Submission from the ETTA on the Draft Senior Cycle Engineering Specification

The Engineering and Technology Teachers' Association (ETTA) which is an association that represents the views of over 300 members nationally. The ETTA would like to acknowledge and commend the work undertaken by the Senior Cycle Engineering Development Group. The proposed specification is progressive and demonstrates strong alignment with university-level engineering programmes. We want to highlight that the ETTA national executive and its members remain open to constructive discussions to ensure a robust and progressive specification that takes the best interests of students, Engineering as a subject, Ireland's workforce and economy into heart going forward.

The ETTA has been represented on the development group through Mr Micheál Martin, who has raised a number of the considerations outlined below over the course of the process. How ever following requests from members through national meetings, surveys and an EGM, we respectfully submit the following key points for consideration by the Development Group, the National Council for Curriculum and Assessment (NCCA), and the Minister for Education, Ms Helen McEntee, as part of the ongoing review of the draft specification.

1. Accessibility of the Specification

While the course is undoubtedly modern and progressive, it appears to lean towards the needs of students who may pursue university education. However, a significant proportion of students who take Engineering at senior cycle go on to pursue apprenticeships, which is a career route currently facing critical shortages.

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We are concerned that these students may feel alienated by the draft specification. International models, such as curriculum for excellence in Scotland, offering, multiple Engineering pathways for example: one focusing on Engineering Science and another on Practical Metalwork which focuses on practical machining skills, metal fabrication and thermal joining processes, catering to a broader range of student abilities and aspirations.

The ETTA respectfully requests that greater emphasis be placed on hands on practical skills development, which is integral to a deeper understanding of engineering principles and to ensuring that all students of various abilities and aptitudes, regardless of their intended career path, are appropriately catered for.

2. Depth of Content vs Available Time

The breadth of content covered in the draft specification is considerable, especially when considered against the revised allocation of a minimum 180 hours of class contact time, which is a reduction of a minimum of 10% from current arrangements. This minimum is class contact will be the allocated time due to time requirements of other subjects.

We recommend a review of the learning outcomes to ensure that they are realistically achievable within this reduced timeframe, without compromising depth of understanding or the quality of teaching and learning.

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3. Assessment and Integrity

ETTA has serious concerns regarding the omission of a second Additional Assessment Component (AAC). Many of the learning outcomes, particularly those focused on practical competencies, cannot be meaningfully assessed through a written examination or the current proposed project model alone. The reasons listed below provide a strong justification for the inclusion of the second AAC.

- *Alignment with Learning Outcomes and Specification Intent*

The draft specification underscores the importance of developing technical proficiency, accuracy, and manual craft skills as central to the discipline of Engineering. Strand 1: *Engineering Processes* and Strand 3: *Design Capability* include specific learning outcomes that directly relate to these areas (e.g. outcomes 1.7, 1.11, 1.12, 1.19, 1.20, 3.15). A *Machining & Bench Skills Assessment* would offer a direct and focused means of assessing these competencies in a valid and authentic context.

- *Reinforcement of Key Senior Cycle Competencies*

This assessment would provide meaningful opportunities for students to demonstrate a broad range of senior cycle key competencies, including:

- **Numerical Reasoning** – through precision measurement and interpretation of technical drawings.
- **Critical Thinking and Problem-Solving** – through real-time execution of manufacturing processes.

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- **Self-Management** – through the structured and time-bound nature of the task.
- **Preparation and Planning** – the processes involved in acquiring and preparing the workpieces to the specifications outlined (accuracy, precision, material selection), along with organising the equipment needed to complete the assessment on the day.
- **Effective Communication** – through the practical interpretation and application of engineering drawings and specifications.

These competencies are embedded throughout the specification, are well-aligned with the learning outcomes and would be authentically assessed through a focused practical task.

– *Complementarity with the Existing Design and Manufacture Project*

The current *Design and Manufacture Project* assesses students' ability to design, plan, implement, and document a project over time. While it encompasses a broad set of learning outcomes, it allows for considerable variation in project complexity. This allows each student a unique opportunity to showcase their talents and skills. In contrast, the *Machining & Bench Skills Assessment* would focus on the standardised execution of core practical skills, providing a consistent and equitable measure of craft competence. Together, these components would offer a more balanced and comprehensive profile of student achievement.

– *Motivation and Integration with Teaching and Learning*

Introducing the Machine & Bench Skills Assessment as a Second Additional Assessment Component would reinforce Engineering's practical nature, providing a motivating goal for students and a clear instructional focus for teachers. Its integration into everyday classroom

practice would promote active, engaged learning and help students connect theoretical knowledge with practical application.

- *Equity and Consistency Across the Technology Subjects*

At present, the draft *Construction Technology* specification includes a *Craft Skills Assessment* as a second additional component, while *Engineering* does not. This creates an inconsistency in how practical competencies are assessed. Including a similar assessment in Engineering would ensure equity of assessment across the technology subjects and properly reflect the full range of skills, knowledge, and abilities that Engineering aims to develop.

4. Conclusion

It is imperative that a second additional assessment component – the *Machining & Bench Skills Assessment* – be introduced in Leaving Certificate Engineering. This component would:

- Strengthen the alignment between assessment and intended learning outcomes.
- Provide a clear, uniform, fair measure of technical proficiency and skill development.
- Motivate students through meaningful practical engagement over the course of the two-year programme.
- Ensure consistency with assessment practices across other technology subjects.

Its inclusion would significantly enhance the validity, equity, and educational relevance of the subject and provide a more accurate reflection of students' capabilities in both theoretical

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understanding and practical execution. Given increasing challenges related to academic integrity in the age of AI, the traditional **Day Practical Examination** has proven itself a robust and authentic assessment method, effectively capturing practical and problem-solving skills in real time.

The proposed Machine & Bench Skills Assessment would serve as a valuable addition to the Leaving Certificate Engineering assessment framework. In line with the key competencies of the Leaving Certificate, this second additional assessment component will cultivate wellbeing by being accessible to all students, regardless of gender, and in line with the reasonable accommodations available from the SEC. It reflects best practice in practical and vocational education, supports the development of essential life and career skills, and contributes to a more inclusive, balanced, and student-centred approach to senior cycle learning.

5. Additional Assessment Component - Project Time Allocation

The draft specification allocates 45 hours for the design project, which now accounts for 50% of the overall assessment. This represents a significant increase in weighting compared to the current system, without a corresponding increase in dedicated time. There are already concerns around the time allocated to the current project with this new specification allocating less time for a higher weighting.

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6. Resourcing/Funding

Many schools have equipment in engineering rooms across the country, that are operating machinery that is of a previous generation. The resourcing and associated maintenance of engineering rooms with appropriate tools and equipment such as manual metal lathe, pillar drill, CNC Lathe, laser cutters, 3D printers, thermal joining equipment, computers, pneumatics etc is a primary concern of the ETTA (this list is not exhaustive and should cater to the full specification when released). We recommend a standardised equipment and furniture list to be released alongside the final specification, with guaranteed ringfenced funding to allow all schools to provide the same educational experience to all students studying engineering. A review of existing engineering rooms should be carried out that is standardised across all sectors regardless of school patronage.

We recommend aligning the assessment weighting more realistically with the time allocation or alternatively increasing the time available for the design project.

We thank the Subject Development Group, the NCCA, and the Minister for Education for their time and commitment to this important work, and we hope that these considerations will be taken on board in the next stage of review.

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Strands/Learning Outcomes

We respectfully propose the inclusion of the sections in green text and the removal of those in red text and with strike-through. These amendments are intended to support a more balanced, inclusive, and practical approach to senior cycle Engineering education.

We kindly request that the Subject Development Group, Senior Cycle Board, NCCA Board, Department of Education and Minister for Education, give due consideration to these suggestions as part of the ongoing review process. We would also like to express our sincere thanks for the time and commitment invested by all involved in developing this important specification.

Strand 1	
Engineering Processes	
Students learn about	Students should be able to
• engineering developments past, present and in emerging areas. • how engineering contributes to the quality of daily life.	1.1 evaluate and discuss the evolution of engineering practice considering the evolution of tools, materials, ethics, sustainability and impact on our world. ~~1.2 appreciate the impact that engineering developments have had on our world.~~

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• the contributions of notable engineers and scientist	1.3 describe the contributions of key figures in engineering and technology. List of key figures to be updated each year, can be updated each year once provided in September of 5th year. 1.4 evaluate the role of key figures in the areas of engineering thinking and practice.
• engineering professions and pathways, to include an awareness of the main engineering disciplines for example mechanical engineering, materials engineering, aeronautical engineering, quality engineering or environmental engineering.	1.5 describe the role of the engineer within a range of engineering disciplines.
• the ethical issues involved in engineering including social, economic and environmental considerations and what measures can be put in place to promote them.	1.6 evaluate the environmental considerations, economic, and societal impacts of engineering decisions in historical and modern times.

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• the principle of sustainable practices to include rethink, reduce, reuse, recycle, and the right to repair.	
• manufacturing processes and technology, including machining processes, thermal and non-thermal assembly techniques and manufacturing techniques	1.7 demonstrate proficiency in the use of craft skills, machining techniques and assembly techniques on a range of materials in the engineering classroom, ensuring an adherence to precision, quality and finish. 1.8 describe and use a range of additive and subtractive manufacturing techniques adhering to ISO standards of accuracy and precision. 1.9 describe and apply the fundamental principles and theories relating to manufacturing processes, assembly techniques, and their applications in a range of contexts. Theories and principles to be included here.

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• the skills that are applicable in the engineering classroom to include both manual and automated processes. • transferring measurements and details from a working drawing to a workpiece, ensuring precision and adherence to specifications. • best practice of health and safety in the engineering classroom	1.10 apply appropriate manufacturing processes for required applications. 1.11 demonstrate proficiency in using hand and machine tools 1.12 apply safe working techniques and practices and display an awareness of the importance of health and safety. xxx. demonstrate an ability to transfer measurements from a working drawing to a working material
• digitally controlled manufacturing equipment and techniques	1.13 describe the fundamental concepts and principles of computer aided manufacturing techniques. 1.14 export data from CAD software systems to manufacture components. 1.15 perform a manufacturing sequence on digitally controlled equipment.

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	1.16 recognise emerging trends and technologies in digital manufacturing.
• the treatment of materials to alter their properties for specific applications. • key criteria for selection of the optimum material for a particular application based on its properties.	1.17 explain the effects of heat treatments/thermal manufacturing methods on materials, their properties, and their applications. 1.18 select appropriate materials for required applications based on their material properties, displaying an awareness for sustainable design and the impact on our environment.
• planning and managing the manufacture of a product. • working in cooperation with others and reflect on their own contribution.	1.19 plan the manufacturing sequence for a range of projects and tasks. 1.20 manage time and resources within the allocated timeframe to produce a product. 1.21 evaluate and critically reflect on the outcome of work completed. 1.22 document work appropriately in tandem with a design process.

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• measurement and metrology, to include application of the SI system, standardisation and calibration of measuring equipment. • the use of precision measuring equipment.	1.23 describe the necessity for a unified system of measurement. 1.24 demonstrate the correct use of simple and precision measuring tools and processes.
• intelligent and sustainable manufacturing technologies and innovations. • contemporary automated manufacturing systems, and the technologies used in them.	1.25 evaluate developments in manufacturing technologies and their impacts on manufacturing and society. ~~1.26 outline the features and the operations of an automated manufacturing facility.~~
• quality assurance in product design and manufacture. • fundamental concepts of reliability.	1.27 describe key concepts involved in quality management, statistical process control and sampling. Key concepts to be included here. 1.28 explain machine maintenance intervals and outline examples of preventative maintenance.

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Strand 2	
Automation and Control Systems	
Students learn about	Students should be able to
• mechatronic systems and their applications. • system analysis techniques to capture and communicate the operation of control and monitoring systems.	2.1 determine the functional requirements of an engineering control system. 2.2 model systems inputs, processes and outputs and the relationships between them ~~using state machine diagrams~~ 2.3 recognise the key role that control and energy systems play in engineering.
• hardware and software inputs, processes and outputs required for control and monitoring of hydraulic, pneumatic, electronic, electrical and computer based systems.	2.4 identify appropriate inputs and outputs for an automated system. 2.5 specify and configure sensors and actuators for a range of simple automated systems. ~~2.6 describe the design of a control system using an appropriate technical format.~~
• selecting the energy requirements and sources for a specific control system.	2.7 identify suitable energy sources to meet input and output requirements.

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	2.8 evaluate the relevant inputs and outputs for any energy requirements. 2.9 recognise the importance of energy efficiency and the necessity to use renewable energy sources.
~~• approaches to designing Human Machine Interfaces (HMI) to provide a system with local control and monitoring capabilities.~~	~~2.10 appreciate control and monitoring design practice, in terms of the user experience, safety and inclusion.~~ ~~2.11 implement hardware, software, local control and monitoring interfaces using system analysis specifications.~~
• remote access control and monitoring facilities, using wired and/or wireless based communications.	2.12 use wired and/or wireless communication techniques to remotely control devices. 2.13 test and debug wired and/or wireless communication control and monitoring systems.
• open and closed loop control systems. • autonomous control systems such as electromechanical and mechatronic control systems.	2.14 describe the difference between open and closed loop control systems.

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• automation projects and how to include the design, manufacture and testing of control systems.	2.15 describe the advancements of autonomous control systems. 2.16 describe the role of control systems in advanced manufacturing and society. 2.17 solve design problems using suitable levels of control and automation technology.

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Strand 3	
Design Capability	
Students learn about	Students should be able to
• communication of design principles and concepts using a range of media including sketching, digital and physical models.	3.1 use sketching in visualising concepts and documenting designs. 3.2 create prototypes and models to communicate the physical form of a design. 3.3 communicate engineering concepts and designs using appropriate media incorporating ISO technical symbols and norms. 3.4 analyse and interpret technical sketches and drawings to extract relevant information.
• interpreting and creating engineering drawings in compliance with drafting standards.	3.5 create engineering working drawings through CAD and/or traditional draughting methods that adhere to established ISO drafting standards.

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• the engineering design process as an iterative approach to a design problem. • following a systematic process to arrive at a solution to a design brief and documentation of the process.	3.6 describe and apply the steps involved in the engineering design and manufacturing process. 3.7 create a design folio to document and evaluate the design and manufacture process.
• sustainable and ethical design including reuse, remanufacture and modular design. • ethical sourcing, energy optimisation, and design for safe use • the product lifecycle.	3.8 demonstrate sustainable design practices incorporating ethical design decisions and appropriate safety considerations. 3.9 describe the main stages and characteristics of the product lifecycle.
• systems thinking related to product design and functionality. • human factors and ergonomics in design.	3.10 apply principles of product functionality during the design process. Key principles to be included in the specification. 3.11 apply principles of ~~human-centred design and~~ universal design. Key principles to be included in the specification.

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• specification of mechanical and electrical components. • principles of Engineering design including the design of machine elements, mechanisms and powered systems. • using SI units, basic and derived, for measurement and calculations, and giving due consideration to the limits of the precision and accuracy of measurement	3.12 use engineering judgement ~~and/or basic calculations~~ to specify mechanical components. 3.13 select the correct electrical components for engineering applications using recognised ISO symbology ~~technical data~~. 3.14 calculate the specifications and dimensions required for the design of machine components and powered systems. (formulae to be provided in the specification) 3.15 apply tolerances, limits and fits to the design of assembled components.
• prototyping and testing in design.	3.16 create working prototypes to explore ideas, test functionality, and inform design decisions.

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• key testing concepts and terminology in engineering.	3.17 explain the importance of testing in the engineering design and product development process.

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Strand 4	
Engineering Principles and Energy	
Students learn about	Students should be able to
• the SI system of units. • derivation and conversion of SI units.	4.1 calculate engineering quantities using appropriate SI units for design and manufacture.
• the production of materials including metals and non-metals and their impact on the environment. • sustainable management of natural resources.	4.2 describe the production of common engineering materials. 4.3 explain the impact of production and disposal of materials on the environment. 4.4 identify approaches used to conserve natural resources.
• material testing.	4.5 describe the various tests available to assess material properties. 4.6 interpret and communicate test data from material tests to make informed material selection choices.

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~~• the relationship between the microstructure and macro properties of a range of engineering materials.~~ • corrosion to include galvanic corrosion, stress corrosion, intergranular corrosion, fretting corrosion, sacrificial and cathodic protection.	~~4.7 describe the relationship between microstructure and material properties.~~ ~~4.8 use phase diagrams to explain the effects of heat treatment processes for altering the properties of metals.~~ ~~4.9 identify the effects of mechanical working on material properties.~~ 4.10 explain the process of corrosion and preventative measures.
• the concepts of work, energy and power. • forms of energy and energy conversions. •	4.11 calculate the requirements for energy, work and power in the context of engineering systems. (formulae to be provided in the specification) 4.12 describe the energy conversions occurring in engineering systems and processes.

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• the principle of conservation of energy. • energy efficiency, energy dissipation and energy storage.	~~4.13 analyse closed systems or steady flow systems using a simplified energy balance~~. 4.14 calculate mechanical and electrical power demands and the energy efficiency of engineering systems. (formulae to be provided in the specification) 4.15 evaluate solutions to engineering challenges based on energy efficiency.
• fundamental principles of mechanics, including loads, forces and motion.	4.16 describe the types and applications of forces and motion. 4.17 apply calculations of static forces in the design of load bearing elements and components. (formulae to be provided in the specification)
• elements of machine design. • mechanics of machines to include the specification of machine components. • geared systems, and mechanisms.	4.18 design linkages and mechanisms to produce given motion profiles. 4.19 describe and use different power transfer systems and drive systems.

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• using calculations as part of the design process.	4.20 identify and describe friction forces for drive and braking applications. 4.21 calculate mechanical advantage, velocity ratio and efficiency for simple machines. (formulae to be provided in the specification) 4.22 apply calculations for forces and power in the specification of mechanisms and motor driven systems. (formulae to be provided in the specification)
• AC electrical systems. • voltage, current and power in DC circuits. • DC circuit design, motors and power. • the functions and application of off the shelf electronic components.	4.23 describe applications of AC and DC based power. 4.24 ~~analyse~~ identify and describe ~~DC circuits for~~ sensor and drive systems in DC circuits. 4.25 design and build circuits to integrate with control applications.

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~~• fluid based systems.~~ • basic concepts of pneumatic and hydraulic systems.	~~4.26 calculate the forces acting on master and slave cylinders involving static fluid pressure using Pascal's Law.~~ 4.27 interpret and apply pneumatic and/or hydraulic circuit diagrams involving valves, cylinders and energy supplies. 4.28 describe the applications of fluid-based systems in real life.

Assessment for Certification

Considering the points above, the ETTA proposes the following assessment structure for consideration:

- **Written Examination:** 50%
- **AAC 1 – Design Project:** 25%
- **AAC 2 – Day Practical Assessment:** 25%

This approach would offer a fairer, more balanced, and more inclusive assessment model that retains academic rigour while acknowledging the diverse pathways students pursue after school.

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The ETTA remains open to further discussions around the development the new Engineering specification.

We thank the Subject Development Group, the NCCA, and the Minister for Education for their time and commitment to this important work. We appreciate the Subject Development Group, NCCA and the Minister for Education taking the views of the Engineering Technology Teachers Association, on behalf of our membership, on board in the next stage of the review process.

Yours sincerely,
Engineering Technology Teachers' Association (ETTA)

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