TECHNOLOGY EDUCATION IN THE JUNIOR CYCLE

A FRAMEWORK FOR PROVISION

NCCA CONSULTATION DOCUMENT

March 2003

PREAMBLE

REVIEW OF PROVISION FOR TECHNOLOGY EDUCATION IN THE JUNIOR CYCLE

The NCCA established a Board of Studies to review the provision for technology education in the junior cycle. This Board of Studies has membership drawn from the following bodies:

Subject Teacher Associations (ETTA, ATT, TTA and ISTA)

Teacher Unions (ASTI and TUI)

Management Bodies (ACS, IVEA and JMB)

Department of Education and Science (Inspectorate)

NCCA (Council and Executive representatives).

The brief for the review is to

- specify the purposes and aims of technology education at junior cycle
- specify the key components of technology education at this level
- propose how the purposes, aims and key components specified should be structured and provided for in the curriculum area of technology; in this context a range of options should be considered, including full and short courses
- propose appropriate modes and techniques of assessment and assessment criteria
- take cognisance of the implications of proposals for other subjects within the curriculum
- prepare an implementation plan, with specific recommendations to address the in-career development needs of teachers and the improved presentation and promotion of the technology subjects
- have regard to the resource implications of proposals and indicate the level of resources needed by schools to implement the new curriculum arrangements effectively.

PROGRESS AND OUTCOMES

The Board of Studies has identified the key components of technology education in the junior cycle. In considering how these might be provided for, a number of possible configurations arose for discussion. In order to have a clear view of what these might entail, the Board requested the development of appropriate content areas and associated learning outcomes.

This discussion document sets out a framework for provision that comprises a Core and Options arrangement. The framework provides a range of choices in terms of subject selection, and facilitates students who might wish to take a number of subjects in this area. Individuals and groups are invited to respond to this discussion document, using the Response Questionnaire developed for that purpose.

At the end of the consultation period, the responses will be analysed and a summary presented to the Board of Studies, which will then prepare an overall report on its work in relation to its brief. This report will be presented to the Council of the NCCA, where a decision will be made on further development and on the appropriate structures for preparing syllabus documentation and associated guidelines.

CONTENTS

JUNIOR CYCLE TECHNOLOGY EDUCATION

INTRODUCTION AND RATIONALE

Technology education is an essential component of a broad and balanced curriculum at junior cycle through which students grow in competence, increase in confidence, and become more enterprising. The acquisition of a range of skills is an important component of this sense of competence and can help students to develop the ability to control their physical environment. Through technology education students can develop technological capability, which includes

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

In a world where encounters with a wide range of technologies are part of the daily life experience of all people, students should be equipped to face these encounters with the confidence that comes from learning about, learning through and learning with a range of technologies. It is equally important that they gain an appreciation and understanding of the interface between technology and society. They should have the capacity to engage in discussion about, and make personal judgements in relation to, the impact of technology on their own lives, on society, and on the environment.

The key components of technology education include design and communication, materials and processing, energy and control, health and safety, and technology, society and the environment. Technology education integrates problem-solving and practical skills in the production of useful artefacts and systems.

Technology education is activity-based and, although presented in this document as a number of discrete sections, it should be taught in an integrated fashion. It is designed in a manner that facilitates flexible mediation, depending on the teaching expertise available and the tradition of the school. This will be reflected in the dominant materials and processes chosen when skills are being developed and tasks or projects are being undertaken.

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 technologically literate and creative participants in society
- to encourage and enable students to integrate such knowledge and skills, together with qualities of co-operative enquiry and reflective thought, in developing creative solutions to technological problems and needs—using appropriate materials, equipment and resources to produce artefacts and systems—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 and in a variety of forms, including verbal, graphic and model, and involving the use of appropriate media
- 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.

OBJECTIVES

The following list summarises the general aims of technology education in the junior cycle. Particular student learning outcomes are indicated in each section.

As a result of their experience of a technology education students should be able to

- understand basic technological principles and facts
- describe how the design process can be used in problem-solving
- research, generate and present ideas and solutions in a logical form using appropriate materials and techniques
- understand how information technology can be used in the development of ideas and to communicate data in a variety of forms
- interpret, analyse and communicate technological information in written, verbal and graphic form, using appropriate media
- develop solutions to given design briefs according to specified criteria
- design and manufacture artefacts to appropriate standards
- use their knowledge of materials and their properties to select those most appropriate for a given situation or task
- select and use tools, processes and systems in the realisation of artefacts or systems, with due regard for health, safety, and environmental considerations
- develop an understanding and appreciation of the contribution of past and present technologies to society, and their impact on the economy and the environment.

OVERVIEW

The key components of technology education have been configured through a Core and Options arrangement, in order to give a balanced technology education (See Figure 1 overleaf).

While the core topics are common, the option chosen will influence their mediation, thereby giving a particular emphasis to the way in which a student will experience them. By combining the core with any one option a student can satisfy the requirement for a full subject. A second subject may be chosen in this area by combining the core and another option (which will, therefore, mediate the core differently). [Note that Technical Graphics may be chosen as a stand-alone subject or as a second/third technology subject.]

CORE

- Developing initial knowledge and skills
- A design process and communication
- Energy
- Technology, society and the environment
- Health and safety

OPTIONS

- Materials and Processing (Wood mediated)
- Materials and Processing (Metal mediated)
- Energy and Control
- Other (potential for later development)

In each section within the core and the options, content is listed under main topic headings. These are developed further, into expanded topic details, to indicate the depth of treatment and breadth of coverage required. Student learning outcomes are also specified in each section. Content details in the Options are set out in a way that facilitates the adoption of a particular mediation. An integrated approach to teaching and learning in technology education should take account of its activity-based nature and the range of skills to be developed.

TECHNOLOGY EDUCATION

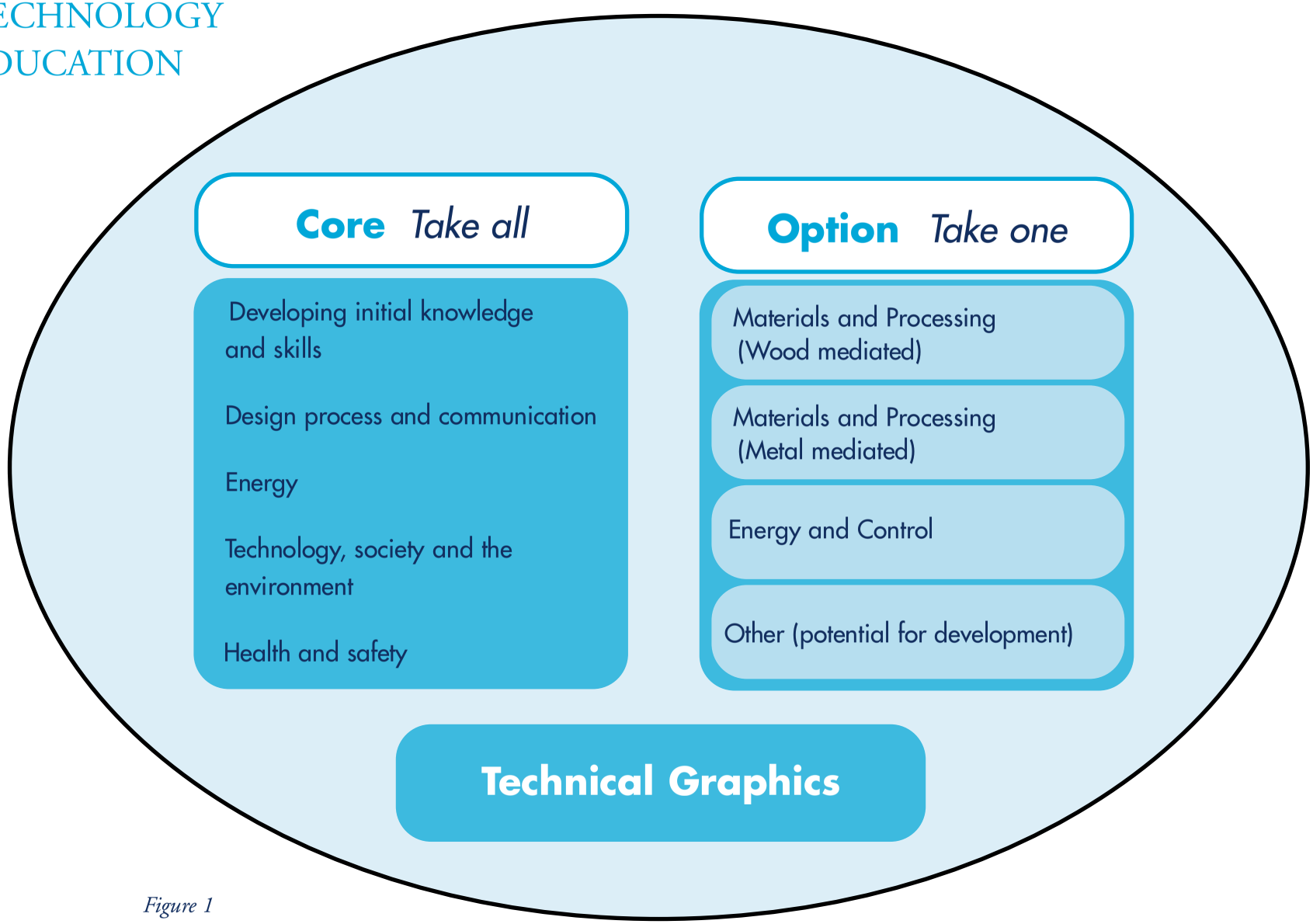

Figure 1

The Core together with any single Option will satisfy a full subject requirement. A student may take a second subject by combining the Core with a different Option. A student may take Technical Graphics as a stand-alone, second or third subject in this area. In the teaching and learning, the focus of study for the core topics will reflect the chosen option.

CORE

CORE – DEVELOPING INITIAL KNOWLEDGE AND SKILLS

The purpose of developing initial knowledge and skills is to ensure that, at an early stage, students experience a good foundation that will empower them to adopt a design-and-make approach in their subsequent study of the subject.

Initial tasks should be of a simple, closed nature and should take account of the student's stage of development. Their purpose is to develop appropriate knowledge and understanding of materials and their properties, in the context of their chosen option, and the procedures to be followed for the safe use of tools and equipment in the work area. It is envisaged that these skills will be developed through the medium of one or more materials, depending on the resources and facilities available to the teacher. Students should develop the ability to integrate knowledge, understanding and skills in devising solutions to problems, and they should appreciate the need for the careful planning of project work.

CONTENT

Main Topic	Expanded topic details
Project work and design process	Project planning; basic analysis of brief; research into existing and proposed solutions; communication, design and realisation; testing and evaluation of simple artefacts/projects
Materials	Identification, classification, properties and uses of common materials; appropriate selection of materials
Tools and machines	Identification, and correct and safe use of hand and machine tools appropriate to the materials and processes selected
Processing skills	Measuring and marking out; cutting, shaping, forming, joining, and finishing materials
Safety considerations	Good practice and proper procedures; awareness of potential dangers and health hazards; safety and first aid equipment; regulations and symbols; protective clothing; evacuation procedures

LEARNING OUTCOMES

As a result of their study of these topics, students should be able to

- identify a range of common materials and list the properties of these with relevance to their use
- measure a number of objects of varying size and shape
- use appropriate hand and machine tools to mark out, cut, shape, form, join and finish given materials
- apply knowledge and skills to communicate design ideas and in the realisation and evaluation of simple artefacts/projects
- select materials, tools and processes appropriate to a given task
- demonstrate an awareness of health and safety issues, describing and observing correct procedures and safety precautions in relation to tools, machines, processes and materials (including their disposal).

CORE – DESIGN PROCESS AND COMMUNICATION

A process of design and realisation is central to technology education in that it provides the mechanism through which problems can be analysed and solved to satisfy human needs. It stimulates the imagination and creative thought, and develops critical thinking in a tangible way. Skills of visualisation and spatial reasoning are developed through communication of thoughts and ideas in visual images in the form of sketches, drawings and reports.

CONTENT

Main Topic	Expanded topic details
Design and communication	Sketching and drawing (conventions, use of instruments, schematic and working drawings, symbols, circuit diagrams, shading and texturing, use of colour to enhance sketches and drawings); measuring and dimensioning; modelling; use of information and communication technologies (ICT) for appropriate research and to enhance the presentation of reports and portfolios: word-processing, database, CD-ROM, internet, CAD; safety and environmental considerations in product design and realisation.
Project work	Analysis and interpretation of a brief: ergonomic considerations, investigation, and research of existing and/or possible solutions; sketches/drawings/models of initial design ideas (freehand, using instruments, computer-aided); evaluation of initial ideas against identified criteria; development of a selected design idea (model and/or working drawings); selection of materials and processes appropriate to the chosen idea, with due regard for safety and environmental considerations; manufacture and final assembly of artefact; testing and evaluation of the finished product; folio production and presentation.

LEARNING OUTCOMES

As a result of their study of these topics, students should be able to

- critically evaluate existing artefacts and/or design ideas according to identified criteria, and propose possible alterations or improvements where appropriate
- recognise and use standard symbols and notation in sketches and working drawings and interpret relevant information from given drawings and data
- describe and follow a design process when undertaking project work
- interpret and analyse a given brief and establish appropriate criteria
- investigate and research possible solutions to a given problem or brief
- develop design ideas and present these by means of sketching, drawing or modelling
- evaluate design ideas against identified criteria and select an appropriate solution
- communicate the chosen solution through appropriate drawings and/or models (including scaled drawings or models) and the use of colour, shading or rendering, and present data in graphic, tabular and other forms
- have due regard for safety and environmental considerations when undertaking a project
- list the appropriate stages, processes, and materials required for the design and manufacture of an artefact
- manufacture and assemble an artefact in accordance with the chosen solution
- test and evaluate a finished product against established criteria
- prepare and present a project folio
- use ICT to research, prepare, present, or enhance their work as appropriate, at various stages of a project
- integrate and apply previous knowledge and skills in multi-component projects.

CORE – ENERGY

There are many sources of energy, which can exist in a variety of forms. It can be changed from one form to another and used to operate and control simple devices and machines in the safe and efficient performance of tasks, and in the enhancement of projects. In the design and realisation of artefacts as solutions to given tasks or briefs, an understanding of how energy can be used, transmitted and transformed should lead to an awareness of the need for the conservation of energy.

CONTENT

Main Topic	Expanded topic details
Energy forms/ conversions	Renewable and non-renewal sources of energy; forms of energy: energy conversions (input-output model); use of devices that transmit and transform energy and motion
Electric/electronic circuits	Investigation of the relationship between voltage, current and resistance; simple components and circuits; assembly and testing of electric/electronic circuits; use of components in projects as required; recognition and use of standard symbols
Mechanisms	Gears, pulleys, linkages, cams, belts and chains; assembly and investigation of simple models involving one or more mechanisms; basic calculations of speed
Control	Selection and use of a range of electric/electronic components and mechanisms to provide simple control devices and systems

LEARNING OUTCOMES

As a result of their study of energy and control, students should be able to

- identify and describe different forms of energy transmission used in the construction and operation of projects
- select appropriate energy transmission and control systems
- integrate a variety of mechanisms with suitable structures for given situations
- investigate the basic function and principles of common electrical and electronic components and circuits
- assemble simple circuits and components by temporary and permanent methods
- use electrical and electronic components and circuits to power and enhance the functionality of projects
- manufacture and assemble the component parts of mechanisms used in projects.

CORE – TECHNOLOGY, SOCIETY AND THE ENVIRONMENT

There is a need to understand how people influence and interact with technology, and how it affects our lives and the environment. Students should consider how materials, machines, processes and communications impact on society, and should demonstrate innovative approaches to design that take this into account. They should demonstrate awareness of environmental and ergonomic factors in the design and manufacture of projects.

CONTENT

Main Topic	Expanded topic details
Technology, society and the environment	Impact and effects of technology in the home, in school and in the workplace, and on transport, industry and leisure; forms of pollution and control
Design considerations	Selection of materials, tools, process and systems with regard to their impact on society; the impact of good design practice on waste generation and disposal
Case study	Examination of the structure, development and use of everyday objects, machines, appliances and systems (washing machine, motor car, central heating, CD player, mobile phone, computer)

LEARNING OUTCOMES

As a result of their study of the relationship between technology and society, students should be able to

- investigate and explain how familiar technological activities and products impact on our lives and on the environment
- develop an awareness of, and list the limitations and appropriate use of, technology
- give examples of how people have influenced the development of technological products and services
- identify and describe the positive and negative effects of design considerations
- investigate and report on the social and economic impact of common everyday objects, machines and appliances

OPTIONS

STUDENTS MUST STUDY ONE OF THE OPTIONS IN CONJUNCTION WITH THE CORE.

OPTION 1 – MATERIALS AND PROCESSING (WOOD MEDIATED)

In the study of this option, students will be required to follow a process of design. There will be increased emphasis on the development of skills in relation to both the selection and the processing of the material, and this should be reflected in student project work.

CONTENT

Main Topic	Sub-topics
Materials: properties and classification	Properties: physical (mechanical, thermal); chemical; biological; performance Classification: identification of wood types and products; thermoplastics and thermosetting plastics; ceramics, composites, and metals Use of timber and timber products Adhesives: properties and suitable applications Selection of materials appropriate to a task; specification of desirable properties as a result of service requirements
Processing of materials	Measuring and marking out: use of measuring and marking out tools; accurate transfer of drawing plans Tools and equipment: hand tools; sharpening tools; power tools (band saw, scroll saw, sanding machine); CNC equipment Processing: cutting; drilling; boring; shaping/forming (planing, carving, routing, turning, inlaying, steam bending); laminating, sanding Joining and fastening materials: common joints, dowelling, screws and nails, adhesives Assembly of components: selection and integration of standard components to increase functionality: motors, linkages, chains, gears, pulleys and belts; common electronic components Surface and applied finishes (painting, varnishing, polishing, waxing, veneering, use of preservatives, pyrography, marquetry) Safety procedures: handling, use and storage of materials and equipment; fire extinguishing and evacuation; personal protection and hygiene Impact and effects of materials and processes on people and their environment: waste management; waste reduction; awareness of environmental impact of waste products, and the recycling of materials.

LEARNING OUTCOMES

As a result of their study of these topics, students should be able to

- investigate and describe the properties and resultant uses of a variety of materials
- identify and classify wood types and wood products, plastics, ceramics, composites and metals
- describe the use of timber and timber products
- list the properties and suitable applications of common adhesives
- specify desirable properties of materials, recognising constraints imposed by these, and select materials and processes appropriate to a task
- show awareness of safety considerations in respect of the selection, use and storage of materials, tools or equipment and have due regard for personal safety and the safety of others when working individually or in groups
- demonstrate skill in selecting and using a variety of tools, machines and equipment to cut, shape, and finish a range of materials appropriate to a task
- use tools accurately to measure and mark out selected materials and transfer information from design sketches and drawings
- use appropriate computer applications (CAD/CAM) to prepare and manufacture component parts in order to enhance their work
- measure and check components and parts for accuracy and finish, within pre-determined parameters
- join selected materials using permanent and semi-permanent methods, using appropriate techniques and processes
- select and integrate standard components to increase the functionality of projects
- adopt correct safety procedures in the event of fire or evacuation, and take responsibility for personal protection and hygiene
- demonstrate awareness of the effects of materials and processes on people and their environment, and recognise the benefits of waste reduction and the recycling of materials
- take steps to minimise the waste produced in the manufacture of an artefact, and dispose of materials, including waste, in a safe manner.

OPTION 2 – MATERIALS AND PROCESSING (METAL MEDIATED)

In the study of this option students will be required to follow a process of design. There will be increased emphasis on the development of skills in relation to both the selection and the processing of the material, and this should be reflected in student project work.

CONTENT

Main Topic	Sub-topics
Materials: properties and classification	Properties: physical (mechanical, thermal, electrical); chemical Classification: ferrous (plain carbon) and non-ferrous metals; alloys; thermoplastics and thermosetting plastics; wood; ceramics; composites Production of iron and steel; heat-treatment of high carbon steel Selection of materials appropriate to a task: specification of desirable properties as a result of service requirements
Processing of materials	Measuring and marking out: use of marking out and measuring tools (rule, scriber, try-square, surface plate and surface gauge, vernier callipers) Tools and equipment: saws, files, shears, pistol and pedestal drills, manual and CNC lathes Processing: cutting; drilling; shaping/forming; hot and cold bending; twisting; beaten metalworking; engraving; scrolling; vacuum forming Joining and fastening materials: machine screws, rivets, soldering, brazing, adhesives, sheet metal joints Assembly of components: selection and integration of standard components to increase functionality; motors, linkages, chains, gears, pulleys and belts, common electronic components Surface and decorative finishes: polishing; painting; etching; dip-coating; enamelling Safety procedures: handling; use and storage of materials and equipment; fire extinguishing and evacuation; personal protection and hygiene Impact and effects of materials and processes on people and their environment: waste management; waste reduction; awareness of environmental impact of waste products, and the recycling of materials

LEARNING OUTCOMES

As a result of their study of these topics, students should be able to

- investigate and describe the properties and resultant uses of a variety of materials
- identify and classify ferrous and non ferrous metals and alloys, plastics, woods, ceramics and composites
- describe the production of iron and steel
- specify desirable properties of materials recognising the constraints imposed by these, and select materials and processes appropriate to a task
- show awareness of safety considerations in respect of the selection, use and storage of materials, tools or equipment, and have due regard for personal safety and the safety of others when working individually or in groups
- demonstrate skill in selecting and using a variety of tools, machines and equipment to cut, shape, and finish materials appropriate to a task
- use tools accurately to measure and mark out selected materials and transfer information from design sketches and drawings
- use appropriate computer applications (CAD/CAM) to prepare and manufacture component parts in order to enhance their work
- measure and check components and parts for accuracy and finish, within pre-determined parameters
- join selected materials using permanent and semi-permanent methods using appropriate techniques and processes
- select and integrate standard components to increase the functionality of projects
- adopt correct safety procedures in the event of fire or evacuation, and take responsibility for personal protection and hygiene
- demonstrate awareness of the impact and effects of materials and processes on people and their environment, and recognise the benefits of waste reduction and the recycling of materials
- take steps to minimise the waste produced in the manufacture of an artefact and dispose of materials (including waste) in a safe manner.

OPTION 3 – ENERGY AND CONTROL

In the study of this option students will be required to follow a process of design. There will be increased emphasis on the selection of appropriate components/circuits and their incorporation into control systems, and this should be reflected in student project work.

CONTENT

Main Topic	Sub-topics
Energy	Forms of energy; common sources of energy; energy conservation; energy transformation as simple input-output systems; units of energy Basic electricity and electric circuits; electric current (conventional), unit of current (ampere), measurement of current (ammeter or multimeter); use of electric current to provide heating, lighting, sound; polarity in circuits; potential difference (voltage), unit of voltage, measurement of voltage (voltmeter or multimeter); resistance, unit of resistance, colour coding of resistors, measurement of resistance; Ohm's law expressed as $V = I \times R$; series and parallel circuits; potential divider using fixed and variable resistors; simple electronic components and their use in circuits; circuit assembly and testing
Control	Types of motion and motion change (linear, rotary, reciprocating) with everyday applications of these Mechanisms: levers, pulleys, gears, linkages; mechanical advantage; friction and its effects; DC motors; electrical/electronic control; automatic switching; pneumatics; robotics; systems approach (input, process, output) Safety procedures: handling, use and storage of materials and equipment; fire extinguishing and evacuation; personal protection and hygiene Impact and effects of use of energy, materials, systems and processes on people and their environment: waste management; waste reduction; awareness of environmental impact of waste products, and the recycling of materials

LEARNING OUTCOMES

As a result of their study of these topics, students should be able to

- describe a variety of forms and sources of energy, and explain, using an input-output model, how energy is converted from one form to another
- recognise and describe the benefits of energy conservation
- identify and describe linear, rotary and reciprocating motion, and give examples of everyday applications of these
- prepare or assemble models to illustrate changes of motion from one form to another
- recognise and use standard symbols for electronic, electrical and mechanical control components
- understand and explain the functioning of control components and simple control systems
- demonstrate appropriate knowledge and skill in selecting and checking components and parts for suitability within pre-determined parameters
- skilfully assemble (by permanent and semi-permanent methods) and test simple mechanical or electronic control devices and systems using appropriate materials, tools and processes
- show awareness of safety considerations in respect of the selection, use and storage of tools or equipment, and have due regard for personal safety and the safety of others when working individually or in groups
- adopt correct safety procedures in the event of fire or evacuation, and take responsibility for personal protection and hygiene
- demonstrate awareness of the impact and effects of the use of energy, materials, systems and processes on people and their environment, and recognise the benefits of waste reduction and the recycling of materials
- take steps to conserve energy and to minimise the waste produced in the manufacture of an artefact, and dispose of materials, including waste, in a safe manner.

ASSESSMENT

Assessment will be at two levels, Ordinary and Higher, by means of a student project and a terminal examination paper.

STUDENT PROJECT

Each candidate will be required to undertake a project chosen from a selection of briefs and within specified parameters. The project should reflect the student's ability to integrate the knowledge, understanding and skills obtained through the study of the subject and should represent the highest standard that he/she can attain. The project must be the unaided work of the student and be undertaken in the school. It should result in the production of an artefact and the presentation of all work associated with this in an accompanying portfolio. The selection of briefs will include some of an open nature, through which the student's creativity and innovation in respect of design and realisation can find expression. Some briefs of a closed nature, in which a specified design/drawing may be adapted and extended by the student, will also be included. Separate projects will be specified for Ordinary and Higher levels.

EXAMINATION PAPER

The terminal examination paper at Ordinary level will be of one and a half hours duration; at Higher level the paper will be of two hours duration. Based on the specified learning outcomes, all sections of the syllabus will be examined.