



Engineering Mathematics for VET Articulants Transitioning to University Study

**Irene Penesis¹, Sue Kilpatrick¹, Dayna Broun¹,
Shaun Belward², Robin Barnes¹, John Roddick³, Giles Thomas¹,
Bernardo Leon de La Barra¹,
Karl Sammut³ and Richard Symmonds³**

1. **University of Tasmania**
2. **James Cook University**
3. **Flinders University**

Background

Bigger project - Development of Mathematics Pathways for VET Students to Articulate to Related Higher Education Courses

Disciplines covered include Education, **Engineering**, Health Science and Business

Funded by OLT: 2013 to 2015 (2.5 years), \$219000.

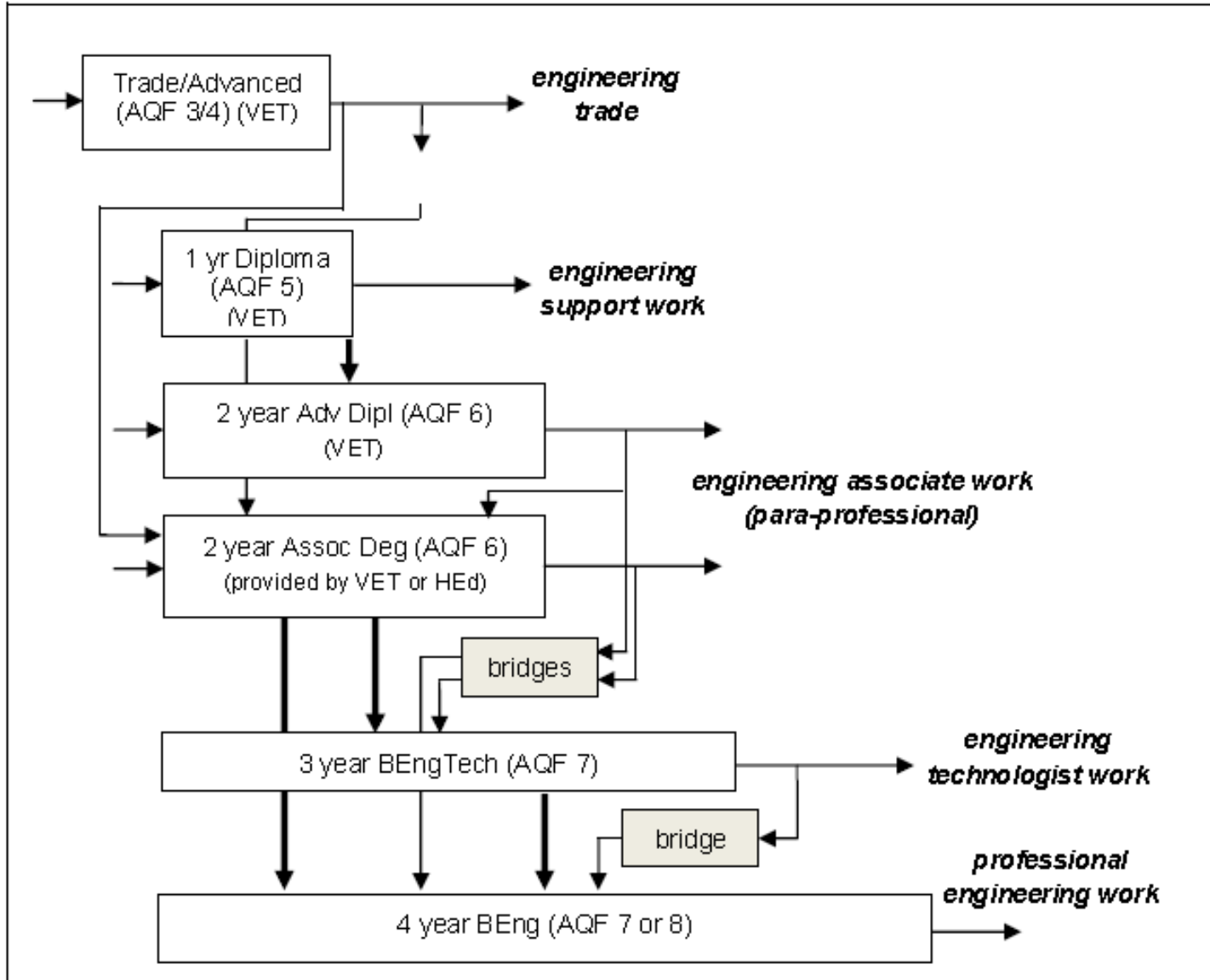
Need in engineering

Under-supply of engineering graduates through Australian higher education (HE) programs

Under-representations of female undergraduates and from low SES backgrounds

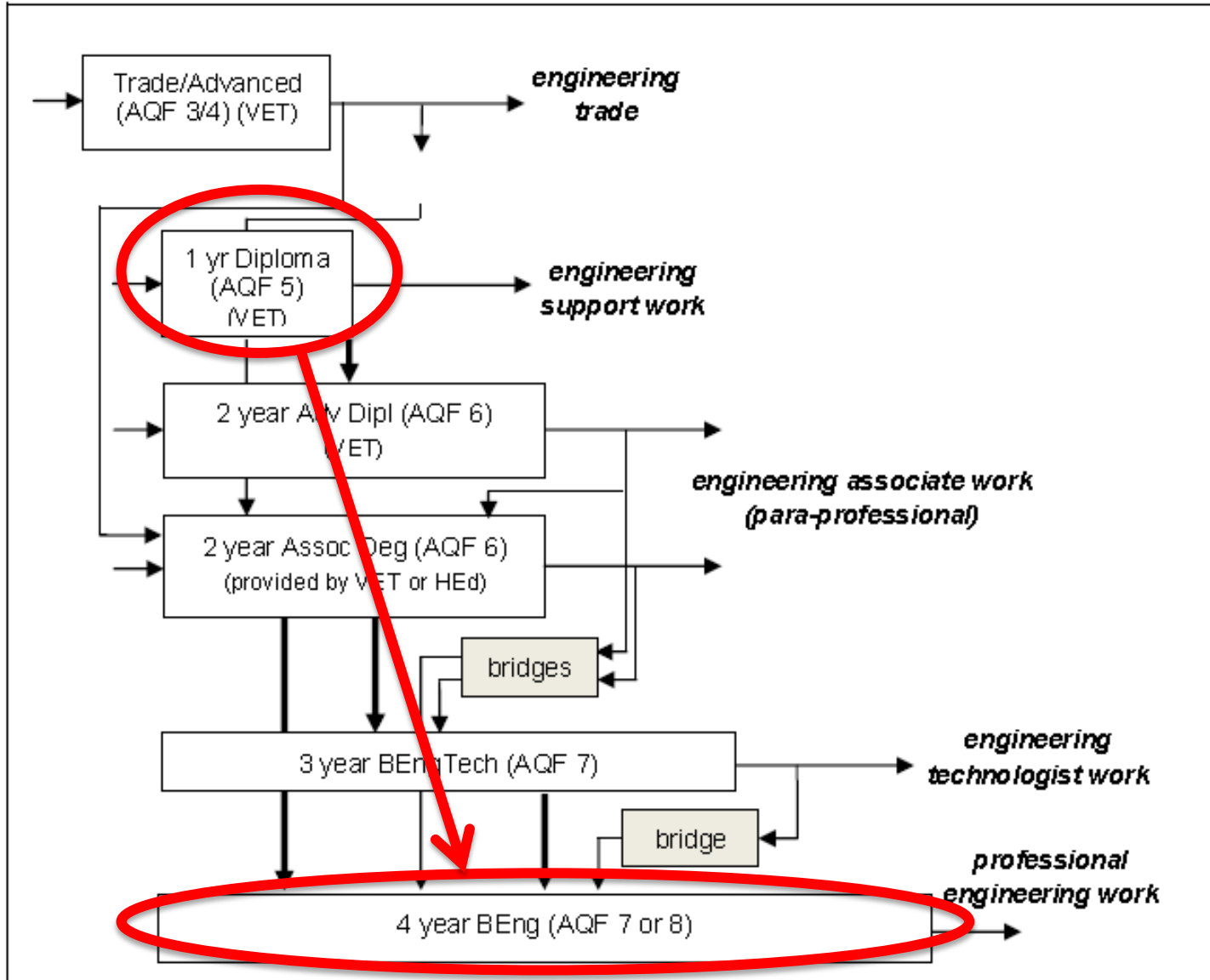
There is a need to facilitate transfer of students from vocational education and training (VET) to HE

From VET to HE



Copied from:
Pathways from VET Awards to Engineering Degrees: a higher education perspective
 Robin King,
 David Dowling
 and Elizabeth Godfrey (2011)

From VET to HE



Copied from:
Pathways from VET Awards to Engineering Degrees: a higher education perspective
 Robin King,
 David Dowling
 and Elizabeth Godfrey (2011)

What is in the pathway?

This OLT-funded project only looks after mathematics

Mathematics to satisfy the prerequisite or assumed knowledge for entry to BEng:

[Mathematical Methods](#) in the new Australian Curriculum (intermediate senior mathematics)

Pathways to HE (BEng)

OLT Mathematics Pathways

Engineering

The Engineering pathway could be completed through

VET Diplomas

MEM50212	UEE50511
MEM50105	ICT50210
UEE50111	MSA50108
UEE50411	RII50509

UTAS/JCU/FU

Engineering courses that the partner Universities offer
 FU – Engineering Fundamentals A&B
 UTAS – KMA002&003
 JCU – MA1020 & 1000

Online

Through existing online Foundation courses for example: UniLearn, USQ, Open Uni

Resources – free and available online – self-directed learning and self assessed through online quizzes

New Learning Resources

Existing Online Resources

All learning materials will be contextualised for Engineers

Pathways to HE (BEng)

OLT Mathematics Pathways

Engineering

The Engineering pathway could be completed through

VET Diplomas

MEM50212	UEE50511
MEM50105	ICT50210
UEE50111	MSA50108
UEE50411	RII50509

UTAS/JCU/FU

Engineering courses that the partner Universities offer
 FU – Engineering Fundamentals A&B
 UTAS – KMA002&003
 JCU – MA1020 & 1000

Online

Through existing online Foundation courses for example: UniLearn, USQ, Open Uni

Resources – free and available online – self-directed learning and self assessed through online quizzes

New Learning Resources

Existing Online Resources

All learning materials will be contextualised for Engineers

VET Diploma - example

The minimum requirements for achievement of the **MEM50212 Diploma of Engineering - Technical** are:

- completion of the **five (5) core units** of competency, and
- **fifteen (15) elective units**,

VET Diploma - example

The minimum requirements for achievement of the **MEM50212 Diploma of Engineering - Technical** are:

- completion of the **five (5) core units** of competency, and
- **fifteen (15) elective units**,

Elective units must be selected as follows:

- up to **eight (8) general elective units from 66** in the list in Group A
- at least **seven (7) specialist elective units from about 120** in Group B, to bring the total number of elective units to fifteen (15).

VET Diploma - example

The minimum requirements for achievement of the **MEM50212 Diploma of Engineering - Technical** are:

- completion of the **five (5) core units** of competency, and
- **fifteen (15) elective units**,

Elective units must be selected as follows:

- up to **eight (8) general elective units from 66** in the list in Group A
- at least **seven (7) specialist elective units from about 120** in Group B, to bring the total number of elective units to fifteen (15).

MEM50212 Diploma of Engineering – Technical

Core units	General electives (choose 8)	Specialist electives (choose 7)
... communicate informationstatistical computations
...computing technology	... statistical quality control	.advanced statistical quality
... engineering materials	...	Apply statistics
...math techniques	Apply technical mathematics
...sustainable work practices	...	Apply calculus ...

VET Diploma - example

The minimum requirements for achievement of the **MEM50212 Diploma of Engineering - Technical** are:

- completion of the **five (5) core units** of competency, and
- **fifteen (15) elective units**,

Elective units must be selected as follows:

- up to **eight (8) general elective units from 66** in the list in Group A
- at least **seven (7) specialist elective units from about 120** in Group B, to bring the total number of elective units to fifteen (15).

MEM50212 Diploma of Engineering – Technical

Core units	General electives (choose 8)	Specialist electives (choose 7)
... communicate informationstatistical computations
...computing technology	... statistical quality control	.advanced statistical quality
... engineering materials	...	Apply statistics
...math techniques	Apply technical mathematics
...sustainable work practices	...	Apply calculus ...

Core/elective in Diploma

Core: transposing and evaluating formulae, polynomials, straight line coordinate geometry, introduction to indices, introduction to trigonometry, functions and graphs

Elective: software for math analysis and graphical representations, binomials and polynomials, exponential and log, trigonometric equations, sequences and series, two dimensional vectors, **complex numbers**, determinant and matrices, probability

Elective: determine relevant calculus techniques for applications, using appropriate software and/or scientific calculators to generate solutions to statistical and probability-related engineering problems, using differentiation to find rates of change, **partial derivatives**, applying special calculus techniques to solve more complex integrals, such as: method of substitution and using trigonometric identities, identifying and **solving simple first and second order differential equations**, identifying key points to find constants of integration, finding integrals of algebraic, trigonometric and exponential functions, establishing appropriate procedures for checking and validating solutions, logical layout and presentation of data developed using calculus, reporting and effectively communicating the results of calculus-based analysis

Appropriate units in VET

Appropriate mathematics units already exist in VET

BUT almost nobody teaches them

Resolution – tertiary institutions teach those units so that aspiring students may take them as part of their VET engineering Diploma

Some gaps between existing university subjects and VET mathematics units

Build on strength of VET



Use **contextualised** resources to develop mathematics:

Helping Engineers Learn Mathematics

<http://helm.lboro.ac.uk/index.html>

Mathematics for Engineering: An Additional and Specialist Learning Qualification for the Advanced Diploma in Engineering

<http://www.raeng.org.uk/education/diploma/maths/default.htm>

Mathematics in Education and Industry (MEI)

http://mei.org.uk/?section=teachers&page=engineering_support

Implementation

MOU agreement to teach VET mathematics units using University staff has been made between UTAS and TasTafe beginning 2014

UTAS foundation mathematics units will be used, and “topped up” with content produced within the project, so that students cover the prerequisite knowledge equivalent to passing Mathematical Methods and ensuring the content of the equivalent VET units is covered

Flexible modes of delivery will be used – online content, contextualised for engineering applications will be used to support the foundation mathematics units

CENTRE FOR UNIVERSITY PATHWAYS AND PARTNERSHIPS

BACHELOR OF GENERAL STUDIES

— ENGINEERING PATHWAY



UNIVERSITY OF TASMANIA

Did you know that UTAS offers pathways into degree study?

The Bachelor of General Studies — Engineering Pathway provides a supported introduction to university level study in engineering, setting you up for success and helping you achieve your goals.

WHAT IS THE BACHELOR OF GENERAL STUDIES — ENGINEERING PATHWAY?

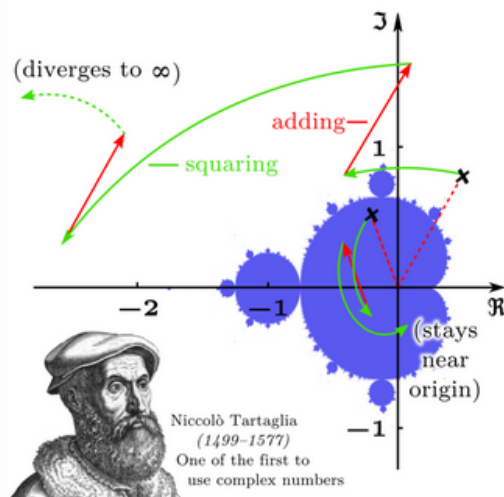
The Bachelor of General Studies — Engineering Pathway foundation year is for students wishing to study a Bachelor of Engineering at UTAS. Students who successfully complete this foundation year will automatically qualify (with credit) for entry into a Bachelor of Engineering in either the Australian Maritime College or the Faculty of Science, Engineering and Technology. The program incorporates a combination of the necessary preparation/foundation study, along with some first year engineering units. It may be used as an alternative entry for trades people, school leavers who do not meet ATAR entry requirements, and others wishing to pursue a Bachelor of Engineering.

HOW IS THE PATHWAY TAUGHT?

Duration: 1 year (fulltime), up to 3 years part-time

Location: Cradle Coast, Hobart, Launceston





Complex numbers allow us to solve equations that have no 'real solution' and extend the number line into a 2 dimensional complex plane as shown below.

“think of Adam and Eve like an imaginary number, like the square root of minus one: you can never see any concrete proof that it exists, but if you include it in your equations, you can calculate all manner of things that couldn't be imagined without it.” Philip Pullman, *The Golden Compass*

Photo: The complex plane showing operations, and the Mandelbrot set.

Image by Kan8eDie (Own work) via [Wikimedia Commons](#)

Information

Definition

Application

Lessons

Ex. 1

Ex. 2

Review

Quiz

Course Information

Complex numbers are part of the national engineering unit MEM23004A Apply technical mathematics [more details](#) on unit content from training.gov.au

Required skill: to solve problems involving complex number quantities using the properties, operations and theorems of complex numbers.

There are no prerequisites required for this module; however, to complete the lessons and quiz below you should have an understanding of algebra and polynomial equations.

Acknowledgements



Australian Government



Office for
Learning & Teaching

Support for this project has been provided by the Australian Government Office for Learning and Teaching. The views in this project do not necessarily reflect the views of the Australian Government Office for Learning and Teaching.