Advanced Manufacturing Industry
SCHOOLS PATHWAY PROGRAM

SCHOOL DEVELOPED BOARD ENDORSED COURSE

iSTEM

Integrated Skills, Technology, Engineering & Mechanics

Developed by:

Mr Scott Sleap, Mr Matt Davies, Mrs Jane Rose and Mr Roger Allon from Maitland Grossmann High School for the Advanced Manufacturing Industry Schools Pathway Program

Forward

The importance of Science, Technology, Engineering and Mathematics subjects to Australia's future workforce is indisputable. In 2012, Ian Chubb, Chief Scientist of Australia triggered a major focus on the decline of interest in STEM studies across the nation and its potential impact on our future. These sentiments were reinforced in a report by the Chief Executive of the Australian Industry Group, Innes Willox in 2013 stating "It is time for a major re-think of the Australian education system to address the failure to give young people the science, technology, engineering and mathematics (STEM) skills which business so desperately needs."To this end the Advanced Manufacturing Industry Schools Pathway Program, known in the Hunter as the ME Program has achieved significant gains in the uptake of STEM subjects in the Higher School Certificate.

iSTEM is an attempt to capture the essential aspects of the ME Program, to create engaging and meaningful experiences for students and to reflect the skill requirements of industry. The collaborative development of the program across school faculties and through the consultation with industry has led to an academically robust and unique course that will serve their students and ultimately industry well. Regional Development Australia - Hunter would like to congratulate and thank the teachers of Maitland Grossmann High School for their achievement.

ME Program Manager – Ashley Cox

Contents

1. Rationale

Science, technology, engineering and mathematics are fundamental to shaping the future of Australia. They provide enabling skills and knowledge that increasingly underpin many professions and trades and the skills of a technologically based workforce. The iSTEM program utilises these knowledge sources in application to Skills, Technology Engineering and Mechanics.

Australia's graduation rates in science, technology, engineering and mathematics are low by international standards. Yet a high output in these disciplines is seen to be a critical underpinning for the future of innovative economies. Policies are emerging around the world that focus on these fields and seek to grow the supply of graduates with the skills and knowledge developed through a quality education in STEM subjects. The reason is straightforward, the world's dependence on knowledge and innovation will grow and not diminish and to be ahead in the race, a community needs the skills to anticipate rather than follow.[i]

In the United States (U.S.), it is estimated that scientific innovation has produced half of all economic growth in the last 50 years. The science, technology, engineering and mathematics fields and those who work in them are critical engines of innovation and growth, according to one recent estimate, the STEM workforce accounts for more than fifty percent of sustained economic growth in the U.S.[ii]

The economic value of STEM cannot be underestimated with 1 in 18, or some 7.6 million workers in the United States being employed in STEM based careers as a technician, technologist, engineer or scientist. Projected growth in STEM based occupations is 17% between 2008 and 2018; compared to 9.8% for non-STEM occupations. STEM workers earn on average 26% higher wages than their non-STEM counterparts and more than two-thirds of STEM workers have at least a University degree, compared to less than one-third of non-STEM workers. A STEM degree means higher wages regardless of what area they are employed.[iii]

The recommendations from the report, Mathematics, Engineering & Science, in the National Interest, from the of the Chief Scientist, May 2012, states that "teachers, have the greatest influence on the choices students make and we need to ensure that the school sector maximises interest and provides opportunities for all students to study high quality mathematics and science courses leading to careers in those disciplines and in engineering. [i] The Smarter Schools National Partnerships, in particular, the National Partnership Agreement on Improving Teacher Quality, both concur with many of the objectives discussed above.

According to the Australia Bureau of Statistics, in Australia the proportion of mathematics and science students in schools still goes down and in universities (as with engineering) it is virtually flat[iv]. Albert Einstein's definition of insanity is "doing the same thing over and over again and expecting different results", something different has to be done demanding a paradigm shift in our schools.

There are a number of highly successful STEM based intervention programs in operation across Australia, some international and national programs include; F1inSchools, the ME program, Science and Engineering Challenge, RoboCUP, Electric Vehicle Festival, Solar Car Challenge, Pedal Prix, Science and Technology Education Leveraging Relevance (STELR) program, and many others. The challenge for schools has been integrating these programs into their existing curriculum.

At Maitland Grossmann High, we are currently involved in the following STEM intervention programs; ME, F1inSchools, the Science and Engineering Challenge, RoboCUP, Electric Vehicle Festival, and STELR. Many of these programs are run partially within, but mainly outside the current school curriculum. The development of the iSTEM course is in part as a result of the need for the school to provide a more structured approach to gaining the most out of these intervention programs. Although components of the Board of Studies NSW, design & technology, graphics technology and industrial technology – engineering, syllabuses can be adapted to accommodate some parts of these STEM programs, none are suitable to implement the full program of study.

The proposed iSTEM program utilises a practical integrated approach with engineering and technology being used to drive interest in science and mathematics, through the development of technical skills and mechanical engineering knowledge. Its purpose is to increase the numbers of students studying STEM based subjects in the senior years and ultimately the number of student matriculating to tertiary study in the STEM areas.

Pure mathematics and science topics are not included in this course proposal, it is not intended as being a vehicle to increase the number of hours in which students study pure science or mathematics in Stage 5. Instead students learn about technological and engineering concepts which by their very nature are scientific and mathematical. Great effort has been taken to ensure that no specific content that appears in the upcoming science or mathematics NSW syllabuses incorporating the Australian Curriculum have been repeated in this course.

In the recent review of Science, Mathematics and Engineering (2012) by the Office of the Chief Scientist of Australia, it was commented that teaching needs to be high quality and inspirational while science and mathematics based content was generally seen as

…"irrelevant to life after school." and "Content based teaching is seen as boring because so much is seen as knowledge transmission of correct answers with neither time nor room for creativity, reflection or offering opinions". [i]

The development of effective and attractive STEM curricula and teaching methods, - are at the heart of the drive to make STEM studies and careers a more popular option for young learners[v]. Inspiring students to engage with mathematics and science can be best achieved by teachers who are passionate about the subject and have the knowledge and confidence to present the curriculum imaginatively. [vi]

According to Sanders[vii] the integrative STEM education pedagogical model is best practice when delivered through technology education. In addition over the past two decades, the technology education literature has been heavily populated with articles describing instructional materials designed to integrate technology, science, and mathematics and articles addressing issues associated with the integration of STEM concepts and practices. There is strong evidence to suggest that the approach taken in this course is "best practice" and will lead to advantageous outcomes for students. [viii]

This stage 5 iSTEM School Developed Board Endorsed Course is our attempt to provide an innovative and imaginative curriculum which will inspire students to take up the challenge of a career in Technology or Engineering.

2. Course Structure

This School Developed Board Endorsed Course covers a number of modules in the fields of technology and engineering, they include; Engineering Fundamentals, Aerodynamics, Motion, Mechatronics and the Major Research Project. These specific modules are not reflected together in any Board Syllabus document.

There are five compulsory modules of which module 1 is to be completed first as the knowledge and skills developed in this module are applied and enhanced in subsequent modules. Module 2 (50 hours) and modules 3 and 4 (25-30 hours each) can be taught in any order, however, module 5 (40-50 hours) should be completed concurrently, with module(s) 3 and 4 totalling 50 hours. This is to maximise the use of resources and provide adequate time for students to complete quality work.

Individual modules provide specific content related to CNC, mechatronics, aerodynamics, computer controlled machining, computer integrated manufacture, product modelling and testing which will be developed in the key areas of; Skills, Technologies, Engineering Principles and Processes and Mechanics.

100 Hours		100 Hours	
Module 1 Engineering Fundamentals 25 Hours	**Module 2** Aerodynamics 25 Hours	**Module 4** Motion 25 Hours	**Module 5** Mechatronics 25 Hours
Module 3 3D CAD/CAM 50 Hours		**Module 6** Research Project 50 Hours	

Inquiry-Based Learning

To satisfy the requirements of the course students must undertake a range of inquiry-based learning activities which occupy the majority of course time. Inquiry-based learning assists students to actively pursue and use technological knowledge rather than experience it as pre-packaged and complete – to be accepted and practised. Thus in the course structure there are many points at which students raise questions and explore ideas.

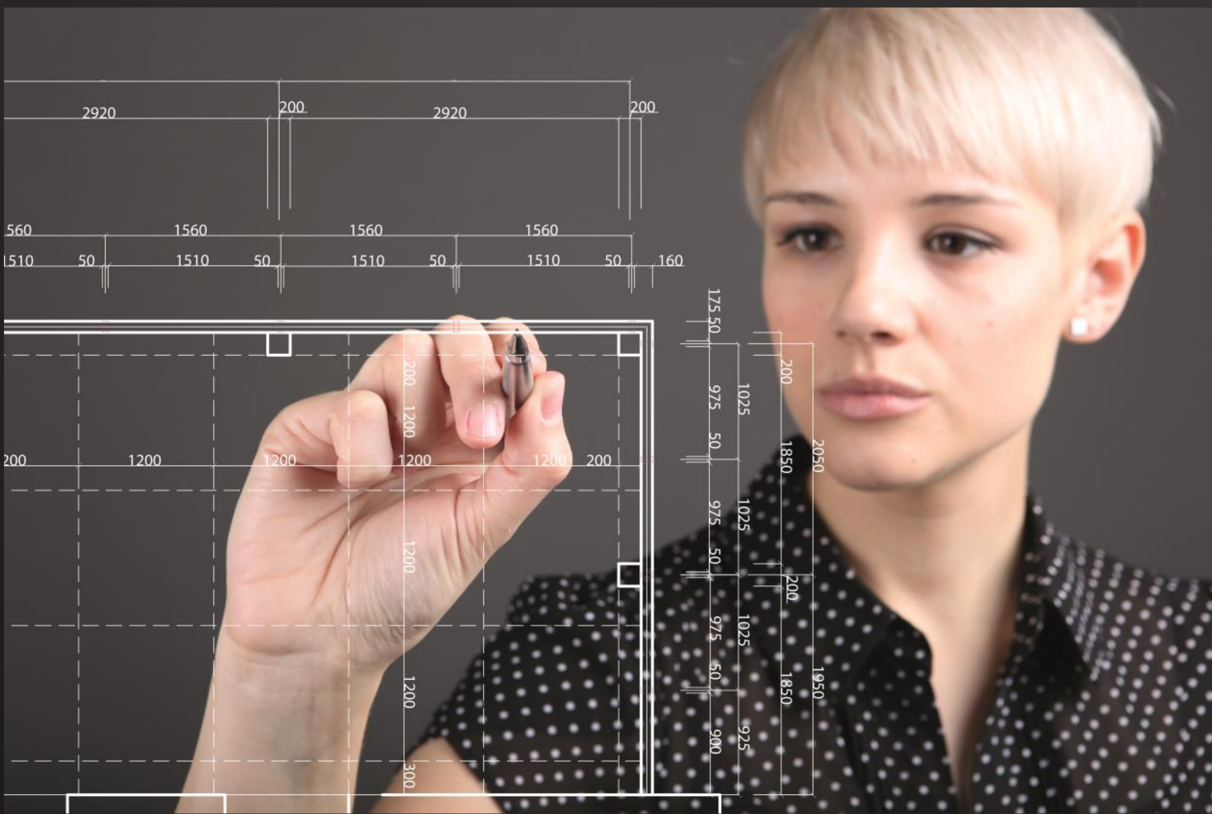
In module 1 activities ‘guided inquiry’ strategies are used, but students are later encouraged to shape their own inquiry around questions that interest them, such as the Major Research

Project (module 5). This involves students being able to design investigative approaches. These include experimental as well as other primary and secondary research approaches.

The core principle that has been used to describe inquiry is ‘explore before explain’, meaning that students are introduced to technological and engineering concepts after they have explored phenomena and raised question implying a need for these;

Inquiry-Based Pedagogies;

- Involve students in initial exploration before ideas are introduced and explanations developed,
- Incorporate and value students’ own questions,
- Involve open ended investigation as part of the teaching sequence,
- Use activities’ to explore and develop ideas rather than simply demonstrate previously presented ideas. [ix]



3. Aims

The aim of the iSTEM course is to promote the areas of science, technology, engineering and mathematics through the study of technology, engineering, skills and mechanics.

Students will learn to use a range of tools, techniques and processes, including relevant technologies in order to develop solutions to a wide variety of problems relating to their present and future needs and aspirations.

iSTEM aims to reverse these lowered participation rates by inspiring and enabling secondary school students to appreciate the role and potential of science, technology, engineering and mathematics in the world in which they live, and to learn from their journey of technological inquiry, the essence of evidence-based critical thinking.

One of the aims of the iSTEM course is to increase the number of students studying physics, chemistry, engineering, design and technology, computing and mathematics subjects at the upper secondary school level. This is to be achieved through an integrative technology and engineering course structure, which give practical relevance to scientific and mathematical concepts.

Secondary aims of the iSTEM course include;

1. Improve the level of technological and engineering literacy and understanding in the community,
2. Prepare students to engage with engineering ideas and be knowledgeable about the way engineers and technologists work,
3. Increase the number of students choosing science and engineering careers to address the shortage of science and engineering graduates,
4. Increase students’ awareness of careers in STEM areas including trades,
5. Improve the quality of classroom teaching practices and enable teachers to develop confidence and skills that will assist them in delivering the Australian Curriculum,
6. Improve teaching quality through a cross-curriculum approach to programming and lesson delivery.

4. Objectives

Knowledge, Understanding and Skills

Students will develop:

1. inquiry based learning skills appropriate to technological and engineering practice;
2. knowledge and understanding of scientific and mechanical concepts through investigations of technology and engineering;
3. knowledge and understanding of technological and engineering principles and processes;
4. skills in solving technology based problems using mechanical, graphical and scientific methods;
5. skills in communicating and critically evaluating;
6. problem-solving skills in a range of technological and engineering contexts.

Values and Attitudes

Students will develop:

1. an appreciation of the role and potential of science, technology, engineering and mathematics in the world in which they live.

5. Objectives and Outcomes

Table of Objectives and Outcomes

Objectives Students will develop:	**Stage 5: Outcomes** A student:
1. inquiry-based learning skills appropriate to technological and engineering practice	5.1.1 develops ideas and explores solutions to technological and engineering based problems 5.1.2 designs and investigates different approaches in the development of engineered solutions
2. knowledge and understanding of scientific and mechanical concepts through investigations of technology and engineering	5.2.1 describe how scientific and mechanical concepts relate to technological and engineering practice 5.2.2 applies and transfers acquired scientific and mechanical knowledge to subsequent learning experiences in a variety of contexts
3. knowledge and understanding of technological and engineering principles and processes	5.3.1 applies a knowledge and understanding of engineering principles and processes 5.3.2 identifies and uses a range of technologies in the development of solutions to engineering problems
4. skills in solving technology based problems using mechanical, graphical and scientific methods	5.4.1 uses mathematical, scientific and graphical methods related to technology and engineering 5.4.2 develops skills in using mathematical, scientific and graphical methods whilst working as a team

5. skills in communicating and critically evaluating	5.5.1 applies a range of communication techniques in the presentation of research and design solutions 5.5.2 critically evaluates innovative, enterprising and creative solutions
6. problem-solving skills in a range of technological and engineering contexts	5.6.1 selects and uses appropriate problem solving techniques in a range of technological and engineering contexts 5.6.2 will work individually or in teams to solve problems in technological and engineering contexts
7. an appreciation of the role and potential of science, technology, engineering and mathematics in the world in which they live	5.7.1 demonstrates an appreciation of the role and potential of science, technology, engineering and mathematics in the world in which they live

6. Content: Stage 5 iSTEM

Module 1: Engineering Fundamentals
25 Hours Indicative Time

This module develops an understanding of the basic principles associated with iSTEM. To satisfy the requirements of this course, students must undertake a range of experimental, group work and inquiry-based learning activities, that occupy the majority of course time. These activities should be used to develop a deep knowledge and understanding of Engineering; Skills, Technologies, Principles & Processes, Mechanics.

Skills	
Students Learn About:	**Students learn To:**
5.1.1 engineering investigations - systematic observation - measurement - experiment - formulation, testing and modification of hypotheses - engineering drawing	- design investigations which produce valid and reliable data - investigate engineering problems using primary and secondary sources - use identified investigative strategies to develop a range of solutions to engineering problems - use AS1100 standards to interpret engineering drawings.
Technologies	
5.1.2 the use of technology in developing engineered solutions to problems - hardware - software - LEAN Manufacturing processes	- describe a range of technologies used to collect, organise and analyse data - use a variety of technologies which assist in investigations into engineered solutions - utilise various hardware and software technologies to solve a broad range of engineering problems - develop an awareness of LEAN manufacturing processes
Engineering Principles & Processes	
5.1.3 fundamental engineering principles - strength of materials - material properties - fluid mechanics - electricity & magnetism - thermodynamics	- carry out experiments to demonstrate basic engineering principles - determine the properties of materials - use models to demonstrate describe Pascal's Principle - complete basic experiments involving electricity and magnetism - explain basic thermodynamic processes.

Mechanics	
5.1.4 fundamental engineering mechanics - basic units - prefixes - statics - dynamics - modelling	- apply units to concepts of engineering mechanics - utilise metric prefixes related to every day technologies - complete basic calculations related to engineering statics - describe the difference between a static and a dynamic - simulate mathematical problems using appropriate modelling techniques.
Problem Solving & Design	
5.1.5 problem solving - nature of - strategies to solve - evaluation - collaboration	- identify the nature of engineering problems - use identified strategies to develop a range of possible solutions to every day engineering problems - evaluate the appropriateness of different problem solving strategies - work collaboratively to solve problems - draw information from a range of sources to aid in the solution of practical everyday problems.

Engineering Applications Module 2: Aerodynamics
25 Hours Indicative Time

Select one or more related areas as a theme for an introduction to the engineering concepts related to aerodynamics. Possible examples include: aeronautics, aerospace industries, F1inSchools program, CO_2 dragsters, Scalectrix cars, kites, motor racing, or sports science. In this module students will utilise inquiry-based learning strategies to develop solutions to aerodynamic problems.

Skills	
Students learn about:	**Students learn to:**
5.2.1 research and exploration - interpreting and analysing data - quantitative and qualitative research - surveys - interviews - observation - testing and experimenting	- analyse, interpret and apply research data in the development of aerodynamic projects - complete quantitative and qualitative research - use research techniques to develop design ideas by testing and experimenting - select and use a variety of research methods to inform the generation, modification, and development of aerodynamic projects - experiment to optimise solutions for aerodynamics related projects.
Technologies	
5.2.2 technologies related to aerodynamics - wind tunnels - smoke tunnels - computational fluid dynamics (CFD)	- describe a range of technologies used in aerodynamics - perform experiments using a range of aerodynamic technologies to solve engineering problems - utilise modelling software to determine optimum aerodynamic conditions using CFD techniques.
Engineering Principles and Processes	
5.2.3 aerodynamics principles - dynamic, static friction - lift/drag ratios - lift, drag, weight, thrust - Finite Element Analysis (FEA) - flight	- explain aerodynamic principles - describe the effects of lift, drag, weight and thrust - design, construct or simulate solutions to problems related to friction - construct models for the purpose of solving aerodynamic problems - describe how Finite Element Analysis is applied aerodynamic systems.

Mechanics	
5.2.4 aerodynamics forces - lift, drag, weight, thrust - simple vectors - efficiency	- apply mathematical and graphical methods to solve aerodynamic related problems - determine solutions using vector notation - solve aerodynamic problems related to lift, drag, weight and thrust - perform simple calculations related to efficiency.
Problem Solving & Design	
5.2.5 aerodynamic design solutions	- develop engineered solutions to meet detailed specifications - evaluate results from testing to improve aerodynamic performance of engineered solutions - uses appropriate design processes and techniques in the context of developing engineered solutions.

Engineering Applications Module 3: 3D CAD/CAM
50 Hours Indicative Time

Students develop skills in Computer Aided Design (CAD) and Computer Aided Manufacture (CAM). Possible examples of CAD Software include: CREO, CATIA, Google Sketchup, & Solid Works. Possible examples of CAM hardware include: 3D printers, CNC Mills, CNC Routers, CNC Lathes, etc. In this module students will manufacture three dimensional objects for which they have designed.

Skills	
Students learn about:	**Students learn to:**
5.3.1 CAD/CAM - 3D drawing on an x, y & z axis. -basic commands in a 3D CAD package - CAM processes	- use common features in a 3D CAD package to produce parts, products and assemblies in order to design 3D objects use photorealistic rendering techniques to professionally present 3D designs - modify 3D CAD drawings so they can be manufactured using 3D technologies - manipulate Computer Aided Manufacturing processes to produce parts for an assembly.
Technologies	
5.3.2 technologies related to CAM - 3D Printers - Computer Numerical Controls - CNC, mills, routers & lathes	- describe a range of technologies used in CAD and CAM processes - perform experiments using a range of CAM technologies to solve engineering problems - use a variety of technologies which assist in the rapid prototyping process - utilise 3D drawing and manufacturing software to produce new products.
Engineering Principles and Processes	
5.3.3 CAD/CAM operations - Reading and interpreting engineering drawings - rapid prototyping - 3D CAD operations - Computer Aided Manufacturing (CAM) - 3D modelling	- read and interpret basic engineering drawing conventions - explain the operation of CAD/CAM software and hardware - describe how rapid prototyping works - design, construct parts, products or assemblies using CAD software and producing them using appropriate CAM software - produce practical solutions to set problems construct 3D models.

Mechanics	
5.3.4 3D environments - vectors - 3D Shapes - Computer Numerical Control - spatial comprehension - 3D Surface Modelling	- apply mathematical and graphical methods to solve questions related to 3D vectors - determine solutions to simple problems using vector notation - manipulate 3D shapes and objects - construct source code for 3D CAM operations.
Problem Solving & Design	
- 5.3.5 CAD/CAM	- design parts, products or assemblies to meet specific criteria - solve problems related to typical Computer Aided Manufacturing issues.

Engineering Applications Module 4: Motion
25 Hours Indicative Time

Select one or more related areas as a theme for an introduction to the engineering concepts related to motion. Possible examples include: solar powered cars, electric vehicles, wind powered devices. In this module students will utilise inquiry-based learning strategies to develop solutions to problems associated with motion.

Skills	
Students learn about:	**Students learn to:**
5.4.1 Electronics - circuitry - motors & generators - fault detection Prototypes - making models - practical applications	- design and construct basic electronic circuitry related to electric vehicles - develop basic motors and generators - use fault diagnosis techniques to isolate problems - use multimeters to test circuits and components - use continuity testers/multimeters in the production and testing of practical projects - develop prototypes using a variety of materials to simulate motion - produce models in order to solve engineering problems related to motion.
Technologies	
5.4.2 technologies related to motion - gyroscopes - accelerometers - sensors - CRO	- describe how various technologies related to motion function - apply various motion technologies to the design of student projects.
Engineering Principles and Processes	
5.4.3 energy - energy sources - motors - electric vehicles - motion	- identify and describe a range of energy sources including renewables and non-renewables - utilise electric motors to develop a project related to motion - select and use a range of components and hardware in the development and production of a practical project related to motion.

Mechanics	
5.4.4 motion - velocity - acceleration - inertia - circular motion - momentum	- apply mathematical and graphical methods to solve motion related problems involving velocity, acceleration, inertia, circular motion and momentum - determine solutions to simple problems related to motion - perform simple calculations related to momentum.
Problem Solving & Design	
5.4.5 developing projects related to motion	- apply problem solving techniques to identified problems related to motion - plan, implement and evaluate a sequence of operations for the completion of design projects related to motion.

Engineering Applications Module 5: Mechatronics
25 Hours Indicative Time

Select one or more related areas as a theme for an introduction to the engineering concepts related to Mechatronics. Possible examples include: Robotics, Lego Mindstorms, PLC's, Pneumatic & Hydraulic systems, etc. In this module students will utilise inquiry-based learning strategies to design & develop solutions to problems associated with combined mechanical and electrical systems.

Skills	
Students learn about:	**Students learn to:**
5.5.1 mechatronics - building mechatronic components - programming logic - writing macros - fault finding	- build mechatronic components using a variety of electrical, and mechanical componentry - use a range of equipment to carry out experiments and construct projects in relation to mechatronic systems - use a programming language to control mechatronic devices - write macros to complete a variety of operations involving mechatronics
Technologies	
5.5.2 technologies related to robotics - sensors and transducers - manipulators - PLC's - actuators (pneumatic & hydraulic)	- apply and understand the uses of a range of sensor and transducer technologies - incorporate mechatronic hardware to complete a variety of problem solving tasks - use a programmable logic controller to actuate a pneumatic or hydraulic device - utilise and program devices to perform a variety of control or monitoring tasks.
Engineering Principles and Processes	
5.5.3 mechatronics - logic gates - mechanical and electrical actuation systems - motors	- plan solutions to problems using logic gates - design, construct and evaluate motorised mechatronic systems which solve identified problems. - use a variety of mechanical and electrical actuation systems to solve every day problems - develop programming skills to manipulate sensors, motors, and actuators.

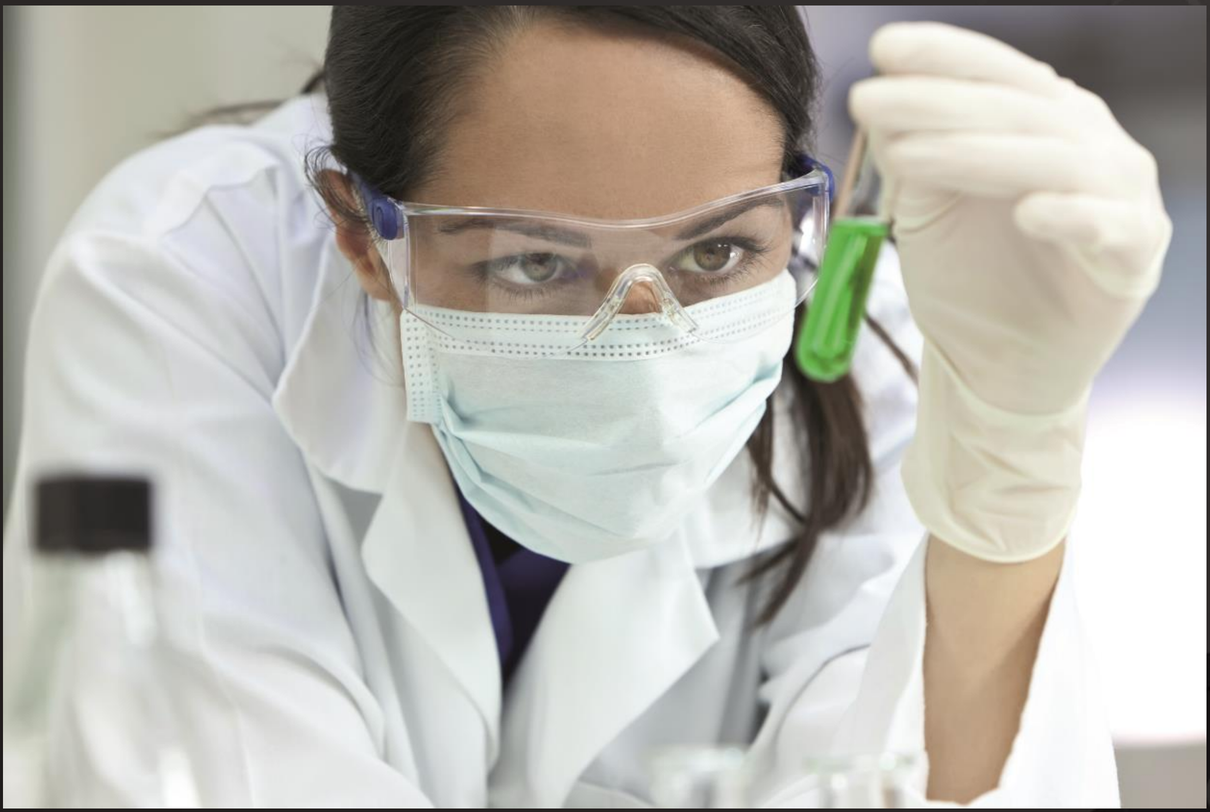
Mechanics	
5.5.4 programming & computations - algorithms - calculating distance - trigonometry - circle geometry - input/output systems	- solve practical logic problems with applications to mechatronics using algorithmic functions - make predictions involving, time, distance, speed, velocity with robotics - use trigonometry to determine efficient pathways - use circle geometry to understand movement in order to solve problems.
Problem Solving & Design	
5.5.5 design mechatronic solutions for a range of applications	- design solutions to various mechatronic applications to meet set criteria(s) - produce peripheral enhancements to mechatronic devices to provide additional functions - use innovative processes to create mechatronic devices which meet societal needs in the near future.

Engineering Applications Module 6: The Research Project
50 Hours Indicative Time

In this module students are to develop and realise a major scientific research project. The project involves students utilising inquiry based learning strategies to apply appropriate design, production and evaluation skills to a contemporary scientific or technological based problem. The students relate the techniques and technologies used in previous modules to those used in the development of the research project. The research project is expected to be similar to a science fair concept, popular in the United States.

Skills	
Students learn about:	**Students learn to:**
5.6.1 design processes - identifying problems - project management - developing solutions to problems - generating ideas	- develop a research project proposal - respond to the findings of experimentation and research follow a process to identify and solve contemporary needs of society - formulate management plans including; i) action ii) time iii) finance - manage a research project that successfully solves an identified problem - select and apply appropriate research methods to solve a scientific or technological problem - justify decisions made based on the analysis of data - identification and exploration of the research problem - areas of investigation - criteria to evaluate success
Technologies	
5.6.2 presentation and communication technologies	- select and use appropriate communication techniques for the development of a major research project - appropriate technological processes
Engineering Principles and Processes	
5.6.3 realisation, evaluation, research methods and experimentation	- test possible solutions to research problems - use tools, materials and processes to produce a solution to an identified research problem - develop methods to communicate solutions to problems through a visual display

	- conduct continual evaluations throughout the design and production of the research project - evaluate the research project in terms of the identified criteria for success.
Mechanics	
5.6.4 mechanical knowledge	- demonstrate mechanical aptitude in the development of research solutions
Problem Solving & Design	
5.6.5 creative and innovative approaches to solve problems	- demonstrate creativity and problem solving skills in the development of the research project.



7. Sample Assessment Schedule

Year 9

Outcomes	Modules 1, 2& 3	Weighting	Components	Task 1 Inquiry Based Learning Activities	Task 2 Aerodynamic Design	Task 3 CAD/CAM Project	Task 4 Examination	Total
5.1.2, 5.2.2	Engineering Fundamentals, Aerodynamics, 3D CAD/CAM	10	Research	5	5			10
5.1.1, 5.4.1, 5.4.2, 5.5.1	Engineering Fundamentals, Aerodynamics, 3D CAD/CAM	40	Skills	5	15	20		40
5.6.1, 5.6.2, 5.3.2, 5.5.2	Engineering Fundamentals, Aerodynamics, 3D CAD/CAM	30	Problem Solving	5	10	15		30
5.2.1, 5.3.1	Engineering Fundamentals, Aerodynamics, 3D CAD/CAM	20	Knowledge & Understanding				20	20
TOTAL		**100**		**15**	**30**	**35**	**20**	**100**

Year 10

Outcomes	Modules 1, 2& 3	Weighting	Components	Task 1 Motion Project	Task 2 Mechatronics DesignTask	Task 3 Research Project	Task 4 Examination	Total
5.1.2, 5.2.2	Motion, Mechatronics, Research Project	10	Research			10		10
5.1.1, 5.4.1, 5.4.2, 5.5.1	Motion, Mechatronics, Research Project	40	Skills	10	10	20		40
5.6.1, 5.6.2, 5.3.2, 5.5.2	Motion, Mechatronics, Research Project	30	Problem Solving	10	10	10		30
5.2.1, 5.3.1	Motion, Mechatronics, Research Project	20	Knowledge & Understanding				20	20
TOTAL		**100**		**20**	**20**	**40**	**20**	**100**

8. Letter of Support Varley Industries

VARLEY
WWW.VARLEYGROUP.COM

12 April 2013

To whom it may concern

I am writing to you to express the support of this company for the STEM Syllabus drafted by Mr Scott Sleap at Maitland Grossmann High School.

My company is a well established manufacturing company which employs a total of more than 600 people. In recent years we have experienced shortages of skilled people to take up a range of positions including but not limited to:

- Trades apprentices
- Qualified trades positions
- Trades assistants
- Draftspersons
- Engineers
- Technical / subject matter experts.

It is my view that the approval and introduction of the STEM Syllabus will provide appropriate opportunities for school students to build their understanding of and skills suited to most, if not all, of the above. The outcome will undoubtedly be new entrants to the manufacturing sector who have built an appropriate foundation of knowledge and who will be highly motivated to contribute to and succeed within our sector.

This Syllabus appears to be ground-breaking through the integration of content areas that have historically been treated as stand-alone. Furthermore, the syllabus provides 'grounded' content through the inclusion of projects which have typically been conducted as extra-curricular activities and yet which are highly relevant in establishing the basis for future vocational studies and applications.

It is clear that this syllabus will develop the capability of today's students to be the thinkers and innovators of tomorrow, contributing to higher levels of productivity in workplaces and strengthening our regional and national economy.

The submission has my full support.

Should you wish to discuss this endorsement with me, please feel welcome to contact me.

Yours Faithfully
GH VARLEY

Jeff Phillips
Managing Director

9. References

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[i]Office of the Chief Scientist of Australia (2012) *Mathematics, Science and Engineering, in the National Interest*, Commonwealth of Australia

[ii] U.S. Department of Labor (2006), *The STEM workforce challenge: the role of the public workforce system in a National solution for a competitive STEM workforce*

[iii]ESA (2009) *Calculations using Current Population Survey public-use micro data and estimates from the Employment Projections Program of the Bureau of Labour Statistics USA*

[iv]*2002-2010 maths participation based on the Annual National Report on Schooling in Australia, DEEWR unpublished data and the ABS*

[v]Kearney, C. (2010) *Efforts to Increase Students' Interest in Pursuing Mathematics, Science and Technology Studies and Careers. National measures taken by 16 of European Schoolnet's member countries*

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[ix]Australian Academy of Technological Sciences and Engineering, STELR program (2010), *STELR Teacher Handbook*