2028L027C2ES

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination
Sample Brief

Engineering

Design and Manufacture Project

Higher Level and Ordinary Level

250 marks

1. Information for candidates, teachers and school authority

The assessment of Leaving Certificate Engineering comprises of two components:

1. Final written examination
2. Design and Manufacture project.

The Design and Manufacture Project is worth 250 marks, which is 50% of the overall marks for Leaving Certificate Engineering. The remaining 250 marks (50%) are for the final written examination.

Coursework must be completed in full and strict compliance with the procedures and conditions outlined in this coursework brief and in the State Examinations Commission (SEC) Coursework Rules and Procedures.

The coursework must be carried out and submitted to the class teacher and will then be stored securely in the school to be marked by a team of examiners appointed, trained and monitored by the SEC.

The authentication process

The authentication process is put in place by the SEC to ensure the **integrity of the examination process** and to ensure **fairness and inter-candidate equity**. The candidate, class teacher, and school authority all have a responsibility to ensure that the ongoing preparation of coursework and that the work ultimately submitted to the SEC is the candidates' own individual authentic work.
The (SEC) Coursework Rules and Procedures contains comprehensive information on the authentication process that **must be read and adhered to**.

It is fully expected that candidates will carry out research as part of their coursework. To fully comply with these SEC Coursework Rules and Procedures, candidates must reference and acknowledge their research sources, including any use of AI, as outlined in **Appendices 1 and 2** of the SEC Coursework Rules and Procedures. To include material that is not created by the candidate and not properly referenced will be considered plagiarism. This is considered cheating. This is a breach of regulations and will be investigated by the SEC - see **Section 18** of the SEC Coursework Rules and Procedures.
It is the responsibility of the candidate, the class teacher, and the school authority to ensure that the work being presented to the SEC is the candidate's individual authentic work.

This brief contains the subject specific information and requirements for the completion of the Design and Manufacture Project, which must also be adhered to.

Note: The Engineering teacher should ensure that a printed image of the final manufactured Physical Model being submitted for assessment is included in the design folio.

Note: Storage of Coursework

On completion of the coursework, school authorities should ensure that the finished model and design folio are kept in a secure place until the examining process (including appeals) has concluded.

2. Instructions to Candidates

1. The completed coursework submitted for assessment must consist of two items:
   - a **Physical Model** and
   - a **Design Folio**.
2. It is your responsibility, as the candidate, to comply with these instructions. If you fail to comply with these instructions, your teacher will not be able to validate and sign off on your coursework and you will not receive any marks for it.
3. The coursework you submit for assessment must be your own unique, individual authentic work and must be completed in school under the supervision of your teacher.
4. You must submit your own, unique, individual authentic coursework. Your unique coursework is intended to include the intellectual activity of design, together with the practical activities of making the model and compiling a design folio. Group coursework is not accepted.
5. Your physical model must not be removed from the school under any circumstances, as doing so may result in such coursework being considered invalid and no marks will be awarded for the model.
6. Your design folio can be presented in A4, A3, or a combination of both formats, noting each A3 page equals two A4 pages. The design folio must be presented in hard copy format only. The suggested page count for each section of the design folio is prescribed on page 9 of this document. If material is presented in excess of the prescribed page count you may lose marks. Note: Section heading pages are not included in a page count.
7. You must finalise the authentication process to confirm that the coursework you are submitting is your own unique, individual authentic work by signing the SEC Authentication Form P.2. This will be provided by your class teacher. Your class teacher and school principal will also sign this form to confirm that you have adhered to the authentication process.
8. The level at which the final written examination is taken, determines the level at which the subject is graded.
9. Where there are clear similarities between your coursework and that of another candidate, whether in the model or in the design folio, you may not receive any marks for such coursework.
10. All coursework submitted for assessment must be clearly identified with your examination number.
11. The model and design folio should be designed, manufactured and completed within the designated time, using the equipment and materials available in the school.
    You must agree the coursework with your teacher before commencing work.
12. All equipment used in manufacturing processes must comply with the current Department of Education and Youth Engineering Room Equipment list.

13. Inappropriate reuse/recycling of components or materials may result in lost marks.

14. To authenticate your own unique, individual work, where computer aided manufacture (CAM) processes are used (e.g. Laser cutting; 3D printing), each individual piece must be supported by the inclusion of a clear, appropriate CAD drawing, identified with your examination number.

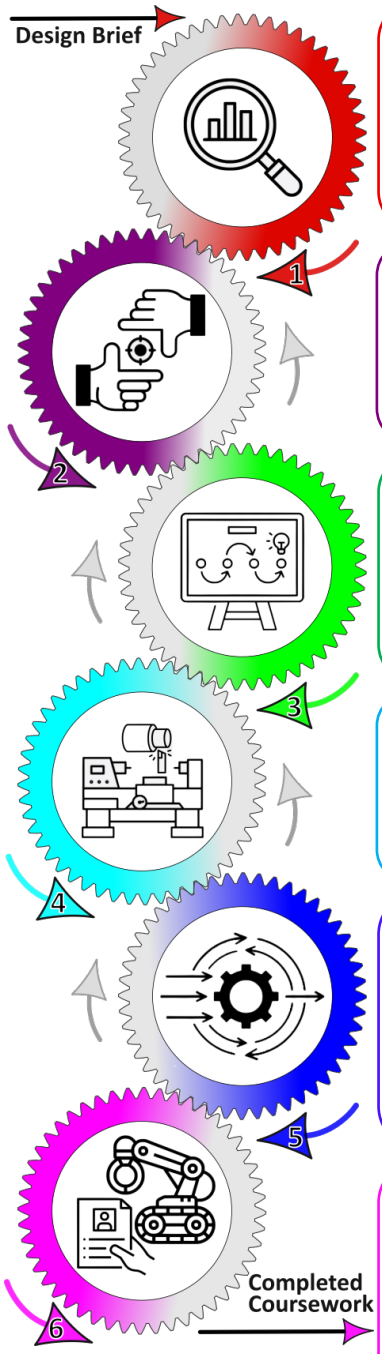
15. You must reference and acknowledge all research sources used such as: publications including books, professional journals and government reports; online sources and other types of media; any material generated using artificial intelligence (AI) software or applications; and material from specialist organisations and relevant individuals. To include such material without properly referencing the source will be considered plagiarism.
In addition, the copying from, or reproduction of, material from such sources may also be considered plagiarism.

16. Any case of suspected copying, plagiarism (which includes the use of AI software), improper assistance, or procurement of work prepared by another party will be thoroughly investigated.

17. To validate your coursework, both your Engineering teacher and the school principal are required to sign the SEC Authentication Form P.2 which states that you have followed these *Instructions to Candidates*.
If your coursework cannot be validated, you will not receive any marks for the coursework component.

3. Engaging with the Design and Manufacture Project

The Design and Manufacture Project provides an opportunity for you to display evidence of learning across all strands of the senior cycle Engineering specification. Completing the Design and Manufacture Project should involve the six stages outlined below, and it is envisaged that it will take up to 45 hours to complete. The iterative nature of the Engineering Design process means that candidates tend not to move through the stages in a linear fashion, but rather progressing forwards and backwards through the process.



Stage 1: Analysis of brief, Brainstorming, and Developing a Work Plan
Conduct a critical analysis of the brief to establish a clear understanding of the challenge presented. This should guide research and inform decisions about which ideas to further explore. Develop a structured work plan to help manage the workload.

Stage 2: Identify the focus of enquiry / research to be pursued
Develop a series of potential solutions through a combination of primary and secondary research. Typically, this will include materials, components, mechanical/electronic control systems, and assembly techniques.

Stage 3: Development of an Optimum Solution
Finalise an optimum solution for manufacture. Decisions should be guided by insights gained during research, investigation, and ideation. Sketches from the previous stages should evolve into detailed working drawings that support manufacture.

Stage 4: Manufacture of Physical Model of the Optimum Solution
Manufacture the optimum solution, demonstrating a range and depth of practical/manufacturing skills and techniques using a variety of materials, components, processes, and assembly techniques.

Stage 5: Testing, Evaluating and Refining
Test and evaluate the final model to ensure it meets both functional and aesthetic expectations. This involves critical reflection, the development of insight, and thoughtful conclusions aimed at improving the process or enhancing the optimum solution.

Stage 6: Finalising of Physical Model and Design Folio
The physical model demonstrates the range and depth of the candidate's manufacturing skills and techniques. The design folio documents the analysis and planning, research, ideation, decision-making, manufacture, testing, evaluation, and any design revisions.

For further and more detailed information on the Engineering Design and Manufacture Project and Stages 1 – 6, see NCCA Guidelines to support the Engineering Design and Manufacture Project.

4. Design and Manufacture Project Brief – Sample

Robotics and automation are widely integrated into modern engineering systems and products. Through the use of cutting-edge design, precision manufacture and advanced automation technology, such products offer reliable, sustainable, and environmentally friendly alternatives to more traditional methods.
One example is the *FJDynamics RM21 Grounds Robot*, which can autonomously mow grass and line mark sports grounds. Control systems for these machines are often engineered using GPS, LED lights, sensors, cameras, and AI mapping, all controlled through an intuitive HMI. Typically powered by lithium-ion batteries and brushless DC motors, they offer high energy efficiency, durability and minimal sound while operating. Similar machines are found in sports clubs, where large grounds are often maintained by local community volunteers.

Design and manufacture a *Model Grounds Robot*. The grounds robot should be your own unique, individual design and should:

a) incorporate an electronic drive system suitable for a typical pitch surface;

b) have an illumination system to indicate its location in dark conditions;

c) be automated to cut **OR** spray in a rectangular path, no bigger than the area of an A3 page;

d) have a collision detection/avoidance system to prevent the robot striking an obstacle;

e) be equipped with an appropriate HMI to control the robot and to indicate the operational state of the robot.

NOTE: It is **not** expected that the model should be capable of spraying paint or cutting grass.

The following constraints should be observed:

- The completed model should demonstrate proficiency across a range and depth of practical and manufacturing skills.
- A range of materials and processes, available in the engineering room, should be used.
- Electrical Power used in the control/automation of the model should not exceed 9V.
- All main operating features should be clearly visible and the longest dimension of the model should not exceed 400 mm.

5. Design and Manufacture Project - structure and content

Your Design and Manufacture Project will require the submission of a Design Folio and a Physical Model. The structure will be based on the following headings, which provide a guide to the requirements of each element of the coursework.

Design Folio - structure and content

Your hard copy Design Folio should include the following:

1. Analysis of Brief

- Interpret the design brief
- Identify and explore the key terminology
- Conduct a detailed analysis and identify the specific project brief requirements
- Engage in a process of brainstorming, recording ideas/concepts, using visual representations – spider diagrams/mind maps/sketches
- Consider use of materials, processes, components, control and assembly methods
- Formulate a work plan, with consideration of resources, time and completion date.

2. Focus of enquiry/research

- Conduct primary research
- Conduct secondary research, with a focus on detail
- Generate concept design solutions, in part, or in full
- Presentation of possible design solutions. These may be presented as: annotated sketches/ digital drawings, prototypes, or in combination. Each concept should be assessed and reviewed according to its alignment with the design brief
- Selection and justification of optimum design solution. Include an explanation and detailed description of components/assembly, material selection, operating principles, and function.

3. Development of Optimum Solution

- Produce fully dimensioned working drawings, to recognised drafting standards for all manufactured parts, to enable precise manufacture and effective assembly
- Present a parts list, inclusive of all manufactured and additional components
- Outline the manufacturing process for each part
- Provide all details of assembly
- Include calculations where relevant, e.g. drive ratios, power requirements etc.
- Describe the control system (HMI) using suitable technical formats, e.g. state machine diagram, circuit diagram, code, etc.

4. Testing, Evaluation and Refining

- Test the model in accordance with the specific brief criteria, as set out in the design brief
- Assess the level of functionality for each aspect of the brief criteria, and the overall functionality
- Evaluate the effectiveness of each element of the design solution. What worked well, what challenges arose and how you addressed them
- Detail any changes or modifications you have made from the original optimum solution(s)
- Suggest areas for refinement or improvement that would further enhance the quality or function of the manufactured model.

5. **Relevant referencing**
    - Appropriately record and reference all sources of information gathered, including any material generated using artificial intelligence (AI) software or applications, as set out in the guidelines.

Model - structure and content

Your Physical Model should include the following:

1. **Compliance with Design Brief**
    - Ensure all aspects of the brief are adequately addressed
    - Model complies with the constraints listed on page 6.

2. **Design and function**
    - Demonstrate creativity in effective design and efficient use of materials
    - All operating mechanisms/systems work effectively
    - Control system(s) is functional and safe to operate. Instructions should be provided if necessary.

3. **Manufacture**
    - All manufacturing should be based on your working drawings, with a focus on accuracy and precision
    - Ensure a range of suitable and appropriate materials and processes are used
    - Demonstrate a range and depth of manufacturing skills and techniques, blending processes such as, precision marking-out, bench skills, shaping/forming, machining, fitting, additive/subtractive manufacturing, appropriate joining/assembly methods. A combination of advanced manufacturing and hand-skills are expected, to accurately reflect the key learning, as set out in the specification
    - Various suitable assembly techniques may be employed to facilitate efficient construction and dismantling. Consideration should be given to accuracy, tolerances and appropriate types of fit
    - The manufacturing and assembly processes must demonstrate adherence to safety standards. Material finishes, quality of assembly, inclusion of control systems, should all combine to present a model that is safe to handle and operate.

4. **Presentation**
    - Demonstrate competency in applied finishes to manufactured engineering components. All surfaces should have a high-quality finish for optimal assembly, appearance, and function
    - Consideration should be given to: choice of materials, scale, proportionality, neatness of assembly and colour combinations that enhance the aesthetic properties of the manufactured model.

6. Mark allocation

The Design and Manufacture Project carries a total of 250 marks. When your work is marked, assessment criteria will be applied, and marks will be allocated as outlined below. While the general headings and marks below will largely remain the same, the breakdown of marks may vary depending on the actual project for any given year.

Design Folio - Content / Criteria		Suggested no. of A4 pages	80 Marks
A Analysis of brief	• Critical analysis of brief • Brainstorming of ideas • Work plan	2 - 4	10
B Focus of inquiry	• Primary and secondary research • Formation of ideas – annotated sketches/drawings • Prototyping • Selection and justification of optimum solution	6 - 12	25
C Development of optimum solution	• Working drawings • Parts list/materials • Manufacturing • Assembly • Control/Calculations	8 - 16	25
D Testing, evaluation and refining	• Testing - in accordance with the stated brief • Critical Evaluation • Conclusions	2 - 4	10
* Overall coherence and presentation	• Overall quality / Coherence / Relevant referencing	*N/A*	10

Model - Content / Criteria		170 Marks
E Compliance with brief	• Meeting brief criteria • Constraints	20
F Design and function	• Creativity • Operation • Control	40
G Manufacture	• Range and depth of practical and manufacturing skills • Range of materials and processes • Assembly techniques • Safety	90
H Presentation	• Quality of finishing • Aesthetics	20

***Overall Coherence** is not a distinct section of the design folio. Marks awarded for Overall Coherence are based on the quality of organisation, communication, and cohesion of the material presented in the design folio.