Focus Area: Industrial Technology Control Systems Unit title: Soccer Bot & Submarine

Description: This unit will allow students to gain a basic understanding of electronics, a variety of control systems including float valves, bi-metal switches, garden watering systems and micro switches. The construction of the soccer bot and the Submarine will develop students' skills in hypothesising, experimenting, plan drawing, marking out, cutting and communicating ideas. Students will be introduced to algorithms. Students will consider the wide use of control systems in our everyday life and their varied forms and applications. Students will consider some legal and ethical considerations of their applications.

The project will include a project report that will incorporate the following aspects:

- Selection and use of resources,
- Industry related terminology,
- Safety tests
- Societal and environmental implications,
- Sketches and drawings

The project report will be developed using appropriate workplace communication skills.

Suggested unit length: - weeks 20

Outcomes:

A student:

› identifies, assesses, applies and manages the risks and WHS issues associated with the use of a range of tools, equipment, materials, processes and technologies IND5-1

› applies design principles in the modification, development and production of projects IND5-2

› identifies, selects and uses a range of hand and machine tools, equipment and processes to produce quality practical projects IND5-3

› selects, justifies and uses a range of relevant and associated materials for specific applications IND5-4

› selects, interprets and applies a range of suitable communication techniques in the development, planning, production and presentation of ideas and projects IND5-5

› identifies and participates in collaborative work practices in the learning environment IND5-6

› applies and transfers skills, processes and materials to a variety of contexts and projects IND5-7

› evaluates products in terms of functional, economic, aesthetic and environmental qualities and quality of construction IND5-8

› describes, analyses and uses a range of current, new and emerging technologies and their various applications IND5-9

› describes, analyses and evaluates the impact of technology on society, the environment and cultural issues locally and globally IND5-10

Resources:

Metal or Wood workshop
Hand tools and hot glue guns
Soldering irons
Scorpio Technology kits
Internet and other computer resources
WMS proformas
Laser cutter
Material as per cutting list
OnGuard
Computers - Illustrator

Differentiation Strategies Used

- Introduce students to the picture dictionary. Students to add to the dictionary as they encounter new key terms.
- EALD students to use split screen when on the computer to utilise Google translate to better understand assignment content.
- 8 Ways of Learning -Use a variety of delivery methods to engage a broad range of learning styles.
- Provide scaffolded responses to worksheets.
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INDUSTRIAL TECHNOLOGY – ENGINEERING –

Content	Teaching Strategies or Tasks Used
WHS and risk management ***Students***	
• demonstrate safe workshop practices and procedures, for example: – clamp materials securely when cutting or drilling – follow electrical safety procedures – follow workshop signage instructions – work collaboratively	Complete Onguard safety tests. General safety, general machines, soldering irons, glue gun, drill press. Construct projects in a safe manner.
• safely use and maintain hand, power and machine tools	Construct projects in a safe manner.
• select and use personal protective equipment (PPE) when working with tools, materials and machines, for example: – wear appropriate footwear – wear eye protection, eg safety glasses when using power tools – wear protective clothing	Safety glasses used when soldering and using machines. Black leather shoes during class eye protection when using the drill press
• describe the WHS Act and WHS Regulations, and the role of SafeWork NSW in maintaining a safe workplace	Notes and worksheets on WHS Act 2011
• identify and apply the principles of risk management, for example: – identify a particular risk and implement risk-reduction procedures	Complete a WMS for the construction of the Submarine . Introduce the hierarchy of control & concept of risk matrix Hierarchy of Control posters.

• identify and apply the principles of first aid, for example: – outline the procedure to follow after a particular incident, eg burns, cuts	Discuss fact sheets on burns, eye injuries, electric shocks & bleeding.
Design Students:	
• develop and produce practical projects allowing for the characteristics and properties of materials, systems, components, tools and equipment available (ACTDEK046)	Construct Soccer Bot & Submarine . Discuss acrylic v ply and their properties, cost and ability to be shaped, ie laser cut, bent etc.
• identify and investigate factors influencing design in control systems, for example: – efficiency of energy use – efficient use of materials – reliability of systems	Students to complete an algorithm to explain the programming of a garden watering system. Understand materials properties to maximise the efficiency and longevity of the system.
• identify the functional and aesthetic aspects of design in control systems, for example: – intuitive user interface – labelled control panel – water-level systems in cisterns	Investigate the function of a garden watering system. Discuss components and how to program. Discuss advantages & disadvantages.
• select standard International System of Units (SI) and Australian Standards for design, for example: – correct units used for electrical quantities	Examples in notes and on board of calculations converting units ie mm to m, imperial to metric. Change settings in 2D design and Illusrator
• use and/or modify designs when completing projects (ACTDEP049)	Students to design Submarine body and produce drawings in 2D design and Illustrator to own specs to maximise functionality of final vehicle
• calculate quantities and costs of materials and components used in the completion of projects, for example: – determine processes for the efficient use of materials – use spreadsheets to calculate material quantities and monitor project costs	Complete excel SS on costing whole class of projects cost analysis sheet for soccer bot and

● apply project management techniques and follow a planned sequence through to project completion	Complete project production sequence worksheet before completing SWMS Submarine .
● evaluate the impact of design and work practices/processes on the quality of finished projects, for example: – develop criteria to evaluate engineering design choices – designing with block diagrams to clarify relationships between components	Develop criteria to evaluate success for Submarine Evaluation sheet on the soccer bot

Engineering principles and processes **Students:**	
● investigate control system purposes, for example: – applications for remote control – applications for mechanical or wired control – evaluate past and present control systems – use of actuators, sensors and controllers	Investigate and program the components of an automatic garden watering system. Experiment with inputs and outputs. Eg Controller, solenoids, moisture and rain detectors. **https://www.youtube.com/watch?v=d9HNaeS9N0A** Compare with an Arduino controlled watering system with a pump and moisture detector. Discuss the need for relays in low current systems.
● identify and describe control system types, for example: – electronic – hydraulics – mechanical – pneumatic	Discuss hydraulic digger project from last year. Investigate yr 8 EEE Arduino claw arm project and parallel with robotic welders and milling machines in the industry. **https://www.youtube.com/watch?v=34ro1uVguUs** **https://www.youtube.com/watch?v=RnIvhlKT7SY** Compare the control and outputs achievable with the school's 3d printers, laser cutter and 3d mill.
● evaluate the principles of control systems, for example: – accuracy, eg automated production lines – reduced worker fatigue	Students to produce their own sticker to embellish their Submarine . Evaluating the accuracy and automation of Stika cutter.

• conduct experiments with a range of control devices and systems, for example: – calculate the efficiency of a system – determine the effect of moisture on a system – record the effect of vibration on a system	Interact with the laser cutter, Stika cutter, watering system, cistern float valve as well as soccer bot and Submarine .
• investigate the function of feedback in a control system	Experiment with the moisture sensor on the Arduino watering system. Discuss the use of rain sensor in watering system.
• follow a planned construction sequence, for example: – constructing projects within a prescribed timeframe	Develop a time plan for the production of the Submarine .
• examine work practices and apply these to quality of practical projects, for example: – using collaborative process to achieve efficiencies	Discuss the impact of efficient work practices and thorough planning on productivity and profitability
• modify component parts of a control system, for example: – adjusting tolerance – changing lever length	Design and cut the body of their Submarine with Illustrator and laser cutter.

Materials Students:	
• explore engineering properties of materials suitable for control systems, for example: – electronic properties – insulating properties – strength, toughness and durability	Discuss Ply vs acrylic, costs, advantages and disadvantages of other options and the pros and cons of strength and durability vs weight.
• apply an understanding of material properties in the design and production of control systems	Discuss and demonstrate the bimetal switch from a hot water system. Discuss implications of having a heating element on at all times. Discuss cost implications, implications on longevity.
• recognise the basic structure of metals, alloys, polymers, ceramics	
• investigate the properties and applications of materials, for example: – conductivity test of various wire types	

– copper as a conductor – polylactic acid (PLA) in 3D printing	

ols, equipment and techniques udents:	
● use a range of equipment, hand and power tools, and machines to carry out experiments and construct projects/working models/prototypes in control systems, for example: – holding and joining tools – marking-out and cutting tools – using power tools to drill, cut, shape and assemble components	Use tools and workshop equipment to produce projects
● apply a range of measuring tools and methods, for example: – allowing for tolerance on parts – micrometer – vernier caliper	Using a document camera demonstrate the method of reading and interpreting a vernier caliper and micrometer. Measure material thicknesses to input data into laser cutter for setup of cutting different materials
● investigate input and output components, for example: – stepper motors – book press – light, temperature, moisture and voltage sensors – using a smartphone to control home lighting	Students interact with a range of inputs and outputs such as cistern float, solenoid from remote central locking system, micro switches, motors, ultrasonic sensors, buzzers, water solenoid in a watering system, etc.
● investigate advanced manufacturing techniques to assist in the production of projects, for example: – CNC equipment – laser/plasma/water cutters – rapid prototyping	Students to be involved in the cutting of the components on the laser cutter. Students to view video of components being cut on the water jet cutter at Riverina jet cut. Show examples and discuss components cut on laser and water jet. Discuss the advantages of different applications. Eg heat can warp, crack or deform some materials, water jet good for glass, marble and stone.

Workplace communication skills Students:	
● recognise and comply with WHS signage	Produce safety sign for hot glue gun, soldering iron and drill press using St Claire safety sign builder
● select and use specialist terminology in context, for example: – glossary – procedure/storyboard – record of production	Complete steps of production worksheet before producing WMS
· read and interpret plans and/or materials lists to prepare materials for the completion of projects	Interpret and modify plans of Submarine body
● represent control systems using freehand sketching, for example: – the components of an oven temperature control system	Complete sketches of wiring diagrams of Submarine and algorithm of watering system
● produce annotated freehand sketches of project components and/or projects to visualise, communicate, understand and record ideas	Produce minimum 3 annotated design ideas for Submarine body before producing CAD drawings.
● modify and/or apply workshop drawings in the completion of projects, for example: ● – use CAD applications in the production of workshop drawings	Modify existing drawing of body and include in the project report.
● complete drawings applying relevant Australian Standards, for example: – orthogonal top and front views of a component in a system – pictorial sketch showing relationships between system component parts – correct standards applied to projection of views	Draw Submarine body in OnShape
● develop engineering reports using appropriate ICT, for example: – CAD – graphing results – project management tools – spreadsheets	Draw Submarine body in OnShape Complete project report in Word including a costing SS

● prepare engineering reports to describe the management and processes undertaken in the production of practical projects	Produce report with the production of the Submarine

cietal and environmental impact udents:	
● describe the impact of engineered control systems on society and the environment, for example: – driver assistance systems in motor vehicles, eg lane departure warning systems – traffic management systems, eg Sydney Coordinated Adaptive Traffic Control System (SCATS)	Discuss programming ethics. Complete moral machine as a class group, focusing on implications of decisions made during programming. Also discuss implications on employment rates, training required and numbers of low vs high skilled workforce.
● examine ethical and legal issues that apply to engineered control systems, for example: – the ethical responsibilities of system designers – the legal responsibility should a control system fail	

Links to industry Students:	
● compare and contrast contemporary industrial manufacturing techniques, materials and equipment with classroom experiences	Investigate yr 8 EEE Arduino claw arm project and parallel with robotic welders and milling machines in industry. **https://www.youtube.com/watch?v=34ro1uVguUs** **https://www.youtube.com/watch?v=RnIvhlKT7SY** Compare the control and outputs achievable with the school's 3d printers, laser cutter and 3d mill.
● compare technologies used in control systems engineering, for example: – autonomous transport compared to human driven transport – traffic control systems – wired compared to wireless sensors	

● identify and discuss various career opportunities in engineering that are involved in control system design, for example: – electrical engineer – software engineer	Careers research task

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Week	Planning & Theory	Practical	Registration
1	Complete Onguard safety tests. General safety, general machines, soldering irons, glue gun.	Demonstrate safe use of soldering irons and hot glue guns	

	Discuss fact sheets on burns, eye injuries, electric shocks & bleeding. Stick in books.		
2	Notes and worksheets on WHS Act 2011 Introduce Hierarchy of Control poster.	Start design of the Soccer bot and controller on Adobe Illustrator	
3	Introduce the hierarchy of control & concept of risk matrix Produce safety sign for hot glue gun, soldering iron and drill press using St Claire safety sign builder	Continue design of soccer bot and controller on Illustrator.	
4	Discuss programming ethics. Complete moral machine as a class group, focusing on implications of decisions made during programming. Also discuss implications on employment rates, training required and numbers of low vs high skilled workforce.	Continue design of soccer bot and controller on Illustrator. Students use the laser printer to cut their designs out of 3mm Ply.	
5	Students receive the Controled Systems Assignment due Week 11.	Students use the laser printer to cut their designs out of 3mm Ply. Using the Scorpiotec soccer bot pack students begin to assemble their soccer bots.	
6		Using the Scorpiotec soccer bot pack students contine to assemble their soccer bots.	
7		Using the Scorpiotec soccer bot pack students finish assembling their soccer bots.	
8	Discuss and demonstrate bimetal switch from a hot water system. Discuss implications of having heating element on at all times. Discuss cost implications, implications on longevity.	Using the Scorpiotec soccer bot pack students finish assembling their soccer bots.	

9	Discuss acrylic v ply and their properties, cost and ability to be shaped, ie laser cut, bent etc. Develop criteria to evaluate success for Submarine Start project report in Word	Using the students soccer bots race them around the obsitcal cource to see who receives the best time	
10	Develop a time plan for the production of the Submarine . Discuss the impact of efficient work practices and thorough planning on productivity and profitability	Complete the evaluation sheet for the soccer bot.	
11	Complete steps of production worksheet before producing WMS Complete a WMS for the construction of the Submarine . Controlled Systems Assignment is due	Investigate the function of a garden watering system. Discuss components and how to program. Experiment with inputs and outputs. Eg Controller, solenoids, moisture and rain detectors. Students interact with a range of inputs and outputs such as cistern float, solenoid from remote central locking system, micro switches, motors, ultrasonic sensors, buzzers, water solenoid in a watering system, etc.	
12	Students to complete an algorithm to explain the programming of a garden watering system. Understand materials properties to maximise the efficiency and longevity of the system. **https://www.youtube.com/watch?v=d9HNaeS9N0A** Compare with an Arduino controlled watering system with pump and moisture detector. Discuss need for relays in low current systems.	Produce minimum 3 annotated design ideas for Submarine body before producing CAD drawings. Modify existing drawing of body and include in project report.	
13	Examples in notes and on board of calculations converting units ie mm to m, imperial to metric. Change settings in Illustrator.	Students to design Submarine body and produce drawings in Illustrator to own specs to maximise the functionality of the final vehicle.	

14	Discuss hydraulic digger project from last year. Investigate yr 8 EEE Arduino claw arm project and parallel with robotic welders and milling machines in industry. **https://www.youtube.com/watch?v=34ro1uVguUs** **https://www.youtube.com/watch?v=RnIvhlKT7SY** Compare the control and outputs achievable with the school's 3d printers, laser cutter and 3d mill. Students to view video of components being cut on the water jet cutter at Riverina jet cut. Show examples and discuss components cut on laser and water jet. Discuss advantages of different applications. Eg heat can warp,	Continue designing the Submarine in Illustrator.	
15	Complete project production sequence worksheet before completing SWMS Submarine .	Design and cut the body of their Submarine with Illustrator and laser cutter.	
16		Complete sketches of wiring diagrams of Submarine and algorithm of watering system	
17	Using a document camera demonstrate the method of reading and interpreting a vernier caliper and micrometer. Measure material thicknesses to input data into laser cutter for setup of cutting different materials	Begin to assemble the motors on the students submarines	
18		Continue to assemble the submarines	
19	Complete excel SS on costing whole class of projects	Students to produce their own sticker to embellish their Submarine . Evaluating the accuracy and automation of Stika cutter.	

20	Careers research task	Test students submarines in a large bucket of water.	