assessment is an individual project.

The report should be no more than 3000 words.

**Demonstration Marking Rubric:**

The following rubric provides an overview of how marks will be allocated for the demonstration:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Learning Outcomes** | | **D (< 50)** | **C Range (50 - 65)** | **B Range (65 - 85)** | **A Range (85 – 100)** | **Grade (/100)** |
| ***Poor***  *Learning outcome not achieved.* | ***Adequate***  *Adequate standard achieved across all learning outcomes.* | ***Good***  *Good standard achieved across all learning outcomes, with some elements of excellence.* | ***Excellent***  *Excellent standard achieved across all learning outcomes.* |
| 1 | Build a mechatronic sub-system using pneumatics and hydraulics. | The demonstrated mechatronic device, and its sub-systems, are built to a poor standard, e.g. assembled with hot glue; uses inappropriate material, e.g. laser cut acrylic; is not robust, e.g. some parts aren’t secure, or breaks during demonstration; and is only able to perform its action a few times, e.g. approximately 2 times or more.  The demonstrated system provides an ineffective interface between a controller and user. | The demonstrated mechatronic device, and its sub-systems, are built to an acceptable standard, e.g. may be assembled with hot glue; uses some appropriate material, e.g. laser cut MDF; is reasonably robust, e.g. some parts aren’t secure; and is able to perform its action repeatedly, e.g. approximately 4 times or more.  The demonstrated system provides an interface between a controller, e.g. push buttons, and user. | The demonstrated mechatronic device, and its sub-systems, are built to a very good standard, e.g. not assembled with hot glue; largely uses appropriate material, e.g. laser cut metal where required; is robust, e.g. parts don’t fall off when shaken; and is able to perform its action repeatedly, e.g. approximately 6 times or more.  The demonstrated system provides an interface between a controller, e.g. a PC, and user. | The demonstrated mechatronic device, and its sub-systems, are built to a high standard, e.g. not assembled from hot glue; makes use of appropriate materials, e.g. laser cut metal; is robust, e.g. parts don’t fall off when shaken; and is able to perform its task repeatedly, e.g. approximately 8 times or more.  The demonstrated mechatronic device provides an effective interface between a control PC and user. | 20% |
|  |
| 2 | Configure and use PC and PLC control systems. | 20% |
|  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 3 | Build a mechatronic sub-system using mechanical and electrical actuators | The demonstrated mechatronic device integrates the constituent sub-systems poorly, e.g. mechanical linkages are not very robust, parts jam, and a sensor may measure the state of the device. | The demonstrated mechatronic device integrates the constituent sub-systems, e.g. mechanical linkages are robust, parts may jam, a sensor measures the state of the device, and the use interface provides a means to control the device. | The demonstrated mechatronic device integrates the constituent sub-systems well, e.g. mechanical linkages are robust, parts don’t jam, sensors measure the state of the device accurately, and the use interface provides an appropriate means to control the device. | The demonstrated mechatronic device integrates the constituent sub-systems effectively, e.g. mechanical linkages are robust, parts don’t jam, sensors measure the state of the device accurately, and the use interface provides an effective means to control the device. | 20% |
|  |
| 4 | Integrate mechatronic sub-systems to build a mechatronic device. | 40% |
|  |

**Report Marking Rubric:**

The following rubric provides an overview of how marks will be allocated for the report.

|  |  |  |  |
| --- | --- | --- | --- |
| **Introduction/Aim/Objective** |  |  | **5 Marks** |
| 0 | 1 - 2 | 3 - 4 | 4 - 5 |
| No introduction, aim, or objective provided. | Simple introduction, aim, and objective provided. | Average introduction, aim, and objective provided. | Above average introduction, aim, and objective provided. |
|  | E.g. Copy of project brief’s introduction, aim, and objective. | E.g. Copy of project brief’s introduction, aim, and objective.  Some personal aims, objectives. | E.g. Reference to project brief’s introduction, aim, and objective. Personalised introduction, aim, and objective. Clear overview of project. |
| No effort applied. | Minimal effort applied. | Average effort applied. | Above average effort applied. |

|  |  |  |  |
| --- | --- | --- | --- |
| **Methodology/Solution** |  |  | **15 Marks** |
| 0 | 1 - 5 | 6 - 10 | 11 - 15 |
| No Methodology provided. | Simple methodology provided. | Average methodology provided. | Above average methodology provided. |
|  | E.g. Simple description of what was done. | E.g. Moderate description of what was done and how. | E.g. Detailed description of what was done, how, and why. |
| No effort applied. | Minimal effort applied. | Average effort applied. | Above average effort applied. |

|  |  |  |  |
| --- | --- | --- | --- |
| **Results/Discussion/Conclusion** |  |  | **5 Marks** |
| 0 | 1 - 2 | 3 - 4 | 4 - 5 |
| No results, discussion, and conclusion provided. | Simple results, discussion, and conclusion provided. | Average results, discussion, and conclusion provided. | Above average results, discussion, and conclusion provided. |
|  | E.g. Simple description of project outcome, minimal discussion, and simple conclusion provided. | E.g. Moderate description of project outcome, some discussion, and average conclusion provided. Some critical evaluation of processes and methodology provided. | E.g. Detailed description of project outcome, detailed discussion and above average conclusion provided. Detailed critical evaluation of processes and methodology provided. |
| No effort applied. | Minimal effort applied. | Average effort applied. | Above average effort applied. |

|  |  |  |  |
| --- | --- | --- | --- |
| **Presentation/Structure** |  |  | **5 Marks** |
| 0 | 1 - 2 | 3 - 4 | 4 - 5 |
| No presentation. | Simple presentation and structure. | Average presentation and structure. | Above average presentation and structure. |
|  | E.g. Report consists of a “wall of text”. No figures. No tables. No clear structure. | E.g. Report has some structure. Includes some figures. Includes some tables. | E.g. Report has appropriate balance between text, figures, and tables. Excellent structure; includes table of contents, list of figures, sections, and captions. |
| No effort applied. | Minimal effort applied. | Average effort applied. | Above average effort applied. |