An Roinn Oideachais agus Eolaíochta

Leaving Certificate

TECHNOLOGY SYLLABUS

(Ordinary Level and Higher Level)

LEAVING CERTIFICATE PROGRAMMES

Aims and Principles

1. The general aim of education is to contribute towards the development of all aspects of the individual, including aesthetic, creative, critical, cultural, emotional, expressive, intellectual, for personal and home life, for working life, for living in the community and for leisure.

2. Leaving Certificate programmes are presented within this general aim, with a particular emphasis on the preparation of students for the requirements of further education or training, for employment and for their role as participative, enterprising citizens.

3. All Leaving Certificate programmes aim to provide continuity with and progression from the Junior Certificate programme. The relative weighting given to the various components – e.g. personal and social (including moral and spiritual) development, vocational studies and preparation for further education and for adult and working life – within the programmes may vary.

4. Programmes leading to the award of the Leaving Certificate are of two years duration and are offered in three forms:

   i. The Leaving Certificate (Established)

   ii. The Leaving Certificate Vocational Programme

   iii. The Leaving Certificate Applied

5. All Leaving Certificate programmes, in contributing to a high quality education, emphasise the importance of:

   - self-directed learning and independent thought
   - a spirit of inquiry, critical thinking, problem solving, self-reliance, initiative and enterprise
   - preparation for further education, for adult and working life
   - lifelong learning.

The Leaving Certificate (Established)

The Leaving Certificate (Established) programme offers students a broad and balanced education while allowing for some specialisation. Syllabuses are provided in a wide range of subjects. All subjects are offered at Ordinary and Higher levels. In addition, Mathematics and Irish are also offered at Foundation level.

The certificate is used for purposes of selection into further education, employment, training and higher education.

The Leaving Certificate Vocational Programme (LCVP)

The Leaving Certificate Vocational Programme is an intervention within the Leaving Certificate (Established). LCVP students study a minimum of five subjects (at Higher, Ordinary or Foundation levels), including Irish and two subjects from specified vocational subject groupings. They are also required to take a recognised course in a Modern European language, other than Irish or English. In addition LCVP students take three Link Modules on Enterprise Education, Preparation for Work and Work Experience.

In particular, the LCVP aims to foster in students a spirit of enterprise and initiative and to develop their interpersonal, vocational and technological skills.

The Leaving Certificate Applied

The Leaving Certificate Applied is a distinct, self-contained Leaving Certificate programme. It is designed for those students who do not wish to proceed directly to third level education or for those whose needs, aspirations and aptitudes are not adequately catered for by the other two Leaving Certificate programmes. The Leaving Certificate Applied is structured around three main elements – Vocational Preparation, Vocational Education and General Education - which are interrelated and interdependent. This programme is characterised by educational experiences of an active, practical and student-centred nature.

Leaving Certificate

TECHNOLOGY SYLLABUS

(Ordinary Level and Higher Level)

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PREFACE
TECHNOLOGY EDUCATION AT SENIOR CYCLE

Introduction

Technology education is an essential component of the curriculum. In a world where encounters with a wide range of technologies are part of the daily life experience of all people at work or at leisure, students should be equipped to face these encounters with the confidence which comes from learning about, through and with a range of technologies. It is equally important that they gain an appreciation and understanding of the complex interface between technology and society. As citizens they should have the capacity to enter discussion about, and make personal judgements on, issues related to the impact of technology on their own lives, on society, and on the environment.

Through technology education students grow in competence, grow in confidence, become more enterprising and are empowered in terms of their ability to control elements of the physical environment. These are important educational outcomes, which contribute significantly to the provision of a broad and balanced curriculum and illustrate why participation in technology education represents a valuable educational experience.

The nature of technology education

Technology is a distinct form of creative activity where human beings interact with their environments, using appropriate materials and processes in response to needs, wants and opportunities. It integrates problem solving and practical skills in the production of useful artefacts and systems.

More specifically, the value of technology education comes from the use of the wide variety of abilities required to produce a drawing or make an artefact, leading to a sense of competence and a feeling of personal empowerment. The acquisition of manipulative skills is an important component of this sense of competence and can help to give students a feeling of control of their physical environment. In a rapidly changing global society, students need to appreciate that technological capability is necessary and relevant for all aspects of living and working. Many subjects can contribute to the development of a technological capability. However, the technology subjects, which incorporate the principles of design and realisation in a creative manner, are central to this development.

Technological capability includes

- the understanding of appropriate concepts and processes
- skills of design and realisation
- the ability to apply knowledge and skills by thinking and acting confidently, imaginatively, creatively and with sensitivity
- the ability to evaluate technological activities, artefacts and systems critically and constructively.

Leaving Certificate technology subjects

Within the Leaving Certificate, technology education is provided through the subjects Architectural Technology, Engineering Technology, Design and Communication Graphics, and Technology, thereby providing progression with junior cycle. These subjects contribute to a broad, balanced and general education of students, with particular reference to their vocational, further education and training aspirations on completion of the Leaving Certificate.

At a more practical level, the technology subjects at senior cycle share a number of common features. The syllabuses

- are constructed on the basis of core areas of study and optional areas of study, reflecting the different topics and sections within the subject area
- are offered at two levels, Ordinary and Higher
- have been designed for completion in 180 hours of class contact time
- place a strong emphasis on practical learning activity
- include a range of assessment components aimed at assessing student achievement in both practical and theoretical aspects of the subjects.

LEAVING CERTIFICATE TECHNOLOGY INTRODUCTION AND RATIONALE

There is a growing awareness of the impact of technological developments on many aspects of people's lives. Leaving Certificate Technology, by virtue of its broad treatment of topics, should help students to respond confidently to a world that is characterised by rapid change in the social, economic, work and leisure environments. The syllabus is designed to enhance the students' ability to meet successfully the challenges they face in both their personal and their working lives. It is equally relevant to all students, whether they plan to proceed directly to employment or training, or to pursue further studies after completing Leaving Certificate.

All students should become active participants in their own learning. Leaving Certificate Technology emphasises the use of knowledge, its practical application to real-life situations, and the interaction between thinking and doing. This puts decision making in the hands of the student, leading him or her to greater independence, self-confidence and personal satisfaction. The course encourages practical activities and the production of artefacts and systems as solutions to identified problems or briefs. Students taking this course should develop their problem-solving skills and a sense of responsibility for their own learning, and become self-directed, creative and autonomous learners, thus laying the foundation for lifelong learning.

The development of technological capability, a central goal of technology education, can enable students to take advantage of present and emergent vocational opportunities and to become informed citizens in a rapidly changing world.

This Leaving Certificate syllabus has been developed to provide greater progression from the junior cycle and should encourage more students to extend their experience of a technology education throughout their years at post-primary level. Its modular structure allows schools considerable opportunity to build on existing resources and expertise, and should enable more schools to provide a technology education for their students in the senior cycle.

AIMS

The general aims of technology education are

- to contribute to a balanced education, giving students a broad and challenging experience that will enable them to acquire a body of knowledge, understanding, cognitive and manipulative skills and competencies and so prepare them to be creative participants in a technological world
- to enable students to integrate such knowledge and skills, together with qualities of co-operative enquiry and reflective thought, in developing solutions to technological problems, with due regard for issues of health and safety
- to facilitate the development of a range of communication skills, which will encourage students to express their creativity in a practical and imaginative way, using a variety of forms: words, graphics, models, etc.
- to provide a context in which students can explore and appreciate the impact of past, present and future technologies on the economy, on society and the on the environment.

The additional syllabus aims are

- to enable students become aware of the breadth of today's technology through their experience of its practical applications in response to everyday opportunities problems and challenges
- to enable students, through their experience and developed understanding of the technological process, to evaluate and judge critically existing products and the products of their own work from an aesthetic, technical, functional and ethical point of view.

OBJECTIVES

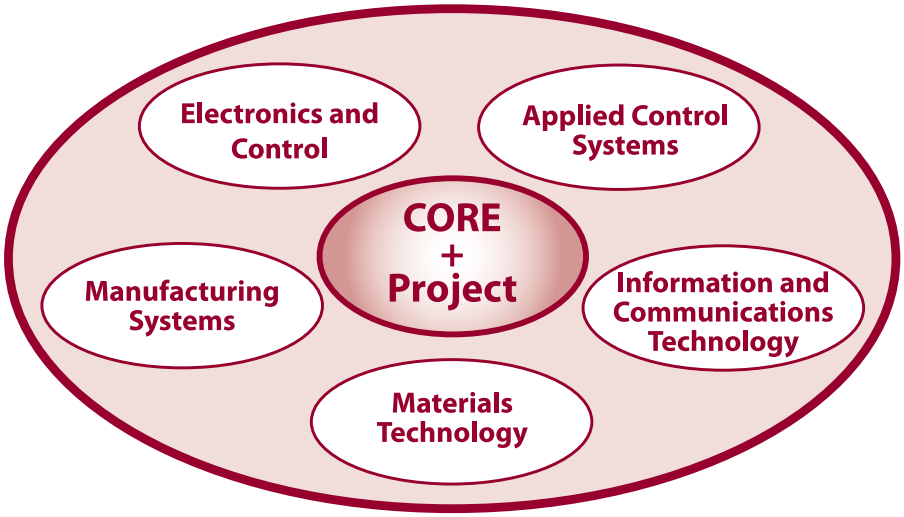
The following list summarises the syllabus objectives. Particular student learning outcomes are indicated in each section of the syllabus. The problem-solving dimension of the course emphasises skills and competencies; knowledge and understanding are the foundations for the process. Successful participation in the course should result in improved student attitudes to self and increased awareness of the impact of technology on the social and environmental aspects of today's world.

On completion of the course, a student should

- know basic technological principles and facts and the terminology associated with technology, including relevant symbols and units associated with physical quantities
- understand and be able to process and communicate technological information in written, verbal, graphic and mathematical forms
- understand the role of, and be able to apply, design principles in the solution of specific problems, using mathematical and scientific concepts where appropriate
- appreciate that technology impacts on our everyday lives and contributes to personal, social and economic development, and that technological solutions are linked with their specific cultural and environmental settings
- know and adhere to the health and safety requirements associated with planning and conducting practical work, and understand how these requirements, together with environmental considerations, affect the design of artefacts or systems
- be able to identify challenges and opportunities that can be met using a technological methodology, select appropriate methods for dealing with these and recognise the limitations and constraints of knowledge, time, resources and other factors that can restrict solutions to technological challenges
- be able to work both independently and co-operatively in evaluating existing solutions and in proposing novel/creative solutions to technological challenges
- recognise that technological developments have resource implications, that resources need to be carefully managed and that developed societies have moral responsibilities in their appropriation of world resources
- be able to prepare and execute a plan for the realisation of an artefact or system as a solution to a technological problem or challenge, working accurately and safely with materials and equipment
- select and use appropriate materials, tools and equipment in the production of an artefact or system, according to a chosen design, in response to a given brief or an identified problem
- have developed a competence in the processing of materials
- be able to evaluate a completed artefact or system against its original specification, propose alterations and modifications at the design, implementation or completion stages to enhance its appearance or function
- be able to prepare and present a report in a concise, accurate and comprehensive manner.

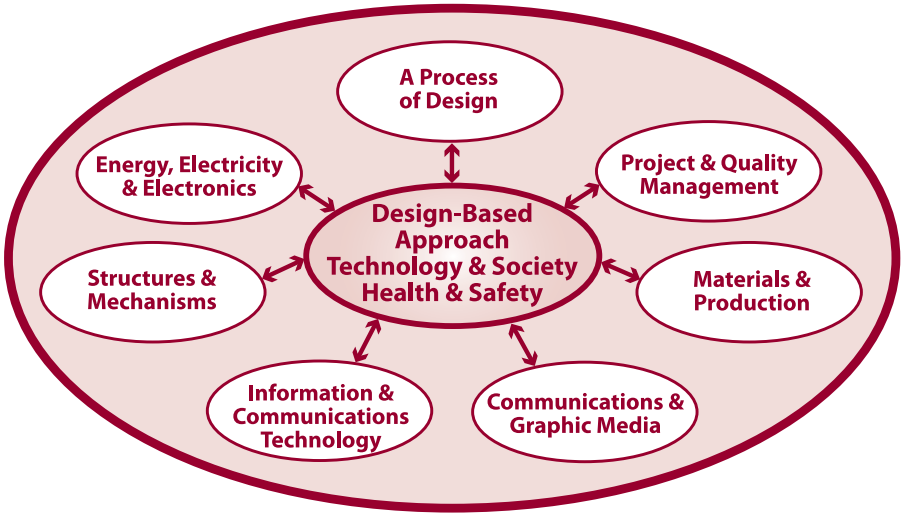
STRUCTURE OF THE TECHNOLOGY SYLLABUS
CORE AND OPTIONS

The course consists of core areas of study, which are mandatory for all students, and five optional areas of study, from which each student must take two.



The Core

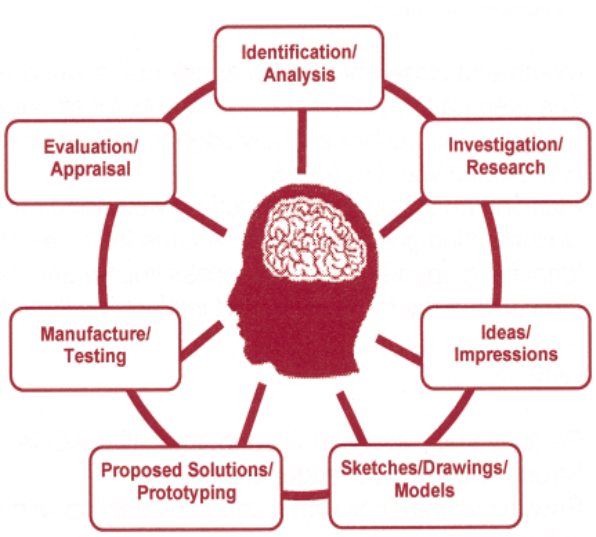
The core is intended as a broad general introduction to the nature of technology. It is also intended to provide students with a consolidation, extension and refinement of the knowledge, skills and techniques acquired in the junior cycle. The main elements of the core are illustrated in the graphic below.



Structure of the Core

A design-based approach, which is central to the core, requires students to relate their work to the logical steps of a systems approach in the solution of practical problems. This approach does not preclude ingenuity, creativity and intuition, nor is it intended that a design process be linear.

The main elements of a design-based approach, which combine cognitive and procedural knowledge, understanding and skill, are illustrated in the graphic below.



Simplified Diagram of a Design Process

Technology, society and the environment

Technological activity includes human responsibility for decision and action. It is not intended that this be dealt with in isolation: it should permeate all aspects of the treatment of the course. It is intended to foster a sound understanding of technological developments and the changes brought about in industry, transport, health, communications, lifestyle, work and leisure as the result of these developments.

It is also intended to develop critical faculties in relation to the energy and resource implications of technological development. Students should appreciate that the manufacture and use of products have social and economic implications and they should develop sensitivity to human and environmental concerns, both local and global. They should appreciate that manufacturing processes, waste processing and storage may give rise to conflicting interests between those of the individual, the society and the environment. In particular, attention should be paid to the safe disposal of waste materials and the by-products of manufacturing processes in ways that protect the environment.

Students should understand how legislation affects the consumer. Students should understand the functions of safety officers and the importance of legislation such as consumer law, health and safety, equal opportunities and data protection.

Health and safety in the work area

Throughout the course, safe working practices and recommended procedures must be observed. Students should be fully aware of the potential dangers of the various energy sources, machines, equipment and devices they use. They should be familiar with the location and correct use of safety equipment, be familiar with evacuation procedures in the event of an emergency, and know the location of emergency exits. They should maintain a safe working environment, applying appropriate safety precautions to avoid danger and to minimise risks.

Options

The options provide an opportunity for students to undertake a more in-depth study of particular aspects of technology. Students must choose two of the following five options:

- Electronics and Control
- Applied Control Systems
- Information and Communications Technology
- Manufacturing Systems
- Materials Technology.

Differentiation between Ordinary level and Higher level

There are three main differences between Ordinary level and Higher level:

1. **Depth and style of treatment:** Ordinary level provides an overview of technology and its applications. Higher level involves a deeper and more analytical treatment.
2. **Skills development:** All students will be required to attain a wide range of skills. A more refined expression of these skills will be required at Higher level.
3 **Range of syllabus material:** In addition to the syllabus content required at Ordinary level, Higher level students will be required to study a broader range of subject matter. Elements designated for Higher level only are printed in black text throughout the syllabus.

Presentation of Syllabus Content

Syllabus content for both core and options is presented in three columns:

- Topic
- Sub-topic (students should learn about/to ...)
- Learning outcomes (students should be able to …).

Further details and suggestions for teaching methodology may be found in the accompanying *Guidelines for Teachers.*

Mathematical requirements

The Leaving Certificate Technology syllabus does not require a sophisticated knowledge of mathematics –– a basic understanding of algebra, arithmetic, geometry and trigonometry will suffice. Students will be expected to understand, use and present numbers expressed in standard form.

Symbols and units

Throughout the course, students will be expected to recognise and use the correct symbols and units for physical quantities. They will also be expected to recognise and use standard prefixes representing multiples of these quantities.

Relationships and formulas

Students should know and be able to use appropriate relationships and formulas. The derivation of these formulas is not required.

ASSESSMENT

Assessment Components

The syllabus will be assessed in terms of its stated objectives at each of two levels, Ordinary and Higher, by means of a terminal examination paper and a project. The assessment components and weightings at both levels are summarised in the table below.

Component	Sub-component
Examination Paper [50%]	Section A: Core
	Section B: Options
Project [50%]	Artefact
	Report/Portfolio

Terminal Examination Paper

There will be one examination paper at Ordinary level (2 hours) and one at Higher level ($2^1/_2$ hours). At each level, the paper will be presented in two sections, as indicated in the table above. Since the Core is mandatory, students will be assessed on all main elements of the Core in Section A of the examination paper. Section B will cater for the five Options and students will be required to answer questions related to two of these.

The Project

Students will be required to undertake a project, based on a specified thematic brief and within stated parameters. The project involves the design and production of an artefact and an accompanying folder. In undertaking the project, students combine knowledge and skills developed through their study of the core and chosen options. The project, which must be completed in school and be the unaided work of the student, should integrate the various elements of the study of technology and should represent the highest standard of knowledge and skills attained by the student. The folder should reflect all stages of the student's work from design to realisation, and should include an overall evaluation.

In undertaking the project, students will be expected to analyse or develop the brief/theme, develop design specifications, conduct research into original and existing ideas and artefacts, develop potential or part solutions and evaluate these, prepare outline designs of possible solutions, choose one—or an appropriate combination—of these for development and justify their choice, prepare a plan of manufacture, select and use appropriate materials and processes to produce the artefact or solution according to that plan, and evaluate the final product in the light of the original brief.

In both the design and realisation of the project, students must take due account of ergonomic and safety requirements.

A more detailed treatment of assessment issues may be found in the Guidelines for Teachers and in the sample assessment materials for Leaving Certificate Technology.

SYLLABUS CORE

Students are required to study all sections of the Core.

- A PROCESS OF DESIGN
- PROJECT AND QUALITY MANAGEMENT
- MATERIALS AND PRODUCTION
- COMMUNICATION AND GRAPHIC MEDIA
- INFORMATION AND COMMUNICATIONS TECHNOLOGY
- STRUCTURES AND MECHANISMS
- ENERGY, ELECTRICITY, AND ELECTRONICS

CORE: A PROCESS OF DESIGN		
Topic	Sub-topics *Students should learn about*	Learning Outcomes *Students should be able to*
Design Brief	• the interpretation of design briefs/ themes and the development of design specifications	• interpret a design brief/theme; identify a need and/or opportunity for a design project and write an appropriate design brief
Identification and Analysis of Problems	• the contribution of existing ideas, works, systems to current technologies • the interpretation of a technological challenge • the impact of technological developments on society	• appreciate and describe how historical and cultural settings have influenced existing designs • analyse situations with a view to improving them and see the potential for developing novel solutions • describe applications of technologies in everyday life • identify and discuss how technological products and developments have contributed to meeting people's needs and have changed the way we live and communicate • take into account the requirements of the individuals or groups for whom they are designing
Recognition of Constraints	• the requirements of those for whom it is proposed to design an artefact, for example a child or a person with a particular disability • the constraints accompanying design proposals, with particular emphasis on safety and environmental effects	• consider resource constraints in product design including cost, time, skills and equipment • describe the environmental effects and safety implications of the processing of materials and the disposal of waste products
Investigation and Research	• stages in planning and making to ensure efficient use of time, labour and material resources	• identify and plan the stages in production to achieve a completed artefact or system within a specified time and make modifications where appropriate

CORE: A PROCESS OF DESIGN (continued)		
Topic	Sub-topics *Students should learn about*	Learning Outcomes *Students should be able to*
Investigation and Research (continued)	• sharing of knowledge, ideas and experience • researching existing or similar artefact/ systems, developments; recognising and identifying design shortcomings • critical appraisal of solutions for choice of materials, functionality, deployment of technology features, and reliability • understanding human factors when designing and appreciating the importance of ergonomics, colour, aesthetics, etc. in the design of an artefact • aesthetic considerations and visual sensitivity in the design of products/ artefacts	• work in collaboration with others • examine existing solutions and describe features which they have found relevant to their work • refine or modify existing artefacts or systems to enhance performance or to meet specified criteria • analyse and appraise existing solutions under such headings as: form, function, materials, technologies, environment • apply consideration of human factors and use appropriate anthropometric data, where relevant, in product design • apply aesthetic and visual considerations, where appropriate, in the selection of the optimum solution for manufacture
Generation of Ideas	• generation of new ideas or exploration and modification of existing designs	• use various techniques, to develop new ideas; identify situations and propose creative alternatives to existing designs
Presentation of Ideas	• presenting results of investigations in an appropriate form • written, graphic or other forms of recording and presenting information, including the use of ICT and multimedia as appropriate	• sketch, draw, model and present a range of proposed design ideas and investigation results, using a variety of media
Selection/ Development of Chosen Idea(s)	• criteria for selection of the optimum idea (or combination of ideas) • selection of the most appropriate materials, tools, equipment, procedures and processes to make the product, taking into account environmental considerations and safety requirements	• select and develop the optimum idea • identify the working properties of various materials and use this knowledge to select appropriate materials and processes for project work

CORE: A PROCESS OF DESIGN (continued)		
Topic	Sub-topics *Students should learn about*	Learning Outcomes *Students should be able to*
Production Planning	• production plans for the manufacture of the artefact • the manufacturing feasibility of the proposed design	• draw up a production plan/schedule • analyse the final product design and the manufacturing considerations in a real-life situation
Making and Testing	• integration of knowledge and skills in the realisation of a chosen design, recognising that manufacturing activity is constrained by a range of factors and resources including knowledge, skills, available materials, cost etc. • testing the product/system against the design brief and specification.	• use a range of skills, processes and techniques to produce work of a high standard • demonstrate a range of skills and follow safe work practices in product production • test and describe how well the prototype/product meets initial specifications
Evaluation	• evaluation of the product or system against the initial design task or specification • social and environmental costs and benefits • design and manufacturing modifications and improvements	• identify how the prototype/product conforms with or differs from the initial specifications • identify the social and environmental costs or benefits of the proposed solution or artefact • analyse the trade-offs involved in the design and manufacture of a product • list and describe the modifications that need to be implemented to improve the design and/or manufacture of the product
Presentation of Design Folio	• production of a design folio to accompany an artefact	• use a range of presentation media to record all stages of work from initial ideas to completed artefact

CORE: PROJECT AND QUALITY MANAGEMENT		
Topic	Sub-topics *Students should learn about*	Learning Outcomes *Students should be able to*
Project Management	• the basic principles of project management	• interpret and construct Gantt charts identifying, scheduling and monitoring the phases of a design and design execution project • construct critical path diagrams for design and execution of simple projects
Quality Management	• quality and the quality attributes of simple products • quality and product life-cycle	• list and describe the quality attributes of simple products, including existing and proposed products • identify and analyse the quality attributes of a product and their impact on its life-cycle • describe, in simple terms, the relationship between quality, market share and manufacturing costs
	• simple quality problem-solving tools	• use cause-and-effect diagrams; present data using simple statistical measures, charts and scatter diagrams • identify and quantify the degradation of the quality attributes during and after design execution of simple projects • identify, measure, collect, present and analyse data using these tools/ techniques at the design specification and execution phase of simple projects
	• quality and cost	• identify, estimate and classify the costs associated with a product and the relationship between cost and quality

CORE: PROJECT AND QUALITY MANAGEMENT (continued)		
Topic	Sub-topics *Students should learn about*	Learning Outcomes *Students should be able to*
Quality Management (continued)	• the concept of reliability and its impact on product quality and performance	• describe the reliability features of simple products • identify the information required for analysing reliability • describe a simple reliability programme • devise a programme of material, component or product testing to assist in identifying and measuring the appropriate design specification parameters in order to estimate the reliability of the proposed product

CORE: MATERIALS AND PRODUCTION		
Topic	Sub-topics *Students should learn about*	Learning Outcomes *Students should be able to*
Manufacturing Processes and Materials	• development of manufacturing skills, in the context of a design and make framework, to enable the production of an artefact	• select and use, in a safe and competent manner, a range of hand and power tools to work a variety of materials
	• safety procedures in the use of hand and power tools and other equipment	• follow standard working procedures to ensure personal safety and the safety of others
	• the properties of a range of materials	• describe the properties of a range of materials and recognise these properties when selecting materials for particular uses
	• the importance of accuracy in the measuring and marking-out of materials	• transfer information accurately from drawings, models, sketches, templates and patterns
	• manufacturing processes	• shape and process a range of materials such as ceramics, composites, fabrics, metals, plastics, woods
		• select and use the most appropriate methods of joining and assembling materials in permanent and semi-permanent forms
	• finishing materials	• select suitable finishes for materials, with due regard for environmental factors
		• show an awareness of the effects of environmental conditions on materials and the importance of suitable finishing techniques
Resource Management	• the economic use of resources	• recognise the need for economic and sustainable use of energy and materials (including recycling), and take account of time and other factors

CORE: COMMUNICATIONS AND GRAPHIC MEDIA		
Topic	Sub-topics *Students should learn about*	Learning Outcomes *Students should be able to*
Projection systems	• the use and purpose of the main systems of projection	• select the most appropriate projection convention to communicate design ideas and to produce, e.g. two dimensional working drawings in orthographic projection
Measured Drawings	• the use of dimensioned drawing systems to communicate information and the importance of scaled drawings in the communication of design ideas and in the preparation of working drawings	• produce and interpret dimensioned and scaled drawings using any of the main systems of projection
Pictorial Representation	• 3D representations in communicating design ideas	• produce and interpret 3D representations in appropriate forms • produce drawings in accordance with standardised drawing conventions
Freehand Drawings	• freehand drawing in both 2D and 3D forms and their importance in developing design ideas • the use of light and shade, texture, rendering, colour, and reflection • standard graphic signs, symbols and conventions in current use • schematic drawings, procedural sketches, charts and diagrams	• produce freehand drawings to communicate ideas • use a range of methods to enhance design drawings • select the drawing modes most appropriate to the tasks undertaken
Computer Graphics	• computer graphics software	• use computer graphics software to develop and visually represent ideas
Modelling	• use of modelling techniques to clarify and present ideas	• model ideas in easily worked materials and/or through the use of appropriate computer software
Presentation of Information	• communicating and presenting information	• use appropriate language and media to convey information in a concise and accurate form
Production of Report	• recording, processing and presenting information, including audio and/or visual presentation where appropriate	• make use of information and communications technology (ICT) tools, using suitable software, in the development and production of a report

CORE: INFORMATION AND COMMUNICATIONS TECHNOLOGY		
Topic	Sub-topics *Students should learn about*	Learning Outcomes *Students should be able to*
Introduction to Computer Systems	• the main components and specifications of a computer system	• identify, and describe the components and functions of a computer system (hardware and software, input, output, and storage devices) • understand system specifications, e.g. memory, clock speed and storage capacity
	• management of a computer system; personal safety and the safe operation of the system	• use a computer system safely; launch, execute and exit from software • use input and output devices; manage files • describe and use system and data security procedures, including virus protection measures
Skills Development, Applications and Software	• development of basic skills in the use of information and communications technology (ICT) • use of the computer as an aid to investigation and research in a design process	• use ICT skills in the development and presentation of information • conduct practical investigation and research and integrate findings into design projects
	• use of applications software	• use appropriate software such as wordprocessing, graphics and spreadsheet applications • use spreadsheet applications to store and manage data, and to produce output in a variety of forms

CORE: STRUCTURES AND MECHANISMS		
Topic	Sub-topics *Students should learn about*	Learning Outcomes *Students should be able to*
Structures	• naturally occurring and manufactured structures	• describe and analyse naturally occurring and manufactured structures
	• classification of structures	• describe, with aid of sketches, arch, shell, frame, beam and box structures
	• forces and their effects on structures; moments of a force	• describe and analyse the effects of forces acting on a structure: tension, compression, shear, torsion, bending
		• perform simple calculations of moments
	• the principle of triangulation and how structures are stabilised using triangulation	• classify struts and ties in a framework show how structures can be stabilised using triangulation
	• what is meant by equilibrium and centre of gravity	• explain and show, using an appropriate method, how location of the centre of gravity affects the stability of a structure
	• structural principles applied to design; models of structural forms	• identify existing structural designs; construct models and test their characteristics
	• factor of safety and its importance in structural design	• describe the importance of factor of safety in structural design
	• destructive and non-destructive testing of structures	• use examples to explain destructive and non-destructive testing
Mechanisms	• mechanisms, their operation and application	• identify and describe mechanisms and their operation using appropriate terminology
	• first, second and third order levers; linkages	• sketch and give examples of various levers and linkages in everyday use; identify first, second and third order levers
	• simple and compound pulleys; types of belt drives	• sketch and give examples of pulley systems and belt drives in everyday use

CORE: STRUCTURES AND MECHANISMS (continued)		
Topic	Sub-topics *Students should learn about*	Learning Outcomes *Students should be able to*
Mechanisms (continued)	• gear trains	• sketch and describe the application of each gear type
	• the use of cams	• describe the appropriate use of cams
	• the terms work, power, torque, friction, load, effort, mechanical advantage, velocity ratio, efficiency	• use appropriate terminology in describing a variety of mechanisms and their operation; perform simple calculations of mechanical advantage, velocity ratio and efficiency

CORE: ENERGY, ELECTRICITY AND ELECTRONICS		
Topic	Sub-topics *Students should learn about*	Learning Outcomes *Students should be able to*
Energy and Energy Conservation	• sources of energy – renewable and non-renewable • different forms of energy, e.g. mechanical (potential, kinetic), chemical, electrical • the principle of conservation of energy and its application • energy transformation • the cost of energy • energy efficiency	• describe the main sources of energy and demonstrate how the principles of energy conservation and energy conversion can be used in project design and manufacture • distinguish between the different forms of energy • state and apply the principle of conservation of energy • describe and analyse energy transformations in some common devices • calculate the cost of energy • appreciate the efficiency of different energy conversions
Electricity	• electricity as a form of energy distribution • basic electrical concepts: electric current, voltage, resistance, power and the relationship between them • the units in which electric current, voltage, resistance, power and frequency are measured • the resistor colour code • current, voltage, resistance measurement • the difference between a.c. and d.c.	• describe how the use of electricity influences the way we live • demonstrate understanding of the relationship between voltage, current and resistance (Ohm's Law) • apply Ohm's Law, where appropriate • use appropriate units and their symbols: ampere, volt, ohm, watt, hertz • identify resistor values using the colour code • use multimeters correctly and appropriately • differentiate between types of electricity – from mains supply (a.c.) and from batteries (d.c.)
Electronics	• electronic input, process and output components including switches, relays, temperature/moisture/light sensors, resistors, capacitors, transistors • circuits and circuit diagrams; construction of simple circuits; fault-finding	• assemble, test and modify simple sensors for sound, heat and light from given circuit diagrams • read and interpret given circuit diagrams; assemble components correctly into circuits; identify and correct faults in circuits

CORE: ENERGY, ELECTRICITY AND ELECTRONICS (continued)		
Topic	Sub-topics *Students should learn about*	Learning Outcomes *Students should be able to*
Electronics (continued)	• resistors connected in series and parallel; cells in series and parallel	• demonstrate understanding of voltage and current in circuits • test the outputs, and calculate the voltage across resistors in series and parallel
	• potential divider and voltage control	• use the potential divider to vary an applied voltage
	• simple transistor circuits; use of a potential divider to control the voltage applied to a transistor	• design, assemble, test simple transistor circuits and transistor circuits incorporating the use of a potential divider
	• output devices – lamp, buzzer, LED, speaker, motor, relay	• construct and assemble a number of circuits that incorporate appropriate output devices • design, assemble and modify simple circuits from specified problems and/or design briefs • explain the operation of circuits that they have designed and suggest appropriate modifications
	• the function of basic logic gates AND, OR and NOT; truth tables for each	• decide on the most appropriate gate(s) to use in a circuit and incorporate these into project work where appropriate • explain the function of AND, OR and NOT gates and construct truth tables for each

OPTIONS

Students are required to study two of the five options.

- ELECTRONICS AND CONTROL
- APPLIED CONTROL SYSTEMS
- INFORMATION AND COMMUNICATIONS TECHNOLOGY
- MANUFACTURING SYSTEMS
- MATERIALS TECHNOLOGY

OPTION: ELECTRONICS AND CONTROL		
Topic	Sub-topics *Students should learn about*	Learning Outcomes *Students should be able to*
Electrical Measurements	• measurement of potential, current, resistance, capacitance, frequency (V, A, Ω, F, Hz) • indirect measurement of power	• select appropriate instruments to measure basic electrical quantities, and explain in simple terms what they have measured • calculate power in whole circuits and in components such as resistors and motors
Components and Circuit Design	• resistors, capacitors, inductors, diodes, transistors, voltage regulators, photoresistors, photodiodes, LEDs, phototransistors, variable resistors, potential dividers and potentiometers, and relays • design, assembly and testing of circuits	• use, and understand the function of, components in circuit design • use a potential divider as a voltage control device • design, assemble and test circuits, or circuit sub-units, making appropriate use of the listed components
Power Supplies and Safety	• selection of a suitable power supply for a specified application	• choose appropriate power sources for selected tasks
Electric Motors	• the mode of operation of the d.c. motor; back EMF; the variation of current requirement with the load • reversing a d.c. motor	• measure the efficiency of a d.c. motor • assemble switches and motors to achieve forward and reverse motion
Assembly of Pre-designed Circuits	• assembly of bistables and astables, amplifiers, • assembly of oscillators, timing circuits • printed circuit boards (PCBs) • prototype and batch production of PCBs • use of prototyping boards for initial assembly and testing of circuits	• construct and make appropriate modifications to circuits, based on circuit diagrams • use an appropriate method to produce PCBs for a given circuit • understand both prototype and batch production of PCBs • demonstrate the use of prototyping boards in assembly and testing of circuits

OPTION: ELECTRONICS AND CONTROL (continued)		
Topic	Sub-topics *Students should learn about*	Learning Outcomes *Students should be able to*
Assembly of Pre-designed Circuits (continued)	• operational amplifier circuits (op-amps)	• design, assemble, test and modify operational amplifier circuits for signal amplification, level detection and voltage comparison
Sensors	• sensors for sound, heat, light (photoresistive and photovoltaic), movement	• design, assemble, test and modify basic sensors
Logic Circuits	• basic logic gates: AND, OR, NOT, NAND and NOR; truth tables • combinations of gates • the main logic families (TTL and CMOS) • the use of logic gates with sensors and output devices	• construct truth tables for up to four inputs using an array of up to four logic gates • combine logic gates appropriately using ICs • select the appropriate type of IC for a particular task • design, construct, test and modify simple systems using sensors, combinations of gates and output devices
Inputs and Outputs	• buffers (transistors, amplifiers, paralleled outputs) • Schmitt trigger • binary inputs	• design, construct, test and modify buffer or driver circuits for a variety of output devices • use gates with Schmitt trigger inputs to sharpen digital signals
Counters	• clock circuits, de-bouncers, counters, seven segment displays and display drivers	• design, construct, test and modify simple counting circuits capable of counting inputs from switches or clocks

OPTION: APPLIED CONTROL SYSTEMS		
Topic	Sub-topics *Students should learn about*	Learning Outcomes *Students should be able to*
Robotics	• robotic joints; degrees of freedom; co-ordinate frames • forces and moments; calculations	• identify robot types; classify robotic joints • specify robotic joints for particular applications • give an outline specification of a robotic structure and arm • use appropriate co-ordinate frames • perform simple calculations of forces and moments
Introduction to Robotic Control	• classification of robots by structure; applications, with emphasis on manufacturing applications • principles of open and closed loop control • principles of operation and control of d.c. servos and stepper motors	• identify industrial applications of robotics • identify robotic structures and configurations suitable for specified tasks • construct block diagrams of simple robotic controllers; calculate gains • select d.c. servos or stepper motors and controllers
A/D and D/A Conversion	• analogue to digital and digital to analogue converters (A/D and D/A)	• incorporate and use digital inputs and appropriate A/D converters • incorporate D/A outputs where appropriate
Control; Programmable Devices	• control using computers or other programmable devices (such as PLCs or PICs) • the principles of combinational and sequential logic • operation of a robotic device; sense functions	• use a programmable device to control circuits or sub-assemblies that they have constructed, e.g. LEDs, bulbs, seven-segment displays, d.c. motors • program simple logic sets using Grafcet or function diagrams • programme a robotic device to do specified tasks and to modify outputs in response to sensed conditions • use appropriate calculations and/or charts to facilitate the selection of circuit elements

OPTION: APPLIED CONTROL SYSTEMS (continued)		
Topic	Sub-topics *Students should learn about*	Learning Outcomes *Students should be able to*
Pneumatics	• pneumatic actuators, directional control valves, pressure and speed control valves, stop valves • the principles of selecting control strategies, e.g. totally electronic, electro-pneumatic, totally pneumatic circuits	• identify standard pneumatic devices • design, cost and build single or mixed technology circuits

OPTION: INFORMATION AND COMMUNICATIONS TECHNOLOGY		
Topic	Sub-topics *Students should learn about*	Learning Outcomes *Students should be able to*
Computer Architecture	• the kilobyte as 2^{10} (1024) bytes • computer memory: RAM, ROM	• explain the difference between RAM and ROM
	• the use of buses and different bus standards	• explain the function, capacity, speeds and expansion possibilities of buses
	• hardware and software compatibility	• explain the compatibility requirements of hardware and software • adapt files for transfer between different applications
	• transmission of information via the communications ports using different peripherals	• distinguish between the main types of communications ports
Data Communications and Computer Networks	• characteristics of the Standard Codes for Information Interchange	• explain the main characteristics of standard codes for information interchange
	• operational characteristics of a conventional network	• describe the use and functions of a local area network • log on and off a network; work with a group
	• Local Area Networks (LANs)	• operate a LAN; set up log-on names and password-listed files and folders;
The Internet	• the internet and the World Wide Web	• explain what the internet is and navigate the WWW using a browser • use search engines to locate desired information and explain the differences between two such search engines • use Boolean operators to locate more exact information
		• incorporate security features when uploading and downloading files by remote access
	• email	• send and receive email, including attached files

OPTION: INFORMATION AND COMMUNICATIONS TECHNOLOGY (continued)		
Topic	Sub-topics *Students should learn about*	Learning Outcomes *Students should be able to*
The Internet (continued)	• other internet applications	• demonstrate understanding of Internet Protocols • demonstrate video conferencing
	• data protection	• show awareness of data protection and other relevant legislation
Multimedia and Design	• different image formats	• import images via a scanner/digital camera and create original images in the different formats for incorporation in multimedia applications, in colour or grayscale • convert from one image format to another • alter image properties such as size, scale, brightness, contrast, gamma and tone to achieve desired effects
	• different sound formats	• create (or record from appropriate material) sound files and incorporate them in multimedia applications • convert from one sound format to another and edit formats for length and special effects
	• multimedia applications	• navigate within a multimedia application and use its content to make a presentation • create a multimedia project to incorporate text, images, sound and some interactivity

OPTION: MANUFACTURING SYSTEMS		
Topic	Sub-topics *Students should learn about*	Learning Outcomes *Students should be able to*
The Context of Manufacturing	• generic business and manufacturing strategies	• describe the context and expected outcomes of such strategies
	• generic manufacturing strategies for simple products	• discuss these strategies in relation to simple products
		• apply the Product/Process Matrix to simple product/markets
	• the functional organisation of a manufacturing enterprise and its links with other business functions	• describe the functional organisation of manufacturing and the linking with communications and control systems
	• key success factors in manufacturing competitiveness	• describe the key success factors and their linkage with the market and manufacturing systems
	• basic manufacturing systems	• design simple systems for costing
		• design a simple system for assessing quality during the design and manufacturing stages of a simple product
Quality Management	• the Pareto principle and its application in quality management	• sketch the Pareto distribution and use it in problem-solving
	• construction of N (μ,σ^2), x-R control charts	• collect data for a simple manufacturing process and construct the x-R chart
	• process capability	• calculate and interpret process capability indices for simple manufacturing processes
	• sampling and its application in manufacturing	• describe sampling inspection systems and calculate sample size for the purchased components of a simple product
	• the historical development of Quality Control, Quality Assurance and Total Quality Management	• describe concepts of QC, QA, TQM and their impact on quality management and organisation, in particular, behavioural and organisational factors

OPTION: MANUFACTURING SYSTEMS (continued)		
Topic	Sub-topics *Students should learn about*	Learning Outcomes *Students should be able to*
Quality Management (continued)	• the rationale of just-in-time (JIT) manufacturing	• describe the JIT concept and its implications for manufacturing systems • describe and measure manufacturing performance for a simple manufacturing system • detail a simple JIT process
Project Management	• behavioural dynamics in team work	• work on a project as part of a team
Concurrent Engineering	• the life-cycle spectrum and the application of concurrent engineering methodologies for simple products	• design, test and implement simple market research for product specification • design and specify simple products • discuss the application of QFD (Quality Function Deployment) and Value Analysis concepts to simple product/manufacturing strategies • apply these concepts during the design phase for a simple product
	• the role of geometric and feature-based CAD in design and manufacturing	• describe and explain the techniques for the design of very simple products for manufacture and disassembly using 2D or 3D CAD system
	• the role of testing in product design	• propose testing procedures for simple product performance evaluation
	• the role of accelerated testing for simple products	• apply DfE (Design for Environment) concepts for simple products and processes
	• the impact of product life-cycle on the environment	• incorporate recycling, re-use and waste strategies into simple product specification

OPTION: MANUFACTURING SYSTEMS (continued)		
Topic	Sub-topics *Students should learn about*	Learning Outcomes *Students should be able to*
Manufacturing System Design and Control	• the constraints of workflow, human factors and health and safety legislation on work design • the concepts of capacity management and activity scheduling in the design of manufacturing systems • the principles of plant layout	• devise work cells for simple processes of manufacture, assembly and packaging • devise batch and flow processing scheduling systems for simple product manufacture • devise Kanban systems for simple product manufacture • use simulation tools and simulation games in designing scheduling systems and plant layout for the manufacture of simple products

OPTION: MATERIALS TECHNOLOGY		
Topic	Sub-topics *Students should learn about*	Learning Outcomes *Students should be able to*
Classification of Materials	• the properties of a range of materials and the selection of appropriate materials within the context of design activities • identification of materials in the immediate environment; classification as metals and non-metals	• describe the properties of at least two materials – at least one to be a rigid material • classify a selection of materials as metals (ferrous and non-ferrous), wood, composites, polymers, fabrics or ceramics
Properties of Materials	• physical properties of materials; comparison of materials in terms of their properties • grouping of materials according to properties of electrical and thermal conductivity, thermal expansion, optical, magnetic and mechanical properties • effect of environmental conditions on the mechanical and physical properties of materials	• list and show an understanding of the physical properties of materials – including hardness, toughness, ductility, elasticity, malleability • carry out simple tests to demonstrate properties of selected materials and classify them according to these properties • describe the conditions that cause the physical, chemical and biological degradation of materials • describe how materials degrade in certain conditions and how materials are altered by degradation
Structure of Materials	• the nature of materials and the forces that hold them together • inconsistencies and defects in materials and how these can affect mechanical and/or structural properties	• recall that observable properties of materials are related to their atomic/molecular structures (atomic/molecular details not required) • use simple data from tensile, compressive, bending shear, torsion tests in design situations
Joining Processes	• the methods by which materials are joined – permanent and semi-permanent techniques	• demonstrate a knowledge of the main methods of joining materials – metallurgical processes, mechanical joining and adhesive/chemical bonding

OPTION: MATERIALS TECHNOLOGY (continued)		
Topic	Sub-topics *Students should learn about*	Learning Outcomes *Students should be able to*
Materials Processing	• the role of the properties of materials in determining how they are worked	• describe how the manufacturing/ tooling processes vary according to characteristics of the material
	• the methods by which materials are processed	• demonstrate a knowledge of hand, machine, thermal and chemical methods of material processing
	• the effectiveness of various methods of materials processing	• select and evaluate appropriate methods for processing materials in a classroom context
	• the proper safety procedures and working practices when using materials, tools and equipment	• follow safety precautions in the processing of materials and in the safe use of materials, tools and equipment
Surface Treatments	• commonly applied techniques to prevent or retard the degradation of materials	• describe how and explain why surface treatments are applied to a range of materials
	• reasons for application of a range of finishes to materials	• propose surface finishes for different materials and evaluate effectiveness of finish against specification
Skills Development	• working with materials (a minimum of two, at least one to be a rigid material): fabrics, metals, polymers, wood, ceramics and composites	• select and use materials, based on their working properties • demonstrate high skills development
Materials and the Environment	• environmental and social considerations applied in product design and manufacture	• describe how economic use of the earth's resources informs selection of materials, processes, finish, etc.
Quality Assurance	• standards for the assurance of quality; appraisal of finished products	• complete artefacts to meet specified design briefs • identify appropriate quality standards and critically appraise finished products against these standards
Production Techniques	• once-off and batch production techniques	• demonstrate constraints as applied to craft production and batch production techniques

NCCA

National Council for Curriculum and Assessment
An Chomhairle Náisiúnta Curaclaim agus Measúnachta

Procedures for drawing up National Syllabuses

The NCCA's Course Committees for the Leaving Certificate (Established) have the following membership:

- *Association of Secondary Teachers, Ireland*
- *Teachers' Union of Ireland*
- *Joint Managerial Body*
- *Association of Community and Comprehensive Schools*
- *Subject Association*
- *Irish Vocational Education Association*
- *Higher Education and Training Awards Council*
- *Irish Universities Association*
- *Department of Education and Science (Inspectorate)*
- *State Examinations Commission.*

On the basis of a brief provided by Council, the NCCA's Course Committees prepare the syllabuses.

Recommendations of Course Committees are submitted to the Council of the NCCA for approval. The NCCA, having considered such recommendations, advises the Minister for Education and Science accordingly.

Further information may be obtained by contacting the NCCA at 24 Merrion Square, Dublin 2.

AN ROINN OIDEACHAIS AGUS EOLAÍOCHTA
DEPARTMENT OF EDUCATION AND SCIENCE

NCCA
National Council for Curriculum and Assessment
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