NATIONAL COUNCIL FOR
CURRICULUM AND ASSESSMENT

LEAVING CERTIFICATE
TECHNOLOGY

ORDINARY AND HIGHER LEVEL

Draft Syllabus

December 2000

Contents

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 and Construction Technology, Engineering Technology, Technical 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

Introduction

Over time

- the practical bases of technology—the accumulated inheritance of technological skills and scientific knowledge—have expanded greatly
- procedures for tackling technological challenges have evolved
- technology has become more pervasive in all aspects of life
- a consciousness has developed that technological advances must be considered in a social context.

These considerations give rise to three issues.

1. It has become increasingly difficult to acquire technological competence without a planned introduction to the knowledge base and procedures of technology.
2. An introduction to technology should take due account of the social dimension in which it happens, and on which it has an impact.
3. It is desirable that every student be given an opportunity to experience an education in technology as a necessary element of a broad and balanced education.

The first two issues are addressed in the design of this Leaving Certificate Technology course. It is beyond the scope of normal school activity to place students at the leading edge of technology. However, it is intended that they become aware of the received tradition, of the methodology, of the directions in which advances in technology might go, and of the human issues that may arise from such developments.

The third issue—access for all to technology education—is addressed by the introduction of this syllabus, which has been designed with the intention of enabling more schools to provide a technology education for their students at senior cycle. The modular structure of the course allows schools considerable opportunity to exploit existing resources and expertise. Furthermore, the range and type of learning experiences proposed are intended to be attractive to all students, especially those who have traditionally avoided hands-on subjects.

Technological capability, a central goal of technology education, will enable the student to take advantage of present and emergent vocational opportunities and to become an informed citizen in a rapidly changing world.

Rationale

The introduction of this Leaving Certificate syllabus provides greater continuity from the junior cycle and is intended to encourage more students to experience a technology education throughout their years at post-primary level.

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

All students should become active participants in their own learning. Leaving Certificate Technology places emphasis on the use of knowledge and its practical application to real life situations, involving an interaction between thinking and doing. This puts the decision-making process in the hands of the student, leading him or her to increased control over decisions taken and to greater self-confidence and personal satisfaction. The course encourages practical activities and the production of artefacts and systems as solutions to problems encountered in everyday life. Students taking this course should move towards accepting responsibility for their own learning to become self-directed, creative and autonomous learners.

AIMS

General aims of technology education

1. 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
2. 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
3. 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: verbal, graphic, model, etc.
4. To provide a context in which students can explore and appreciate the impact of past, present and future technologies on the economy, society and the environment.

Syllabus aims

5. To enable students become aware of the breadth of today's technology through their experience of its practical applications in the solution of everyday problems
6. 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.

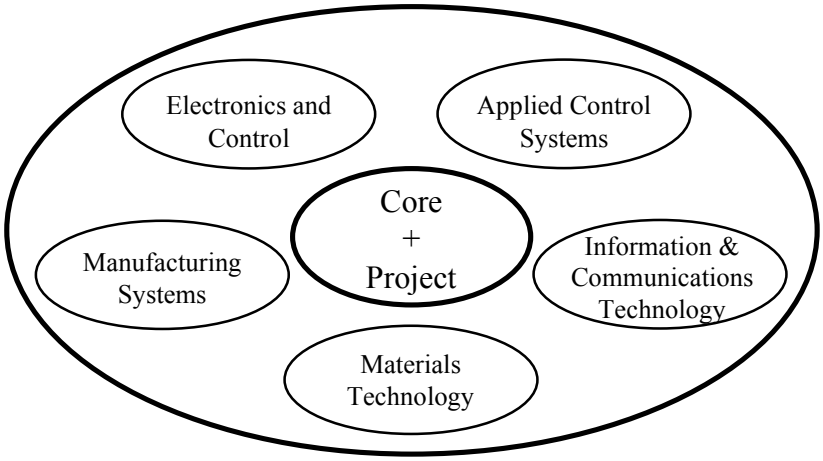
OBJECTIVES

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 reflect in student attitudes to self and to 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
- understand, and be able to 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 the health and safety requirements associated with planning and conducting practical work, and understand how these, together with environmental considerations, affect the design of artefacts or systems
- be able to identify challenges and opportunities which 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 which can restrict technological solutions to problems
- 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
- 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

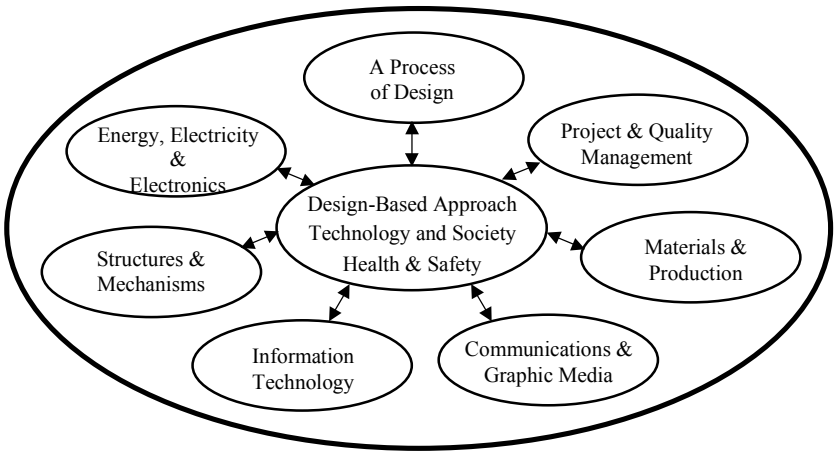


The course consists of core areas of study, which all students must take, and five optional areas of study, of which each student must take **two.** Each candidate is also required to undertake a project, supported by appropriate reports.

The Core (time allocation: 85 hours)

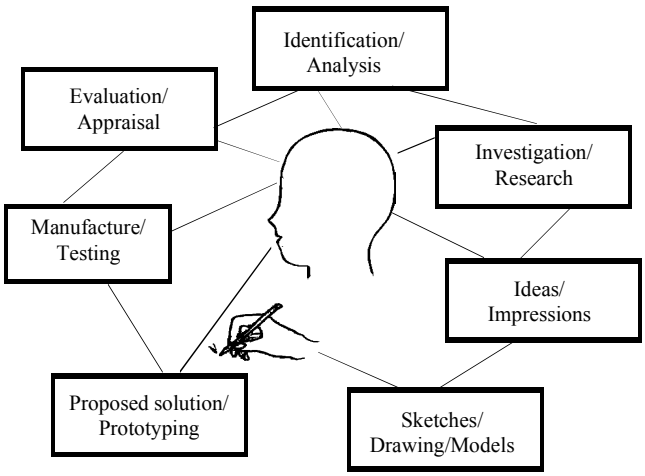
The core is intended as a broad general introduction to the nature of technology. It is also intended to provide students with a consolidation, extension and refinement of the knowledge, skills and techniques acquired in the junior cycle. The main elements of the core are illustrated in the graphic below.

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 many manufacturing processes, waste processing and storage may give rise to conflicting interests between those of the individual, 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 risks.

Options (Time allocation: 2 × 30 hours)

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.

The Project (Time allocation: 35 hours)

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 of the project.

Differentiation between Ordinary and Higher levels

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 shown in italics.

Presentation of Syllabus Content

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

- Topic
- Treatment of topic (students will learn about/to..)
- Learning outcomes (students will be able to..).

ASSESSMENT

Assessment Components

Students will be assessed at two levels, Ordinary and Higher, by means of a terminal examination paper and a project. The assessment weightings are

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 ($2\frac{1}{2}$ hours). At each level, the paper will be presented in two sections. Since the Core is mandatory, students will be assessed on all main elements of the Core in part A of the examination paper. Part 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 submit an artefact and a report/portfolio for assessment, based on a specified theme and within stated parameters. The project – which must be the unaided work of the student – should reflect his/her experience of the syllabus Core and Options and represent the highest standards of knowledge and skill attainable.

Assessment Objectives

Students should be able to:

- recall basic terminology, facts and principles associated with technology, including its development over time
- apply their knowledge of facts and principles, of the design process and the properties of materials in developing solutions to specific technological problems
- conduct basic research and evaluation of artefacts and systems in terms of given specifications
- describe/interpret/explain the impact of existing or proposed technological artefacts and systems on society and the environment
- analyse and evaluate the limitations and constraints which apply in the design of solutions to technological problems
- interpret, process, manipulate and present information in graphic, written, mathematical, and other relevant forms
- select and use appropriate materials, tools and equipment in the production of an artefact or system
- prepare finished drawings and present a report in a concise, accurate and comprehensive manner
- evaluate their own work and propose alterations/modifications to improve or enhance a completed artefact or system.

Syllabus Core

- A Process of Design
- Project and Quality Management
- Materials and Production
- Communication and Graphic Media
- Information Technology
- Structures and Mechanisms
- Energy, Electricity, and Electronics

Students are required to study all sections of the Core

Core: A Process of Design

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
Design Brief	design specifications and the interpretation of design briefs	understand a design brief *and identify a need and/or opportunity for a design project – write an appropriate design brief*
Identification & Analysis of Problems	appreciate the contribution of existing ideas, works, systems to current technologies analyse situations with a view to improving them *and see the potential for developing novel solutions*	state and explain how the historical and cultural setting influence existing designs *discuss the interpretation of a technological challenge*
	identify how existing technological products have contributed to meeting people's needs, and the impact of technological developments on society	state *and discuss* how technological developments have changed the way we live and communicate and describe applications of technologies in everyday life
	understand the requirements of those for whom it is proposed to design an artefact – child, disabled person, etc.	describe the situation, in a cultural context, of the individuals/groups for whom they are designing
Recognition of Constraints	recognise that there are constraints accompanying all design proposals, with particular emphasis on the effects on the environment	list the constraints of time, resources, limitations of skills, machinery, etc. in product design describe the environmental effects of the processing of materials and the disposal of waste products
Investigation & Research	identify the various stages in planning and making to ensure efficient use of time, labour and material resources	plan the stages in production to achieve a completed artefact or system within a specified time and make modifications where appropriate

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
	share knowledge, ideas and experience learn from existing or similar developments, recognise/identify design shortcomings - refine or modify existing artefacts or systems to enhance performance *critically appraise solutions for choice of materials, functionality, deployment of technology features, reliability* *demonstrate an understanding of human factors when designing and appreciate the importance of ergonomics, colour, aesthetics, etc. in design of artefact.* understand aesthetic considerations and develop 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 *analyse 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 considerations, where appropriate, in the selection of optimum solution for manufacture
Generation of Ideas	use a variety of techniques to generate new ideas or to suggest modifications to those already existing	use various techniques to identify situations and propose creative approaches to augment/replace existing designs
Presentation of Ideas	present the results of their investigation in an appropriate form record their researches in written, graphic or other forms as appropriate	sketch, draw, model and present a range of proposed design ideas, using a variety of media, and select the optimum idea from this range
Making and Testing	choose the most appropriate materials, tools, equipment, procedures and processes to make the product, taking into account environmental considerations	identify the working properties of various materials and use this knowledge to select appropriate materials for project work

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
Evaluation	draw up a production plan for the manufacture of the artefact *consider 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*
	match knowledge and skills acquired to suggest optimum design, recognising that manufacturing activity is constrained by a range of factors including knowledge, skills, available materials, cost etc.	use a range of skills, processes and techniques to produce work of a high standard
	use skilfully and safely a range of tools and equipment to make the product	demonstrate a range of skills and follow safe work practices
	evaluate the product or system against the original design task or specification	test and describe how well the prototype/ product meets initial specifications *identify how the prototype/product differs from the initial specifications*
	evaluate the solution and show social costs and benefits of the proposed solution/artefact *recommend design and manufacturing improvements*	*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	produce 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	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
Project Management	understand the basic principles of project management	understand *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	define quality and identify the quality attributes of simple products	list and describe the quality attributes of simple products, including both existing and proposed products
	understand the impact of quality on product life-cycle	*identify and analyse the quality attributes of a proposed product during the design conceptualis-ation and specification phases of simple projects*
		describe, in simple terms, the relationship between quality, market share and manufacturing costs
	understand 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

TOPIC	**TREATMENT OF TOPIC** ***Students should learn about/to:***	**LEARNING OUTCOMES** ***Students should be able to:***
	understand quality costs	describe costs, and their relationship to each other identify*, estimate and classify* the costs incurred during design and execution of simple projects.
	understand the concept of reliability and its impact on product quality including 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	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
Manufacturing Processes	develop a range 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
	show an awareness of the importance of accuracy in the measuring and marking-out of materials	transfer information from drawings, models, sketches, templates and patterns to materials
	appreciate the need for proper safety procedures in the use of hand and power tools and other equipment	follow standard working procedures to ensure the safety of self and others
	develop a knowledge of the physical properties of a range of materials and recognise these properties when selecting materials for particular uses	demonstrate the ability to shape and process a range of materials such as ceramics, composites, fabrics, metals, plastics, woods
	join materials in permanent and semi-permanent forms	select and use the most appropriate methods of joining and assembling materials
	select suitable finishes for materials	show an awareness of *the effects of environmental conditions on materials and understand* the importance of suitable finishing techniques
Resource Management	show regard for the economic use of materials, time, energy and other resources	take account of recoverable and recyclable materials

Core: Communications & Graphic Media

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
Orthographic Projection	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 understand the importance of scaled drawings in the communication of design ideas and in the preparation of working drawings	produce and understand dimensioned and scaled drawings using any of the main systems of projection
Pictorial Projection	understand the use and importance of 3D representations in communicating design ideas.	produce and understand 3D representations in appropriate projection systems produce drawings in accordance with standardised drawing conventions
Freehand Drawings	produce freehand drawings in both 2D and 3D forms and understand their importance in developing design ideas, apply light and shade, texture, rendering, reflection to pictorial drawings understand standard graphic signs, symbols and conventions in current use	produce freehand drawings to communicate ideas display the use of a range of colouring media to enhance design drawings
	select appropriate schematic drawings, procedural sketches, charts and diagrams	select the drawing modes most appropriate to the tasks undertaken

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
Computer-aided Draughting	use computer graphic packages	use simple computer graphic packages to develop and visually represent ideas, using text and graphics
Graphic Modelling	use simple graphic modelling techniques to present ideas	model ideas in easily worked materials
Presentation of Information	report in a concise and accurate form all information they wish to communicate	use language to convey information and be familiar with specialised vocabulary
Production of Report	consider the best style to adopt to record, process and present information, and make an audio and/or visual presentation where appropriate	make use of Information Technology tools, using suitable software packages when appropriate, to communicate information

Core: Information Technology

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
Introduction to Computer Systems	develop the basic skills of Information Technology	use Information Technology skills in the presentation of information
	know the main components of a computer system: • hardware and software • systems units • input, output, and storage devices	identify the components of a computer system and describe their functions understand system specifications e.g. memory, clock speed and storage capacity use input devices; generate output; manage files
	manage a computer system: • boot-up • shut down • personal safety and the safe operation of the system	start up and shut down a computer system safely launch, execute and exit from software describe *and, where appropriate, identify* use of data security procedures and virus protection measures
	use the computer as an aid to investigation and research	conduct practical investigation and research and integrate findings into design projects
Applications and Software	use a word processor	enter text; format text; insert files into a document – e.g. text, graphics, tables; open, close, save, save as, rename files; output files
	use a spreadsheet	*identify types of cell content (value, expression, text); enter data; perform simple arithmetic operations; store and manage data; produce charts, graphs, tables*

Core: Structures and Mechanisms

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
Structures	naturally occurring and manufactured structures	describe *and explain* naturally occurring and manufactured structures
	classify various forms of structures	describe with aid of sketches arch, shell, frame, beam, box structures
	understand what is meant by a force	
	examine how forces affect structures	describe *and analyse* the effects of forces acting on a structure: tension, compression, shear, torsion, bending
	what is meant by the moment of a force	*do 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 centre of gravity affects the stability of structures
	apply structural principles to design, and make models of structural forms	identify existing structures, construct models and test their characteristics.
	understand the idea of factor of safety and its importance in structural design	*outline, using examples, what is meant by destructive and non-destructive testing*

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
Mechanisms	the terms: work, power, torque, friction, load, effort, mechanical advantage, velocity ratio, efficiency	*perform simple calculations, using correct units, as they are required*
	identify first, second and third order levers; linkages	sketch and give examples of various levers in everyday use
	simple and compound pulleys; types of belt drives	sketch and give examples of pulley systems in everyday use
	gear trains	sketch and give examples of belt drives
	the use of cams	sketch and describe the application of each gear type
		describe the appropriate use of cams

Core: Energy, Electricity & Electronics

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
Energy & Energy Conservation	the sources of energy – renewable and non-renewable	demonstrate how the principles of energy conservation and energy conversion can be used in project design and manufacture
	energy as the ability to do work	
	the different forms of energy, e.g. potential, kinetic, chemical	distinguish between the different forms of energy
	the principle of conservation of energy and its application	state and apply the principle of conservation of energy
	energy transformations	*analyse energy transformations in any device*
	appreciate the cost of energy	*calculate the cost of energy*
	the term energy efficiency	*appreciate the efficiency of different energy conversions*
Electricity	electricity as a form of energy	understand how use of electricity determines the way we live
	basic electrical concepts: electric current, voltage, resistance, power and the relationship between them	*understand the relationship between voltage, current and resistance (Ohm's Law)* apply Ohm's Law, where appropriate
	the units in which electric current, voltage, resistance, power and frequency are measured	understand and use appropriate units and their symbols: ampere, volt, ohm, watt, hertz
	the resistor colour code	identify resistor values using the colour code
	use instruments to measure current, voltage, resistance	use multimeters correctly and appropriately
	understand the difference between AC and DC	differentiate between types of electricity – from mains supply (AC) and from batteries (DC)
Electronics		

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
	identify electronic input, process and output components including switches, relays, temperature/moisture/light sensors, resistors, capacitors, transistors	assemble, test and modify simple sensors for sound, heat and light from given circuit diagrams
	read and interpret common circuit diagrams construct simple circuits	given circuit diagrams, assemble components correctly into circuits
	construct basic circuits with resistors connected in series and parallel and cells in series and parallel	have a basic understanding of voltage and current flow in circuits and test the outputs – outline principle of voltage across components in series and parallel
	design, assemble and modify simple circuits from specified design briefs	*be able to identify and correct faults in circuits they have constructed*
	construct simple transistor circuits incorporating a potential divider *and understand its use in controlling the transistor*	use the potential divider to vary an applied voltage; *design, test and modify circuits incorporating the use of a potential divider*
	construct simple transistor circuits to include output devices – lamp, buzzer, LED, speaker, motor, relay	construct and assemble a number of projects which incorporate output devices – sirens, alarms, etc.
	design systems as solutions to specified problems	*understand the operation of circuits which they design and make appropriate modifications to such circuits*
	explain the function of basic logic gates AND, OR and NOT and construct truth tables for each.	decide on the most appropriate gate(s) to use in a circuit and incorporate these into project work where appropriate

Options

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

Students are required to study <u>two</u> of the five options.

Option: Electronics & Control

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
Electrical Measurements	measurement of potential, current, resistance, capacitance, frequency (*V, A, Ω, F, Hz*)	select appropriate instruments, measure basic electrical quantities, and explain in simple terms what they have measured
	indirect measurement of power	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, relays	use, *and understand the function of*, components in circuit design use a potential divider as a volume control
	the design, assembly and testing of circuits	design, test and assemble circuits, or circuit sub-units, making appropriate use of the listed components
Power Supplies and Safety	select a suitable power supply for a specified application	choose appropriate power sources for selected tasks
Electric motors	the mode of operation of the DC motor; back EMF; the variation of current requirement with the load	*measure the efficiency of an electric motor*
	reversing a DC motor	assemble switches and motors to achieve forward and reverse motion

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
Assembly of Pre-designed Circuits	assembly of bistables and astables, amplifiers, *assembly of oscillators, timing circuits*	construct and make appropriate modifications to circuits, based on circuit diagrams
	printed circuit boards (PCBs)	use an appropriate method to produce PCBs for a given circuit
	production of prototype and commercial batches of PCBs	*understand the production of both prototype and commercial batches of PCBs*
	use of prototyping boards for initial assembly and testing of circuits	demonstrate the use of prototyping boards in assembly and testing of circuits
	operational amplifier circuits (op-amps)	*design, assemble, test and modify operational amplifier circuits using integrated 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

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
Logic Circuits	basic logic gates: AND, OR, NOT and NAND truth tables	construct truth tables for up to four inputs using an array of up to four logic gates
	combinations of gates	combine logic gates appropriately using ICs
	the main logic families (TTL and CMOS)	select the appropriate type (CMOS or TTL) of IC for a particular task
	the use of logic gates with sensors and output devices	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	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
Robotics	classify robotic joints by degree of freedom and co-ordinate frames	identify robot types specify robotic joints for particular applications
	do simple calculations of forces and moments involved	size and specify robotic structure and arms
Introduction to Robotic Control	classify robots by structure and application, with emphasis on manufacturing applications	be aware of industrial applications of robotics *identify suitable robotic structures and configurations for specified tasks*
	understand the principles of open and closed loop control	construct block diagrams of simple robotic controllers; calculate gains
	understand the principles of operation and control of dc servos and stepper motors	select DC 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	use of computers or other programmable devices (such as PLCs or PICs) to control various devices	use a programmable device to control circuits or sub-assemblies which they have constructed, e.g. LEDs, bulbs, seven-segment displays, DC motors

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
Programmable Devices	understand the principles of combinational and sequential logic	program simple logic sets using Grafcet or function diagrams
	programme a robotic device to carry out specified operations and to sense functions	programme a robotic device to do specified tasks *and to modify outputs in response to sensed conditions*
Pneumatics	identify pneumatic actuators, directional control valves, pressure and speed control valves, stop valves, service stations	use appropriate calculations and/or charts to facilitate the selection of circuit elements
	understand the principles of selecting control strategies, e.g. totally electronic, electro-pneumatic, totally pneumatic circuits	design, cost and build single *or mixed* technology circuits

Option: Information & Communications Technology

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
Computer Architecture	1 kilobyte as 2^{10} (1024) bytes understand a computer's memory: RAM, ROM, primary and secondary memory	explain the difference between RAM, ROM, primary and secondary memory
	understand the use of buses and different bus standards	explain the function, capacity, speeds and expansion possibilities of buses
	understand hardware and software compatibility	explain the compatibility requirements of hardware and software adapt files for transfer between different applications
	understand the transmission of information via the communications ports using different peripherals	explain the transmission of information from serial and parallel ports through different peripherals
Data Communications and Computer Networks	*understand the characteristics of the American Standard Code for Information Exchange*	*explain the main characteristics of ASCII*
	understand the operational characteristics of a conventional network	describe the use and functions of a local area network
		log on and off a network; set up log-on names and password-listed files and folders; work with a group
	Local Area Networks (LANs)	*operate a LAN*

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
The Internet	the internet and the World Wide Web	explain what the internet is and show how to 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
	other internet applications	explain the uses of Internet Protocols e.g. TELNET, FTP, Gopher, and SMTP (email)
		explain the operation of Usenet and IRC
		demonstrate video conferencing and IRC
	data protection	understand data protection and the law.
Multimedia and Computer Aided Design		

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
Computer Aided 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 either colour or grayscale *convert from one image format to another* *alter image size, scale, brightness, contrast, gamma and tone properties so as to achieve special 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	understand how to navigate around 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	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
The Context of Manufacturing	*identify generic business and manufacturing strategies*	*describe the context and expected outcomes of such strategies*
	identify generic manufacturing strategies for simple products	*discuss these strategies in relation to simple products*
		apply the Product/Process Matrix to simple product/markets
	understand conceptually 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
	identify the key success factors in manufacturing competitiveness	describe the key success factors and their linkage with the market and manufacturing systems
	understand 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
	understand and construct N (μ,σ^2); construct and understand x-R control charts	collect data for a simple manufacturing process and construct the x-R chart

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
	understand process capability	calculate and interpret process capability indices for simple manufacturing processes
	understand sampling and its application in manufacturing	*describe sampling inspection systems and calculate sample lot 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*
	the philosophy 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	understand and appreciate behavioural dynamics in team work	work on a project as part of a team
Concurrent Engineering	understand the life-cycle spectrum and apply some 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 and Value Analysis concepts to simple product/manufacturing strategies

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
Manufacturing System Design & Control	*understand the role of CAD geometric and feature database in design and manufacturing* understand role of testing in product design *understand conceptually the role of accelerated testing for simple products* understand the impact of product life-cycle on the environment *understand the constraints of workflow, human factors and health and safety legislation on work design* understand the concepts of capacity management and activity scheduling in the design of manufacturing systems *understand the principles of plant layout*	*apply these concepts during the design phase for a simple product* *describe and explain the techniques for the design of very simple products for manufacture and disassembly using 2/3 CAD system.* propose testing procedures for simple product performance evaluation. *apply DfE concepts for simple products and processes* incorporate recycling, re-use *and waste strategies* into simple product specification. *devise simple work cells for simple processes of manufacture, assembly and packaging* devise simple 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	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
Classification of Materials	understand the properties of a range of materials to enable the selection of appropriate materials within the context of design activities	understand the properties of at least two materials – at least one to be a rigid material
	identify materials in immediate environment and classify as metals and non-metals	classify materials as metals – ferrous and non-ferrous, wood, composites, polymers, fabrics, ceramics
Properties of Materials	identify the physical properties of materials and compare and contrast properties of materials relative to one another	list *and show an understanding of* the physical properties of materials – to include hardness, toughness, ductility, elasticity, malleability
	group materials according to properties of electrical and thermal conductivity, thermal expansion, optical, magnetic and mechanical properties	*understand the nature of materials, carry out simple tests to demonstrate properties of selected materials and classify according to these properties*
	how environmental conditions can change the mechanical and physical properties of materials	understand 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	*understand the nature of materials and the forces that hold them together*	*understand that observable properties of materials are related to their atomic/molecular structures (atomic/molecular details not required)*
	how inconsistencies and defects in materials can affect mechanical /structural properties	*use simple data from tensile, compressive, bending shear, torsion tests in design situations*

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
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
Materials Processing	recognise that the properties of materials determine 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
	evaluate 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	show knowledge of commonly applied techniques to prevent or retard the degradation of materials	describe how surface treatments are applied to a range of materials
	appreciate reasons for application of range of finishes to materials	*propose surface finishes for different materials and evaluate effectiveness of finish against specification*
Skills Development	use a minimum of two materials (at least one to be a rigid material): fabrics, metals, polymers, wood, ceramics, composites	*understand the working properties of different materials* demonstrate high skills development

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
Materials and the Environment	apply knowledge of environmental and social considerations in product design and manufacture	describe how economic use of earth's resources informs selection of materials, processes, finish, etc.
Quality Assurance	set standards for the assurance of quality and critically appraise finished product against these standards	complete artefacts to meet specified design briefs
Production Techniques	*demonstrate understanding of once-off and batch production techniques*	*demonstrate constraints as applied to craft production and batch production techniques*

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. They will be expected to recognise standard prefixes used with the symbols for physical quantities (see below).
Students may use an electronic calculator that conforms to examination regulations.

Symbols and Units

Throughout the course, students will be expected to recognise and use the correct symbols and units for physical quantities. The table below shows the most common quantities likely to arise in Technology.

Physical Quantity	**Symbol**	**Unit Name**	**Unit Symbol**	**Expressed in terms of other units**
length	l	metre	m	
area	A	square metre	m^2	
mass	m	kilogram	kg	
time	t	second	s	
speed	v	metre per second	ms^{-1} or m/s	
force	F	newton	N	
moment of a force	M	newton metre	Nm	
torque	T	newton metre	Nm	
work	W	joule	J	Nm
energy	E	joule	J	Nm
power	P	watt	W	$J\ s^{-1}$
temperature	T t	kelvin degree Celsius	K °C	
electric charge	$Q,\ q$	coulomb	C	
electric current	I	ampere	A	
potential difference	V	volt	V	
capacitance	C	farad	F	$C\ V^{-1}$
resistance	R	ohm	Ω	
frequency	f	hertz	Hz	s^{-1}
angle	θ	degree	°	

The following SI prefixes may also arise in Technology.

Prefix	Symbol	Factor	Prefix	Symbol	Factor
giga	G	10^{9}	milli	m	10^{-3}
mega	M	10^{6}	micro	μ	10^{-6}
kilo	k	10^{3}	nano	n	10^{-9}
centi	c	10^{-2}	pico	p	10^{-12}

Relationships and Formulas

Students should know and be able to use appropriate relationships and formulas. The derivation of these formulas is not required. Some typical relationships and formulas used in Leaving Certificate Technology are presented below. Others may be found in the Mathematical Tables, copies of which will be available during the examination.

Uniform linear motion: $velocity = \frac{distance}{time}$

Work: $work = force \times distance\ moved\ in\ direction\ of\ the\ force$

Average power used: $\frac{total\ work\ done}{total\ time\ taken}$

Moment of force: $force \times perpendicular\ distance\ to\ fulcrum$

Mechanical advantage: $\frac{load}{effort}$

Velocity ratio: $\frac{distance\ moved\ by\ effort}{distance\ moved\ by\ load}$

Gear ratio: $\frac{speed\ of\ driving\ gear}{speed\ of\ driven\ gear}$ also $\frac{no.\ of\ teeth\ on\ driven\ gear}{no.\ of\ teeth\ on\ driving\ gear}$

Efficiency (%): $\frac{power\ output}{power\ input} \times 100$

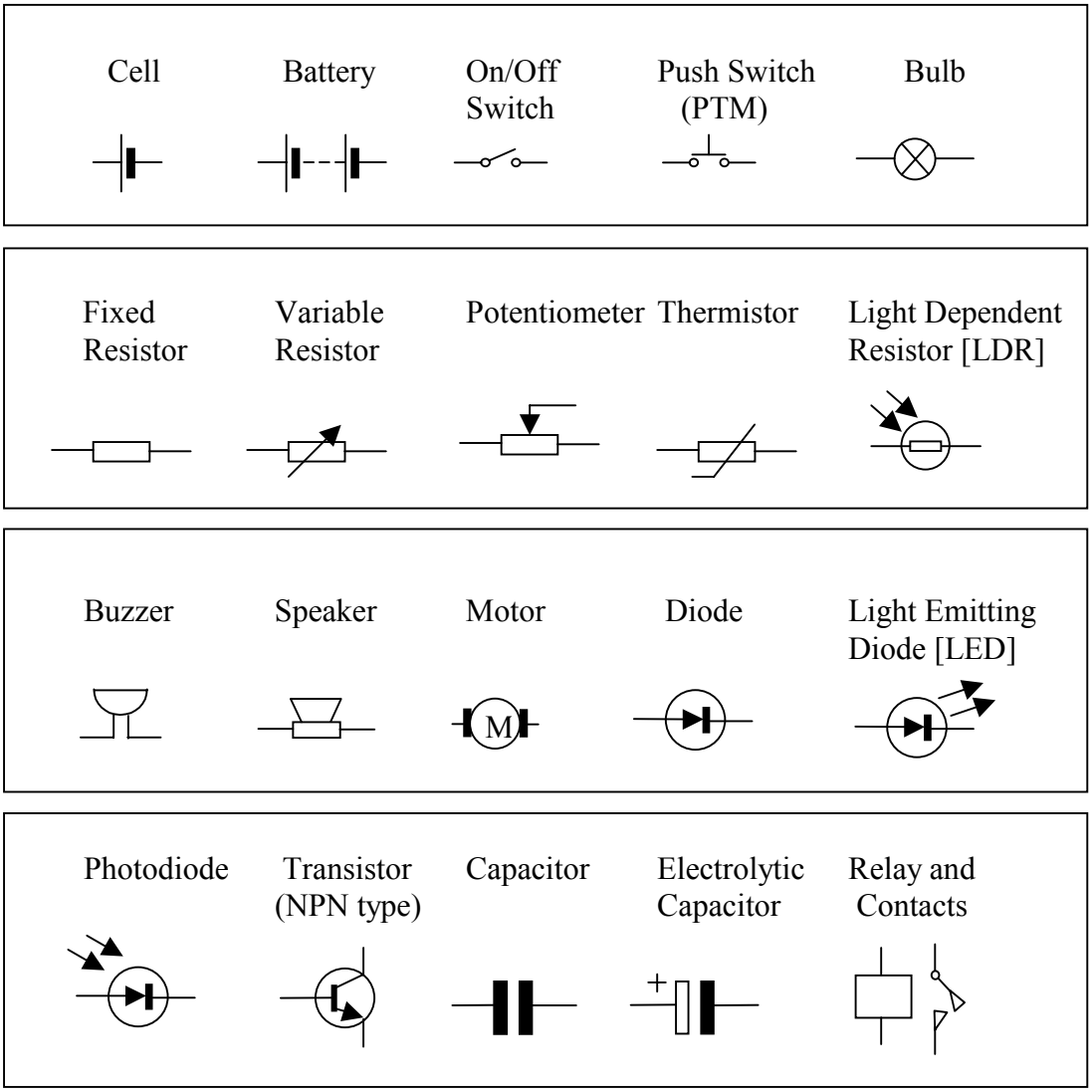
Ohm's law: $V = I \times R$

Resistors in series: $R = R_1 + R_2$

Resistors in parallel: $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$

Electrical power: $P = V \times I$

Electrical/Electronic Circuit Symbols



Logic Gates