Technical Education Networks

Route: Engineering and Manufacturing

Engineering and Manufacturing

Shane Munford, Faculty Lead, Basingstoke College of Technology

Marika Woods, T level Design Engineering Course Leader, Runshaw College

Version 1, [Month] [year]

Purpose of the Day & Introductions

- Network and relationship building
- Tangible takeaways
- Celebrate progress made

Spend some time introducing yourself, please include:

- The name of your provider
- T Level delivery experience

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Hot Topics

Shane Munford and Marika Woods

Add topics

Version 1, [Month] [year]

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Lunch & Networking

Session 2 starts promptly at 13:30pm

Version 1, [Month] [year]

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Welcome back

Engineering & Manufacturing

Version 1, [Month] [year]

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Resources

Shane Munford

Project brief

Version 1, [Month] [year]

Rationale

- Students struggle to apply maths knowledge in engineering/manufacturing contexts, particularly higher-level content (calculus, logarithms, phasors).
- Weak algebra, formula rearrangement, unit conversions, and SI handling limit performance across topics.
- Examiner reports highlight gaps in applied problem-solving, graph interpretation, and embedding maths into technical reports.
- Mathematical ability varies widely (Grade 4–9), requiring scaffolded classroom support and independent practice materials.
- Students engage more effectively when maths is clearly linked to workplace relevance and practical application.
- Resources must provide structured, contextualised practice that integrates skills coherently and develops confidence in real-world problem-solving.

Version 1, [Month] [year]

Resource Introduction & Overview

This resource package is designed to strengthen students' applied maths skills within an engineering and manufacturing context. It focuses on key areas identified as barriers to achievement unit conversions, formula use, calculations, and calculus using authentic industry insight and structured project-based activities.

This resource includes:

- Slide decks
- Worksheets
- Videos

Version 1, [Month] [year]

Resource showcase

Activity 2 Worksheet

The Catastrophic Conversion: NASA's Mars Climate Orbiter (1999)

You are a new member of the official Investigation Board.

The key error with this mission is that not everyone involved was using metric units – some scientists were still using imperial units, which led to critical mistakes when converting data. Your role is to perform an immediate review of all crucial data logs to confirm unit consistency across multiple mission parameters.

The focus of this exercise is **unit conversion accuracy**.

Guidance on Conversion Factors

When converting units using a multiplicative conversion factor (such as those for force, pressure, or length), always structure your calculation so that the original unit is placed in the denominator of the conversion factor. This method ensures the original unit cancels out correctly, leaving only the desired final unit .

For example, to convert a value in lbf (pounds) to N (Newtons), you must multiply by the fraction $\frac{4.45\,N}{1\,lbf}$ to ensure the lbf unit is successfully cancelled, leaving the final answer in N.
For additive conversion, follow the conversion rule or formula given.

Worked example: Converting Celsius to Kelvin

Today's temperature is 30 ºC. What is the temperature in Kelvin?

Use the formula:

$$K = °C + 273.15$$

where:

- K is the temperature in kelvin
- °C is the temperature in degrees Celsius
- Note that this is **additive** conversion.

Activity 2: Worksheet answers

The Catastrophic Conversion: NASA's Mars Climate Orbiter (1999)

Engineering Parameter	Calculation	Final SI Answer
Operating temperature	15 °C + 273.15	288.15 K
Impulse (force-time)	2,500 lbf·s × 4.45 N/lbf	11,125 N·s
Pressure (atmosphere)	0.07 psi × 6,894.76 Pa/psi	482.6332 Pa
Fuel volume	83.27 gal (UK) × 4.546 L/gal (UK)	374.715 L
Dimensions (antenna diameter)	4.92 ft × 0.3 m/ft	1.476 m

Practise questions

Question 1

T(K) = -182.96 + 273K

Answer: 90.04K

Question 2

Impulse in Ns = Impulse in lbs x 4.448N / 1lb

Impulse in Ns = 450 x 4.448

Answer: 2001.60Ns

Question 3

Pressure in Pa = Pressure in psi x 6894.76Pa / 1psi

Pressure in Pa = 2.5 x 6894.76

Answer: 17236.90Pa

Question 4

Length in m = Length in ft x 0.3048m / 1ft

Length in m = 12.3 x 0.3048

Length in m = 3.74904

Answer: 3.75m (Rounded to two decimal places)

Activity 1 Worksheet

Integration for Cumulative Effects

You are a Maintenance Engineer responsible for tracking the performance and energy usage of manufacturing machinery. You cannot simply read the total energy meter because the machine's power output fluctuates over time.

You must use the mathematical technique of integration to calculate the exact total energy consumed by the machine over a specific period, given the function that describes its instantaneous power output.

Part A: Teacher-Guided Worked Examples

Worked example 1: Definite Integration (Cumulative Change)

This example shows how a definite integral (limits) calculates a total quantity, such as volume over time (flow rate).

HINT: Definite Integral: Used to find the total quantity between two points

Problem

The flow rate (Q) of water through a cooling pipe in m^3/min is given by the function

$Q(t) = 3t^2 + 2t + 5$. Find the total volume of water that passes through the pipe during the first 5 minutes ($t = 0$ to $t = 5$).

HINT: When integrating, add 1 to the power and divide by the new power.

Step	Instruction	Working
1.	Formulate the integral. Total Volume V is the integral of the flow rate function $Q(t)$.	$V = \int_0^5 (3t^2 + 2t + 5)dt$
2.	Integrate term by term. $(\int ax^n dx = \frac{a}{n+1}x^{n+1})$	$V = [\frac{3t^3}{3} + \frac{2t^2}{2} + 5t]$
3.	Apply the limits (Definite Integral). Substitute the upper limit ($t = 5$) and subtract the result from the lower limit ($t = 0$).	$V = [\frac{3t^3}{3} + \frac{2t^2}{2} + 5t]_0^5$ $V = [(5)^3 + (5)^2 + 5(5)] - [(0)^3 + (0)^2 + 5(0)]$
4.	Calculate the result.	$V = [125 + 25 + 25] - [0]$

Activity 1: Worksheet answers

Integration for Cumulative Effects

Part C: Student Activity & Practice Questions

Goal

Calculate the total Energy (E) consumed by the motor over the first 5 seconds of operation ($t = 0$ to $t = 5$), where $P(t) = 6t^2 + 4t + 5$.

Step	Instruction	Calculation
1.	Formulate the Definite Integral.	$E = \int_0^5 (6t^2 + 4t + 5)dt$
2.	Integrate the Power function $P(t)$ term by term.	$E = \left(\frac{6t^3}{3} + \frac{4t^2}{2} + 5t\right)\Big\|_0^5$ $E = \left(2t^3 + 2t^2 + 5t\right)\Big\|_0^5$
3.	Apply the Upper Limit ($t = 5$).	$E_{upper} = 2(5)^3 + 2(5)^2 + 5(5)$ $E_{upper} = 250 + 50 + 25 = 325$
4.	Apply the Lower Limit ($t = 0$).	$E_{lower} = 2(0)^3 + 2(0)^2 + 5(0) = 0$
5.	Calculate the Total Energy ($E_{upper} - E_{lower}$).	Total Energy $E = 325 - 0 = 325\ Joules\ (J)$

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Visual Curriculum Models

Friday 6th March 2026

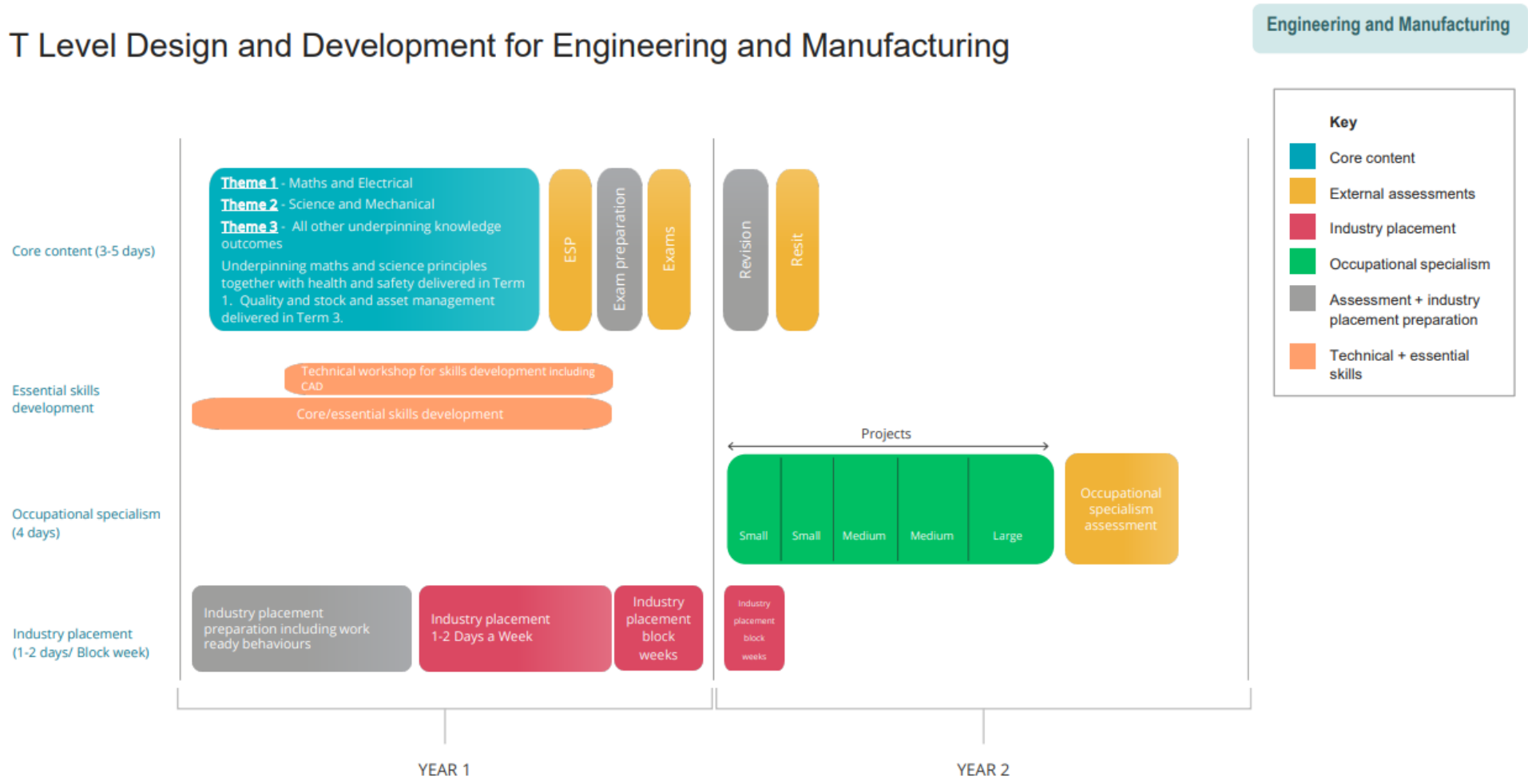
Farhat Khan, AoC

Curriculum Models

Gatsby undertook some work with AoC in 2023/24 to create macro sequencing curriculum models for four T Levels in Construction, Digital, Engineering & Manufacturing and Health & Science.

For these routes we want to update the models based on changes in delivery and decoupling of core assessments and create an additional document to support the curriculum model.

Curriculum Model Example



Curriculum Models

On your tables will be copies of the existing curriculum model and a blank model. Please can colleagues:

- Discuss these on your table and update on the models as clearly as you can.
- Add any useful information to the model you think will be helpful, especially for a new teacher wanting to use the model.
- Include names, emails and provider names on the back of the model(s) who has contributed to these. We'll want to capture this in the information should we need to follow up before publication.

Supporting Document

On your tables will be an example of the supporting documents for Year 1 and Year 2 of the T Level and a blank version. On the blank versions please can colleagues:

- Discuss these on your table and update with the key information as clearly as you can.
- Add any useful information you think will be helpful, especially for a new teacher wanting to use the documents.
- Include names, emails and provide names on the back of the model(s) who has contributed to these. We'll want to capture this in the information should we need to follow up before publication.

Supporting Document Year 1

T Level Technical Qualification in Digital Support and Security: **Year 1**

Technical Education Networks

This document offers an overview of the key curriculum themes and skills that students will develop through each of the two years of the T-level.

TERM 1

Half-term 1

- On entry to the programme, students will be introduced to college systems, procedures, lesson structures, and the unit setup and assessment.
- During induction, students complete initial assessments to gauge interest and suitability. The topics range from digital support services to English and Mathematics.

Half-term 2

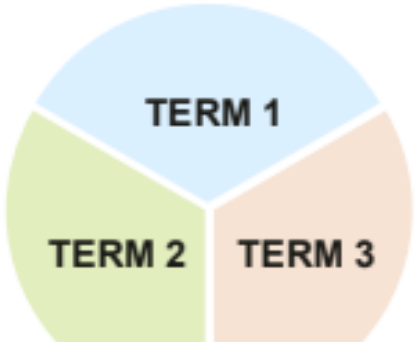
- At the start of Term 1, students explore vocations in digital support services through modules in digital analysis, cyber security, software testing and business context. This aims to highlight the many opportunities in the sector.
- The term focuses on core topics within digital support services, covering digital analysis, cyber security, software testing and business context. Practical training provides hands-on experience with industry-standard tools and platforms – all chosen with input from experts in the main fields of digital support services.

TERM 2

Half-term 3

- By this stage, students will have showcased their skills and knowledge through mock examinations before and after the winter break.
- The start of Term 2 marks the midpoint of the course and introduces supplementary units to strengthen the curriculum and prepare students for end-of-year exams and the Employer Set Project (ESP).
- Students focus on applying theory in practice, to build skills and the confidence needed to thrive.

- Alongside developing their core curriculum knowledge



TERM 3

Half-term 5

- In the final term, students show advanced skills across the curriculum. The focus is on thorough revision, planning and organisation to prepare for end-of-year exams and the ESP.
- The ESP, made up of several tasks, assesses knowledge and skills from the 'Core' element of the course. Regular mock exams and embedded Assessment for Learning techniques give students the confidence to apply their knowledge directly.

Supporting Document Year 2

T Level Technical Qualification in Digital Support and Security: **Year 2**

This document offers an overview of the key curriculum themes and skills that students will develop through each of the two years of the T-level.

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TERM 1

Half-term 1

- On entry to Year 2, students are reintroduced to college systems, procedures, lesson structures and classroom etiquette, with reminders of appropriate behaviour, motivation and work ethic.
- During induction, students review the previous year's grades and work placement, and the key skills and knowledge they developed.

Half-term 2

- At the start of Term 1, students explore careers in digital support services, focusing on networking and servers, digital security, and research techniques. Through dedicated modules, they gain insight into network infrastructure, server management, cybersecurity protocols and advanced research methodologies.
- The curriculum prioritises these core subjects, providing practical exposure to industry-standard tools and platforms to build students' proficiency.

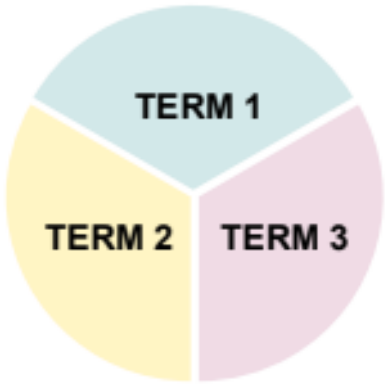
TERM 2

Half-term 3

- By this point, students have shown their skills through mock projects before and after the holidays. Term 2, the course midpoint , introduces additional practical and revision sessions to strengthen preparation for the final exams.
- Students focus on applying theory practically in areas such as networking and servers, digital security, and research techniques. They then refine their skills through practical exams and revision.

Half-term 4

- Alongside developing their core curriculum knowledge and additional pathway content, students focus on revision techniques and materials in preparation for the end-point synoptic assessment.
- At the end of Term 2, additional practical exams measure students' progress, identifying strengths and weaknesses to inform targeted recap sessions.



TERM 3

Half-term 5

- In Term 3, students put all course knowledge into practice to ensure they can meet the synoptic assessment criteria set by the awarding body.
- The synoptic assessment is a practical, task-based project graded at pass, merit or distinction. It focuses on meeting required performance outcomes.

Half-term 6

- End-of-programme celebrations and final assessments mark the culmination of students' T-level journey! Students can reflect on two years of growth and achievement. Awards for academic excellence, technical skill, creativity and overall contribution are presented at a graduation ceremony.
- Students leave with a strong foundation in digital production, design, development, a professional portfolio and industry contacts, ready for success in their digital careers.

Next Steps……

The models and documents created today will be given to Gatsby to work with their publishers to create new documents and hopefully published on the Technical Education Networks website.

Please ensure your name, email address and provider are included on the back of the models you have been working on should we need to follow up to clarify any suggestions made.

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Networking & Discussion

Shane Munford and Marika Woods

Version 1, [Month] [year]

Dates for your diary

Industry Associates Training Programme and Event

29th April 2026

Gatsby have an in-person event in London for FE Leaders/Teaching and Learning leads and stakeholders to share findings and implementation of the Industry Associates training programme pilot

Please contact FEworkforce@gatsby.org.uk for more details or speak to Rory on the Gatsby stand.

Next Community of Practice meeting

- 24th June 2026 at 3:30pm

Route Reflections & Next Steps

Before you leave today

We would really value your feedback before you head off. It takes just two minutes and helps us improve future events.

Please scan the QR code now to share your feedback.

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Thank you for attending

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