NCCA

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

Leaving Certificate Technology Syllabus

Ordinary level and Higher level

For implementation in September, 2007

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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 that 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, Design and Communication Graphics, Engineering Technology, 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 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 composed 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.

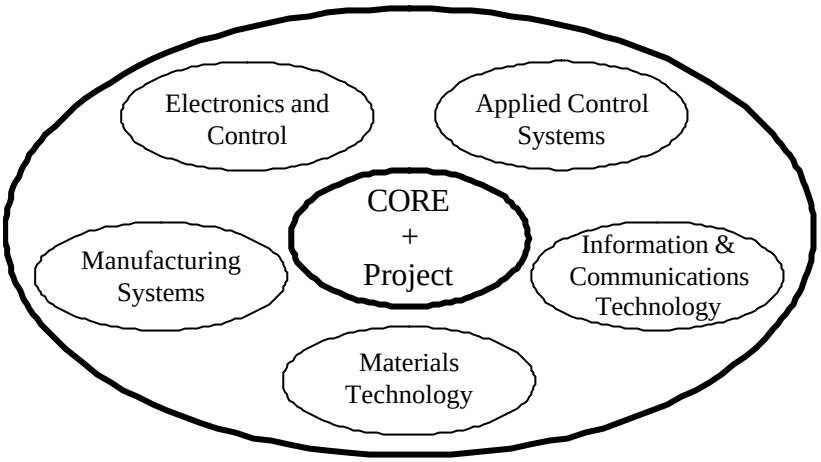
OBJECTIVES

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

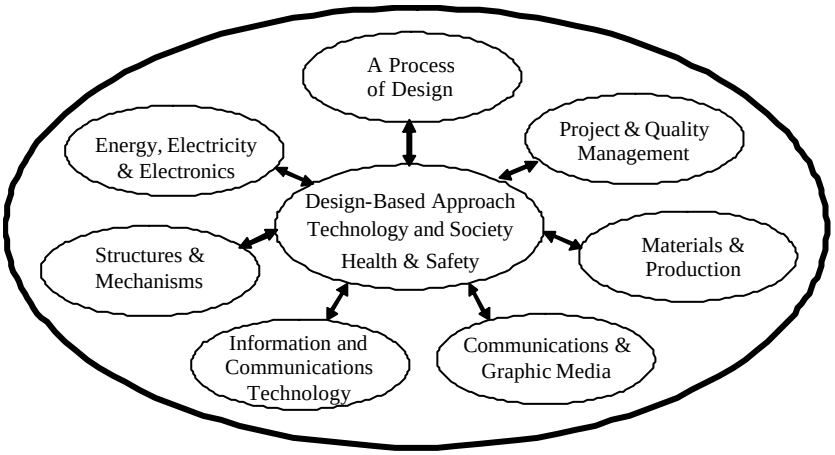


The course consists of core areas of study, which are mandatory for all students, and five optional areas of study, from which each student must take two.

The Core

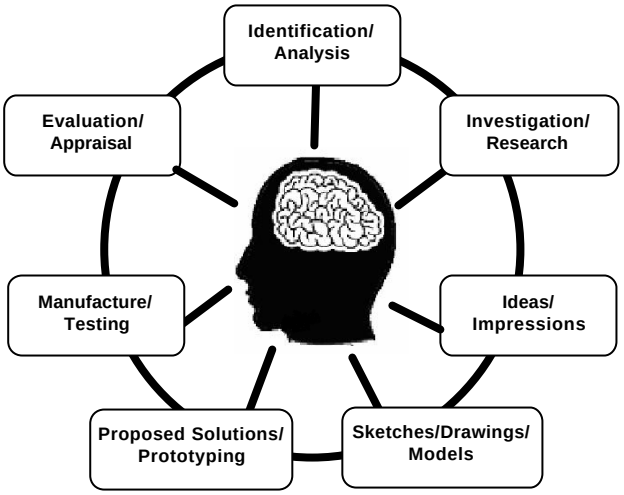
The core is intended as a broad general introduction to the nature of technology. It is also intended to provide students with a consolidation, extension and refinement of the knowledge, skills and techniques acquired in the junior cycle. The main elements of the core are illustrated in the graphic below.

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 underlined 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 will be able to …).

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

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 ($2\frac{1}{2}$ 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 realization 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

- 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

Students are required to study all sections of the Core

Core: A Process of Design

TOPIC	SUB-TOPICS *Students should learn about/to:*	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	• appreciate and describe how historical and cultural settings have influenced existing designs
	• the interpretation of a technological challenge	• analyse situations with a view to improving them and see the potential for developing novel solutions
	• the impact of technological developments on society	• 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
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	• take into account the requirements of the individuals or groups for whom they are designing
	• 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 • work in collaboration with others

TOPIC	SUB-TOPICS *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
Investigation and Research (continued) **Generation of Ideas** **Presentation of Ideas** **Selection / development of chosen idea(s)**	• 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 • generation of new ideas or exploration and modification of existing designs • 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 • 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	• 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 optimum solution for manufacture • use various techniques, to develop new ideas; identify situations and propose creative alternatives to existing designs • sketch, draw, model and present a range of proposed design ideas and investigation results, using a variety of media • 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

TOPIC	SUB-TOPICS *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
	requirements • 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
Production Planning	• 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.	• 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
Making and Testing	• testing the product/system against the design brief and specification.	• test and describe how well the prototype/ product meets initial specifications • identify how the prototype/product conforms with or differs from the 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 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

TOPIC	SUB-TOPICS *Students should learn about/to:*	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 lyse data lyse d0 4
	• quality and cost	

Option: Manufacturing Systems

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	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

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
Quality Management (continued)	• process capability • sampling and its application in manufacturing • the historical development of Quality Control, Quality Assurance and Total Quality Management • the rationale of just-in-time (JIT) manufacturing	• calculate and interpret process capability indices for simple manufacturing processes • describe sampling inspection systems and calculate sample size for the purchased components of a simple product • describe concepts of QC, QA, TQM and their impact on quality management and organisation, in particular, behavioural and organisational factors • 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 **Concurrent Engineering**	• behavioural dynamics in team work • the life-cycle spectrum and the application of concurrent engineering methodologies for simple products	• work on a project as part of a team • 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

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
Concurrent Engineering (continued)	• the role of geometric and feature-based CAD in design and manufacturing	product/manufacturing strategies • 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
	• 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
	• understand the impact of product life-cycle on the environment	• incorporate recycling, re-use and waste strategies into simple product specification
Manufacturing System Design and Control	• the constraints of workflow, human factors and health and safety legislation on work design	• devise work cells for simple processes of manufacture, assembly and packaging
	• the concepts of capacity management and activity scheduling in the design of manufacturing systems	• devise batch and flow processing scheduling systems for simple product manufacture • devise Kanban systems for simple product manufacture
	• the principles of plant layout	• use simulation tools and simulation games in designing scheduling systems and plant layout for the manufacture of simple products

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*

Option: Materials Technology

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	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	• understand 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 • understand the nature of materials, carry out simple tests to demonstrate properties of selected materials and classify them according to these properties • 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

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
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	• understand 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
Materials Processing	• the role of the properties of materials in determining how they are worked • the methods by which materials are processed • the effectiveness of various methods of materials processing • the proper safety procedures and working practices when using materials, tools and equipment	• describe how the manufacturing /tooling processes vary according to characteristics of the material • demonstrate a knowledge of hand, machine, thermal and chemical methods of material processing • select and evaluate appropriate methods for processing materials in a classroom context • follow safety precautions in the processing of materials and in the safe use of materials, tools and equipment

TOPIC	TREATMENT OF TOPIC *Students should learn about/to:*	LEARNING OUTCOMES *Students should be able to:*
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 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
		• demonstrate constraints as applied to craft production and batch production techniques
Production Techniques	• once-off and batch production techniques	