Course: Industrial Technology	**Teaching Period:** Term 2 (Week 1-Week 10)
Subject Area: Engineering Control Systems	**Unit Length:** 10 weeks total (4 weeks documented)

Unit Overview:

Develop a prototype of a device that utilises simple hydraulics to lift an item from point A to point B. the prototype must be accompanied by a rationale explaining the chosen design elements and linking engineering principles. Students develop knowledge on control systems and their real-life relevance and apply engineering principles to evaluate factors affecting the design of engineered control systems. Students develop their technical drawing skills, CAD skills, design communication skills, and make connections to industry practices. Students get hands-on experience with rapid prototyping processes and apply engineering design principles to redesign a component of a hydraulic arm.

Rationale:

Engineered structures and mechanisms are what keep the world running efficiently and effectively. Students will come to understand that over time, engineered solutions have become more sophisticated and can be used to solve complex problems within transport, agriculture, manufacturing, and construction. Together with technology, engineering continues to develop, and students will develop knowledge around how the two are connected, and how technology can be used to inform the design process of engineered solutions. Students will also explore varying feats of engineering throughout time and across cultures.

Learning Outcomes:

IND5-2: Applies design principles in the modification, development and production of projects.
IND5-4: Selects, justifies and uses a range of relevant and associated materials for specific applications.
IND5-5: Selects, interprets and applies a range of suitable communication techniques in the development, planning, production and presentation of ideas and projects.
IND5-6: Identifies and participates in collaborative work practices in the learning environment.
IND5-9: Describes, analyses and uses a range of current, new and emerging technologies and their various applications.
IND5-10: Describes, analyses and evaluates the impact of technology on society, the environment and cultural issues locally and globally.

Prior learning experience:

Completion of Stage 4 Design and Technology as well as Year 9 Industrial Technology, with good understanding of material selection and justification, and basic understanding of design communication. Experience using TinkerCAD and basic understanding of Fusion360. Preliminary understanding of engineered systems and their societal, economic, and environmental impact. Preliminary understanding of numeracy and literacy related to engineering, and some experience working collaboratively to create design solutions.

Assessment tasks:	Resources:
Summative: Hydraulic arm prototype with redesigned component (Weighting: 25%): - Rationale for the redesigned component (40%). - Final model (15%). - Fusion360 model (25%). - Workshop drawing of redesigned component (10%). - Annotated ideation sketches (10%). **Formative:** - Completion of individual and collaborative group tasks. - Observations of student progress with Fusion360 work, and drawings. - Participation of students in class discussions.	Access to workshop with general woodworking tools. Access to laser cutter and 3D printer. Physical materials for rapid prototyping (ABS filament, plywood, acrylic, cardboard). Access to Fusion360. Students' personal laptop devices. Simple hydraulic project kit.
Diverse and Inclusive Teaching and Learning Requirements This unit of work considers students working across the scale of average standard. Students below average standard benefit from the chunking and logical sequence of learning activities. Students above average standard benefit from self-paced tasks and being able to apply prior learned engineering principles to new content. Learning tasks and teaching strategies have been differentiated to account for a student with ADHD, and an EAL/D student. Exceptional and motivated students are encouraged to complete multiple redesigned components however will only be assessed on one.	**Work Health and Safety Considerations** Students participate in a safety and instructional induction that covers the use of any tools and machinery for this unit. Students also complete OnGuard modules for all tools and machinery in use for this unit. **Workshop Hazards and Considerations:** - Correct and safe use of 3D printer and laser cutter. - Appropriate PPE within the workshop. - Operation and use of tools and machinery. - Consideration of peers in same space. - Handling of materials. All students and staff are expected to follow school appointed WHS guidelines, failure to do so will may result in the increased likelihood of injury, and denied access to the workshop.

Weekly Content Organisation

Note: this is the first 4 weeks of a 10-week unit of work.

Week	Learning Outcomes	Topic Focus & Brief Description
1	IND5-6 IND5-9 IND5-10	**Engineering and Control Systems:** - Introduction of new unit of work around engineered control systems, specifically the use of hydraulics. - Revision of core engineering concepts. - Scope of unit, and expectations for the project. - Safety induction.
2	IND5-4 IND5-6 IND5-9 IND5-10	**Real World Engineering:** - Engineered systems, real-world applications, specific terminology. - Factors affecting design. - Revision of key tools and methods (design ideation sketching, hand rendering, CAD, orthographic drawing, laser cutting, 3D printing, AS1100).
3	IND5-4 IND5-6 IND5-8 IND5-9 IND5-10	**Implications of Engineered Systems:** - Specific real-world applications of hydraulic systems, and societal and environmental impacts. - Ethical considerations of engineered systems. - Engineering properties of materials. - Engineering principles that affect design. - Idea generation.
4	IND5-2 IND5-5 IND5-6 IND5-9	**Design Ideation and Fusion360:** - Developing Fusion360 model. - Links to technical drawing process, scale, and real-world application. - Evaluation of principles of control systems.

Weekly Breakdown

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Engineering and Control Systems

Cross Curriculum Priorities:

- Asia and Australia's Engagement with Asia.

General Capabilities:

- Critical and Creative Thinking.
- ICT Capability.
- Personal and Social Capability.

Students learn about:	Students learn to:	Integrated Teaching and Learning Activities	Assessment
Core engineering principles. Introduction of control systems. Opportunity to present an engineered design solution. Relevance of hydraulics in control systems.	Reinforce their prior knowledge. Identify what control systems are. Identify types of control systems. Select and use specific terminology.	**Term 1 recap:** - Summarise feedback from prior unit. - Clarify the rationale for engineering in Industrial Technology. **Introduce new unit of work:** - Demonstrate the relevance and real-world application of different control systems, provide examples of significant feats of engineering within control systems. Demonstrate how different control systems work. - Introduce the use of hydraulics and link to real-world applications. - Class discussion of the revision of core engineering principles that can be linked to control systems. **Group task:** - Each group is presented with a design problem. - Groups come up with creative engineered design solution and present to class. **OnGuard Modules:** - Students to begin completing OnGuard modules for homework.	Students demonstrate prior knowledge of engineered solutions by contributing to class discussion. Students demonstrate understanding of relevance of control systems by linking engineering principles with control systems. Students present creative solutions to design problem that are relevant to control systems and link engineering principles.

	Expectations for the project. Real-world applications. Worked example.	Identify and investigate factors influencing the design of control systems. Manage time and project management through planned sequence. Link design problem to design solution.	**Project presentation:** - Expectations for the project, and relevance within the course. - Demonstrates deeper connection to real-world applications, linking hydraulics to specific industries. - Facilitate class discussion on industry applications. **Worked examples:** - Video of one example. - Presents worked examples and allows opportunity for students to test, investigate, and ask questions about them. **Planning sequence presentation:** - Students fill out planning sequence document while teacher goes through and explains example timeline.	Students demonstrate understanding of industry relevance by contributing to class discussion. Students demonstrate engagement and understanding of project scope through engaging with and asking meaningful questions about worked example. Students are able to create their own timeline that is logical and sequential.
	Real-world applications of safe practices. Safety considerations for the project. Ideation and rapid prototyping process.	Demonstrate safe workshop practices and procedures. Describe the WHS Act and WHS Regulations, and the role of SafeWork NSW in maintaining a safe workplace. Work within a workshop safely.	**Safe practice and procedure presentation:** - Link to real-world applications. - Discussion about safe practices within the school workshop context. - Introduces overview of relevant safety considerations and relevance. - Introduces overview of expected tool use. **Safety induction:** - Students to fill out safety induction sheet while teacher leads class throughout the workshop. **“How to” resource:** - Students are informed on the operation of the laser cutter and 3D printers and are directed to the relevant “how to” documents.	Students demonstrate understanding of safe practices through completed induction sheet. Completion of OnGuard modules.

		Investigate advanced manufacturing techniques.	**OnGuard modules:** - Students to have completed all OnGuard modules by end of week.	
	Differentiation (TWO Focus Students and Class group)	**Student A (ADHD):** - Paired with focussed student/s for group task, clear group roles are defined. - Lesson outline written on board and communicated at the beginning of class. - Regular breaks in presentations for class discussion to reduce loss in focus. - Keeping presentations short and to a minimum. - Hands-on experience with worked example. - Safety induction is interactive and hands on, moving around the workshop. **Student B (EAL/D):** - Providing visual cues on the safety induction sheet. - Easily located “how to” documents that also contain visual cues. - Paired with focussed student for group tasks. - Regular check ins throughout class to confirm clarification. - Provided document of key engineering terms that were covered in Term 1. **Class Group:** - Use of collaborative tasks. - Use of hands-on experiences. - Clear instruction. - Regular feedback. - Consistent questioning.		

2	**Real World Engineering** **Cross Curriculum Priorities:** - Sustainability. - Asia and Australia’s Engagement with Asia. **General Capabilities:** - Critical and Creative Thinking. - ICT Capability. - Personal and Social Capability. - Literacy. - Numeracy.			
	Students learn about:	**Students learn to:**	**Integrated Teaching and Learning Activities**	**Assessment**
	Engineered systems, and specific terminology. Real-world applications of control systems.	Investigate control system purposes. Identify and describe control system types. Define control system terminology.	**Presentation on the real-world application of control systems (link to everyday things)** - Class discussion on control systems in their house. **Individual Task:** - Complete “Control System Types” sheet while listening to presentation on the types of control systems. **Paired Task:** - Work together to complete control system terminology glossary. - Each pair to present a definition to the class and provide an example.	Student contributions to class discussion. Completion of “Control System Types” sheet. Completion of glossary and definition/relevant example contribution.
	Factors affecting design in engineering: - Functionality. - Aesthetics.	Evaluate the impact of design and work practices/processes on the quality of finished projects. Identify and investigate factors influencing	**Presentation on factors affecting engineering design:** - Students presented with evaluative design scaffold that they can apply to their own projects. - Opportunity for questions/discussion about the scaffold. **Control System Case Study (Paired Task):**	Student questions about scaffold or student answers to probing questions for the teacher to clarify understanding.

		design in control systems. Identify the functional and aesthetic aspects of design in control systems	- Using “evaluation of design” scaffold, pairs work together to identify the functional and aesthetic factors of design of a chosen control system from provided list (each pair has a different control system). - Evaluate quality and effectiveness of the control system performing its function. - Each pair to present findings to another pair. - Pairs prompted to ask follow-up questions and provide feedback. - Teacher to walk around and provide additional guidance and immediate feedback (“did you think about x?”, “your evaluation of the functionality was good.”, etc.).	Completed scaffold for case study. Presentation of meaningful findings for case study.
	Key tools: - Laser cutter. - 3D printer. - Fusion360 Key methods: - Design ideation sketching. - Hand rendering. - CAD. - AS1100	Investigate advanced manufacturing techniques to assist in the production of projects. Compare and contrast contemporary industrial manufacturing techniques, materials and equipment with classroom experiences Represent control systems using freehand sketching. Produce annotated freehand sketches of project components and/or projects to visualise, communicate, understand and record ideas.	**Short presentation on the use of advanced manufacturing techniques:** - Link what students will use to real-world production of control systems (laser cutter, 3D printer). - Discussion of how everyday control systems may have been made. **Design communication task (individual):** - Students practice hand-rendering techniques (shading, blending, shadows, etc.). - Students produce hand-rendered, and annotated sketch of redesigned TV remote. - Hand-rendering tips sheet projected on board or accessed by students. **Short presentation on industry used design communication:** - Use of AS1100. - Orthographic drawings. - Technical drawings. - CAD.	Student contributions to discussion. Completed hand-rendered and annotated sketch.

	Differentiation (TWO Focus Students and Class group)	**Student A (ADHD):** - Clear instruction for control system case study, and provision of example questions. - Short presentations that lend themselves to discussion and questions. - Design communication task is flexible and could be completed outside, on the floor, etc. - Chunking the presentations into single content specific formats. **Student B (EAL/D):** - Visual resources and examples for design communication task. - Glossary task is completed in a pair. - Linking discussion of key tools to images of each. - “Control system types” presentation contains images. **Class Group:** - Hands on rendering task with immediate feedback and worked examples. - Opportunities for collaborative learning. - Use of questioning to facilitate class discussion and probe for higher order thinking.

3	**Implications of Engineered Systems** **Cross Curriculum Priorities:** - Sustainability. - Asia and Australia’s Engagement with Asia. **General Capabilities:** - Critical and Creative Thinking. - ICT Capability. - Personal and Social Capability. - Literacy. - Numeracy.			
	Students learn about:	**Students learn to:**	**Integrated Teaching and Learning Activities**	**Assessment**
	Societal and environmental impacts of	Describe the impact of engineered control systems on society and the environment.	**Think, pair, share:** - In pairs students research an engineered control system and evaluate the societal and environmental impact.	Students verbally communicating their findings with each other.

	engineered control systems. Ethical considerations in engineered control systems.	Examine ethical and legal issues that apply to engineered control systems.	- 2 pairs then group together and share their findings with each other. **Presentation on ethical and legal considerations for design of engineered control systems:** - Class discussion on ethical and legal implications for failed control systems.	Informal assessment through teacher check-ins with each group. Student contributions to class discussion.

	Engineering principles and practices that apply to the design process:
	- Cantilevers.
	- Strength to weight ratios.
	- The use of triangles in frames.
	- The effect of wind loads, live loads, and weight.
	
	Principles of hydraulics:
	- Pressure.
	- Flow.
	- Mechanical advantage.
	- Pascal's Law.
		Apply elementary engineering principles and processes in the design and production of structures.
		
		Identify the forces that act on structures.
			Short principles of design presentation:
			- Outlines the principles.
			
			Small group task:
			- Class divided into four groups to research one of: cantilevers, strength to weight ratios, triangles in frames, and the effect of wind loads, live loads, and weight.
			- Each group fills out informational document.
			- Each group to:
			  ○ Address how it affects design.
			  ○ Provide 5 real-life examples.
			  ○ Present findings.
			- Research document must be uploaded to class share-doc.
			- Teacher to follow-up with immediate feedback, clarify information, and link to relevance in unit.
			
			Class discussion:
			- What do you know about hydraulics?
			- What are some real-life applications of hydraulics?
			
			Demonstration of hydraulic control system:
			- Example projects are presented with a focus on demonstrating the hydraulic system.
			- Discussion on how the system works.
			
			Follow-up with "Principles of Hydraulics" presentation.
				Completed research document.
				
				Contributions to class discussion.
				
				Informal queries about hydraulic control system project example.

	Engineering properties of materials: - Electronic properties.	Explore engineering properties of materials suitable for control systems.	**Individual task:** - Complete engineering properties sheet.	Completion of engineering properties sheet.

	- Insulating properties. - Strength. - Toughness. - Durability. Ideation process.	Apply an understanding of material properties in the design and production of control systems. Produce annotated freehand sketches of project components and/or projects to visualise, communicate, understand and record ideas.	- Provide examples of each engineering property in real-life examples. **Class discussion:** - Presentation of different engineered control systems using different materials. - Presentation of different materials. - Discussion as to why certain materials were chosen. - Link to engineering principles from last lesson. **Design ideation:** - Present video on design ideation. - Students begin producing thumbnail sketches for their project.	Student contributions to class discussion. Student progress with thumbnail sketches. Informal assessment through teacher conversations about student's ideas.
	Differentiation (TWO Focus Students and Class group)	**Student A (ADHD):** - Hands-on tasks with using the hydraulic system of the example projects. - Linking content to relatable real-life and visual examples. - Clear group roles are established within group tasks, additional instruction and clear feedback is provided for this student's group. - Explicit teaching tasks with clear instructions provided. **Student B (EAL/D):** - Use of visual cues to explain engineering concepts, and link to real-life examples. - Access to glossary of engineering terms through LMS. - Video examples of hydraulic systems. - Pairing student with a peer that is confident in their knowledge of engineering concepts for group tasks. **Class Group:** - Relating engineering concepts to hands-on experiences through the example projects. - Provision of work examples through example projects to develop deeper understanding of task. - Collaborative learning with clearly defined roles within groups. - Use of whole class Q&As to encourage discussion and gather feedback on student knowledge and engagement.		

4	**Design Ideation and Fusion360** **Cross Curriculum Priorities:** - N/A **General Capabilities:** - Critical and Creative Thinking. - ICT Capability. - Numeracy.			
	Students learn about:	**Students learn to:**	**Integrated Teaching and Learning Activities**	**Assessment**
	Fusion360 skills: - Components. - Defining sketches. - Line tool. - Arc tool. - Ellipse tool. - Extrusion tool. - Dimensioning.	Use CAD to aid the design process. Use and/or modify designs when completing projects.	**Presentation of real-life applications of CAD:** - Introduce the purpose of it for this unit. **I do, we do, you do:** - Initial demo of Fusion360 processes: teacher to demonstrate, class does it together, students then work at their own pace. **Hands-on model access:** - Example models are available to view. - Reference specific parts that Fusion360 skills are needed to create. **Fusion360 tutorial video:** - At “you do”, students follow a pre-recorded tutorial that walks through the creation of two components of the hydraulic arm. **Design ideation:** - Students that have finished the Fusion360 work continue developing their design ideations.	Production of Fusion360 modelled components from pre-recorded tutorial. Informal conversations with students about progress. Student queries regarding Fusion360 procedures. Production of ideation sketches.

	Fusion360 skills: - Sub-assemblies. - Materials. - Combine tool. - Fillet and chamfer tools. - Emboss tool. - Constraints.	Use CAD to aid the design process. Modify and/or apply workshop drawings in the completion of projects. Use and/or modify designs when completing projects. Apply an understanding of material properties in the design and production of control systems. Evaluate the principles of control systems.	**I do, we do, you do:** - Initial demo of Fusion360 processes: teacher to demonstrate, class does it together, students then work at their own pace. **Hands-on model access:** - Example models are available to view. - Reference specific parts that Fusion360 skills are needed to create. **Applying workshop drawings to design:** - At “you do”, students utilise a workshop drawing of one of the components to develop another part of the project. **Design ideation:** - Students that have finished the Fusion360 work continue ideation sketches and begin annotating them with an evaluation of each design with reference to material and engineering principles. - Students can begin their final design sketch.	Completed Fusion360 components. Production of meaningful annotations on ideation sketches. Student progression on tasks.
	Fusion360 skills: - Producing workshop drawings. - Joint tool.	Use CAD to aid the design process. Modify and/or apply workshop drawings in the completion of projects.	**Short presentation on the real-life application of workshop drawings:** - AS1100 standards. - Relevant nuances. **I do, we do, you do:** - Initial demo of Fusion360 processes: teacher to demonstrate, class does it together, students then work at their own pace. **Hands-on model access:** - Example models are available to view. - Reference specific parts that Fusion360 skills are needed to create.	Completed Fusion360 components. Production of meaningful annotations on ideation sketches. Student progression on tasks. Informal conversations with students about progress.

		Self-paced tasks: - Students are able to access workshop drawings/tutorials for remaining components. - Students to have completed Fusion360 model by end of week. - Or students can begin modelling their redesigned component within Fusion360. **Homework:** - Any outstanding Fusion360 work to be completed at home.	
Differentiation (TWO Students and Class group)	**Student A (ADHD):** - Chunking learning tasks in a logical sequence ("I do, we do, you do" process). - Student to present progress to teacher at the end of each lesson. - Regular informal questioning from teacher to students to clarify understanding. - Teacher to regularly walk around and engaging with students to monitor progress and refocus students. **Student B (EAL/D):** - Use of example project to link CAD skills being taught to a physical cue that students can investigate hands on. - Use of video tutorials, and visual instructions. - Students to have access to informational sheet on Fusion360 tools with images of each tool and short description of what it does. **Class Group:** - Teacher to use regular informal questioning to gather information on student progress and common sticking points that they can then address as a whole class. - Self-paced tasks allowing students who are confident in their abilities to move on without hesitation, and students that require extra support can receive it when needed. Any unfinished CAD work at the end of this week will become homework. - Students to use "3 before me" model for questions regarding Fusion360 work (think through the process, consult the tutorial guide or informational sheet, and consult a peer before asking the teacher).		

Weekly Resource List

Week	Workbook/Templates and Teaching Resources	Software	Online Media (Videos)	Text	Excursion
1	Content presentations. Example projects. Safety induction sheet. 3D printing and laser cutting “How to” document. Planning sequence document.	Word processing software.	https://www.youtube.com/watch?v=P2r9U4wkjcc&ab_channel=TheQ OnGuard modules.	AS1100 standards.	
2	Content presentations. “Control system types” sheet. “Evaluation of design” scaffold. “Hand rendering tips” resource.	Word processing software. Google docs.			
3	Content presentations. “Engineering properties” sheet.	Word processing software. Google docs.	https://www.youtube.com/watch?v=71vvkT2aaUQ&pp=ygUoaGFuZCByZW5kZXJpbmcgdGVjaG5pcXVlcyBwcm9kdWN0IGRlc2lnbg%3D%3D	AS1100 standards.	
4	Fusion360 instructional resource. Workshop drawings. Example projects.	Fusion360	Pre-recorded instructional tutorials.	AS1100 standards.	