



Government of **Western Australia**  
School Curriculum and Standards Authority

# MATERIALS DESIGN AND TECHNOLOGY

ATAR COURSE

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Year 12 syllabus

## **IMPORTANT INFORMATION**

This syllabus is effective from 1 January 2017.

Users of this syllabus are responsible for checking its currency.

Syllabuses are formally reviewed by the School Curriculum and Standards Authority on a cyclical basis, typically every five years.

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## Rationale

Materials are the basic ingredients of technology. Materials are used to make machines and these machines use materials to make products. Materials also supply the energy to enable technology to function. Throughout history, the evolution of technology has been largely determined by the availability of materials. These strong historical links between materials, design and technology remain significant in society today. As long as the desire to create new opportunities and to continue to improve our quality of life remains, the development of materials will continue.

Through developments in technology and science, a wider range of materials is now available. These new materials have further encouraged the development of technology and the design of new products.

The Materials Design and Technology ATAR course is a practical course. The course allows for the exploration and use of three materials learning contexts: metal, textiles and wood, with the design and manufacture of products as the major focus. There is also the flexibility to incorporate additional materials from outside the three designated contexts. This can enhance and complement the knowledge and skills developed within the course as many modern-day products are manufactured using a range of different material types. Students may use a few or many materials in innovative designs and explore the interactions between materials, people and their environment. Students examine social and cultural values and the short-term and long-term impacts of the use and misuse of materials and associated technologies. Through this inquiry, experimentation and research, students develop their creativity and understanding of the society in which they live.

Working with materials, students develop a range of processing, manufacturing and organisational skills. When designing with materials, they develop cognitive skills such as critiquing, analysing, solving problems, generating innovative ideas and communicating what they do. This helps them become more technologically literate and, as consumers, enables them to make more informed decisions about the use and misuse of technology. It also prepares them to make predictions about likely changes to technology in the future.

This course connects to the world of work, further vocational education and training (VET) and university pathways. Students may achieve VET competencies as they complete their design projects, while at the same time, developing cognitive skills fundamental to designing in a practical context. This process enhances employability and may lead to further training and employment opportunities in areas that include textiles and clothing, manufacturing, design, built environment, science and engineering.

The Materials Design and Technology ATAR course aims to prepare all students for a future in a technological and material world by providing the foundation for lifelong learning about how products are designed and how materials are developed and used.

## Course outcomes

The Materials Design and Technology ATAR course is designed to facilitate achievement of the following outcomes.

### Outcome 1 – Technology process

Students apply a technology process to create or modify products, processes or systems in order to meet human needs and realise opportunities.

In achieving this outcome, students:

- investigate issues, values, needs and opportunities
- devise and generate ideas and prepare production proposals
- produce solutions and manage production processes
- evaluate intentions, plans and actions.

### Outcome 2 – Understanding the use of materials

Students understand how the nature of materials influences design, development and use.

In achieving this outcome, students:

- understand the structure of materials
- understand the relationship between the structure and properties of materials
- understand how to select appropriate materials based on their structure and properties, and understand how these characteristics influence design, development and usage.

### Outcome 3 – Using technology skills

Students create material products safely and efficiently to specified standards.

In achieving this outcome, students:

- plan and manage resources to create products within constraints
- select and apply appropriate techniques and procedures when creating and modifying technologies
- manipulate equipment and resources safely to meet defined standards.

### Outcome 4 – Understanding materials, society and the environment

Students understand interrelationships between people, the environment and the use of materials.

In achieving this outcome, students:

- understand how values and beliefs influence materials selection, design and technology
- understand the impact and consequences on society and the environment when selecting and using materials, designs and technologies
- understand strategies for safe and sustainable practices when developing and using materials, designs and technologies.

## Organisation

This course is organised into a Year 11 syllabus and a Year 12 syllabus. The cognitive complexity of the syllabus content increases from Year 11 to Year 12.

### Structure of the syllabus

The Year 12 syllabus is divided into two units which are delivered as a pair. The notional time for the pair of units is 110 class contact hours.

#### Unit 3

Students extend their understanding of design aesthetics through the application of the elements and principles of design and the use of creative and critical thinking strategies. Students work with an open and self-directed design brief to manage a project to design products to meet needs. Students investigate a range of materials and analyse the molecular structure, relating material characteristics and properties, and methods of processing and finishing, appropriate to their application and use.

Students identify and manage risks, and select and use appropriate methods for communicating ideas and design development. Students develop competence with production processes and learn to manage projects to determined design specifications.

#### Unit 4

Students investigate and analyse cultural and social factors which may have influenced historical and contemporary design. Students extend their understanding of design aesthetics by using creative and critical thinking strategies. They critically examine current products and explore how emerging materials and technologies may affect, and be incorporated into, the design and development of future products.

Students incorporate a wide range of design concepts and apply sophisticated conceptualisation skills and production processes to realising design ideas that reflect their personal influences in combination with the style and tastes of a target audience/market.

Each unit includes:

- a unit description – a short description of the focus of the unit
- defined contexts – three different contexts have been defined in this course:
  - Metal
  - Textiles
  - Wood.

The course units in each context have different codes. Students can enrol in more than one context in this course but they can only sit one external examination for the course.

- unit content – the content to be taught and learned
  - students study the unit common content and the content of their chosen defined context

## Organisation of content

The course content is organised into common content and context specific content. Students must study all of the common content and at least one of the contexts.

The content areas cover:

### Materials

- Nature and properties of materials
- Materials in context

### Design

- Design fundamentals and skills
  - investigate
  - devise
  - evaluate

### Use of technology

- Skills and techniques
  - information and communication technology (ICT)
  - drawing
  - materials selection
- Safety
- Production management
  - product manufacture
  - ongoing evaluation.

### Common content

The wood, metal and textiles learning contexts in the Materials Design and Technology ATAR course have common content in:

- Design fundamentals and skills
- Skills and techniques
  - ICT
  - drawing
- Safety
- Production management.

Students may use any material as a means through which they approach the course content, or teachers may choose to restrict the choice. Students will explore ways to use the nature and properties of the materials towards the completion of a product.

In design fundamentals and skills, students learn about the elements and principles of design, while developing a common understanding of the design process and variations that can apply to design tasks during the design cycle.



As student safety is a high priority in all activities, a common understanding of safe working practices, risk management and an awareness of occupational safety and health standards is achieved in each unit through coverage of common content under the safety heading.

In all three contexts, students design a product and plan to safely carry out the management of the making of the product. In Unit 3 and Unit 4, students are encouraged to integrate additional and complementary material(s) from other contexts as a means through which they approach the course content, to develop a product. They explore ways to use the nature and properties of the materials towards the completion of a product.

Students are expected to plan and manage production processes and perform ongoing evaluation, recording any changes made to the production processes or the project design. For this reason, the skills required to follow a production plan, and the control of ongoing operations and processes to complete production, are common in all three contexts.

## **Materials**

### **Nature and properties of materials**

This aspect of the course focuses on the properties and characteristics of materials which influence the selection, processing and finishing choices that are made throughout the technology process. The effect and interrelationship of a material's structure, its properties and methods of processing and finishing are addressed in order to help students make appropriate decisions about materials selection and usage.

Various types of materials and classification methods are covered. Materials include solid materials such as metals and alloys (ferrous and non-ferrous), textiles and fibres (natural and manufactured), timbers (natural and manufactured) and other materials (polymers, plastics, composites and other non-contextual materials) and emerging materials.

The properties of materials underpin fundamental design decisions. The course examines materials within each context with reference to a range of physical properties, for example, thermal, electrical and magnetic properties; a range of chemical properties, for example, absorbency, solubility, oxidation, permeability, colourfastness, sun and chemical resistance; a range of mechanical properties, for example, durability, abrasion resistance; hardness, toughness, strength and dimensional stability, shrink resistance, resilience and elasticity; and some aesthetic properties, for example, lustre, colour, drape and texture. Properties of new and emerging, as well as traditional materials, are identified and tested for their suitability in product use and purpose. The course investigates material properties by accessing available materials data and specifications, and by undertaking the testing of materials.

### **Materials in context**

Materials have social and environmental impacts when used in social, cultural and environmental contexts. Analysis of own and others' designs develops a sense of the interrelationships between materials, markets, society, communities and the environment. This involves investigating the impact that production, processing and use of various materials have on societies and the environment. Materials are examined in relation to their personal, social and environmental sustainability. Opportunity, cost, waste management and recycling are considered essential in assessing the environmental impact of projects. Green design principles and the whole life cycle of products are explored. These principles result in less pollution and waste and more efficient use of energy and materials. The potential environmental impact of the product is assessed. This includes efficiently using materials during production, accounting for the disposal of the

product after production and minimising nuisances such as noise, fumes, dust and accumulated waste materials.

## Design

### Design fundamentals and skills

A foundation of design knowledge is critical when developing projects. Concepts related to aesthetics, human factors and consumer markets are covered. Aesthetics include elements of line, shape, form, texture, colour and tone; and principles of unity, variety, proportion, rhythm and balance. Applying human factors requires the understanding of ergonomics, anthropometrics and human-product interfaces. Consumer market knowledge includes demographics, consumer psychology, marketing and consumer trends. Some of these factors vary in different cultural contexts. Historical aspects of design, including significant designers, prominent periods of design and various design movements are investigated. Design styles and influences are considered when design concepts are being developed.

The process of designing consists of a number of skills. These include research and investigation, ongoing evaluation, generation of ideas, communicating design, modelling and testing ideas and developing skills of innovation and enterprise.

Inquiry into problems, the identification of opportunities and the analysis of solutions require a range of research and investigation techniques. Investigating markets, taking into account user needs and requirements and environmental and social issues, are aspects of enterprising approaches. Research into materials also contributes to design decisions. Intellectual property and patent regulations are relevant.

The course incorporates cognitive and creative skills that are used in generating ideas and developing solutions, such as rapid concept development, brainstorming, critical thinking and collaborative designing. It covers strategies for thinking laterally, innovatively and creatively, and problem solving. Experimentation is used as a way of developing and refining concepts.

Communication is an integral part of the thinking process as well as a means for sharing ideas with others. Information and communication technology is developed through the units, with an increasing level of computer technology being used to develop and communicate design ideas and solutions. The course covers graphical, oral, textual and mathematical communication skills. Skills in the graphic representation of design thinking using a range of manual and/or computer-generated techniques, are developed to specific standards. Effective communication and documentation of design intentions and development through to the final outcome is important. Skills associated with modelling and testing ideas include: computer modelling, physical scale modelling, prototyping, and component modelling. Tests may be devised using techniques such as market sampling, product analysis and market research.

### Use of technology

#### Skills and techniques

The course looks at technologies within a studio or workshop environment. This includes the reading and interpretation of plans, patterns, drawings and material specifications and the measurement and calculation of quantities. Different skills and techniques of ICT are developed at the different stages of study. Materials are used to realise designs. Skills and techniques are required for the manipulation of materials and project manufacture appropriate to their purpose. There is a relationship between the material and the processing techniques used. Techniques and skills include: forming, fabricating, cutting, joining, shaping, machine

operations, constructing, embellishing, finishing and computer numerically-controlled processes (CNC). Skills and techniques are progressively extended through the different units.

### **Safety**

Knowledge and information related to working safely is critical in any technology context. It is important to exercise a duty of care and operate in a safe and responsible manner, including the application of occupational safety and health legislation and codes of practice. There are safety issues related to the handling and manipulation of materials, for example, safety data information, materials handling and storage practice, and specific tool and machinery operation safety requirements. Risks have to be identified, assessed and managed.

### **Production management**

Various skills are required to successfully manage the production process. Performance must be evaluated throughout. Environmental factors, including management and reduction of waste and energy efficiencies must be considered. Project management of time, tasks and materials as well as task modification and record keeping are employed throughout the production process; therefore, management skills, principles of quality assurance, ongoing evaluation, and testing are all important factors in ensuring quality outcomes. Communication skills are also important. Working collaboratively with team members, maintaining work schedules and time plans, and producing various oral and written communications are all important aspects of the production process.

## **Representation of the general capabilities**

The general capabilities encompass the knowledge, skills, behaviours and dispositions that will assist students to live and work successfully in the twenty-first century. Teachers may find opportunities to incorporate the capabilities into the teaching and learning program for the Materials Design and Technology ATAR course. The general capabilities are not assessed unless they are identified within the specified unit content.

### **Literacy**

Literacy is of fundamental importance in the study of the Materials Design and Technology ATAR course. Students will access design, materials and technological content through a variety of print, oral, visual, spatial and electronic forms, including data books, texts, computer software, images, and written technical materials. They learn to investigate, interpret, and apply design and technology principles from a variety of sources to design solutions for tasks. They analyse and evaluate information for reliability, relevance and accuracy. They learn to monitor their own language use for accuracy in the use of design principles and technological terms for clarity of ideas, processes and explanations of design activities and development and evaluation of functioning products.

### **Numeracy**

Numeracy is fundamental in calculating materials quantities and evaluating design and technology process costs. Students develop their understanding and skills of numeracy while undertaking tasks to produce, test and evaluate products. Common and context specific theory continues to be studied to forge greater understanding of the scientific, mathematical and technical concepts that explain how designed products function.

## Information and communication technology capability

Information and communication technology capability is important in all stages of the design process. Students use digital tools and strategies to locate, access, process and analyse information. They use ICT skills and understandings to investigate and devise design ideas. Students access information from websites and software programs to develop design solutions. Students use computer aided drawing software and computer control software to produce products.

## Critical and creative thinking

Critical and creative thinking is integral to the design process. The design thinking methodologies are fundamental to the Materials Design and Technology ATAR course. Students develop understandings and skills in critical and creative thinking during periods of evaluation at numerous stages of the design process. They devise plausible solutions to problems, and then through interrogation, critically assess the performance of the most efficient solution. Students identify possible weaknesses in their design solutions, and analyse, evaluate and modify the developing solution to construct a functioning prototype.

## Personal and social capability

Personal and social capability skills are developed and practiced in the Materials Design and Technology ATAR course by students enhancing their communication skills and participating in teamwork. Students have opportunities to work collaboratively during stages of investigation and production of products. Students develop increasing social awareness through the study of the impact of the use of materials, and manufacturing technology in society and on the environment.

## Ethical understanding

Students have opportunities to explore and understand the diverse perspectives and circumstances that shape design processes and technology, the actions and possible motivations of people in the past compared with those of today. Students have opportunities both independently and collaboratively to explore the values, beliefs and principles that have influenced past designs and technological achievements, and the ethical decisions required by global design processes of today.

## Intercultural understanding

Students have opportunities to explore the different beliefs and values of a range of cultural groups and develop an appreciation of cultural diversity. Students have opportunities to develop an understanding of different contemporary perspectives with regard to design inspiration, product styles, building materials, energy supply and use, and design and technological influences on different groups within society, and how they contribute to individual and group actions in the contemporary world.

## Representation of the cross-curriculum priorities

The cross-curriculum priorities address contemporary issues which students face in a globalised world. Teachers may find opportunities to incorporate the priorities into the teaching and learning program for the Materials Design and Technology ATAR course. The cross-curriculum priorities are not assessed unless they are identified within the specified unit content.

### **Aboriginal and Torres Strait Islander histories and cultures**

Students have opportunities to explore Aboriginal and Torres Strait Islander development and use of technology, and the interconnectedness between technologies and identity, People, Culture and Country/Place. Students may explore ways in which materials have been used over time and the methods used to manipulate those materials.

### **Asia and Australia's engagement with Asia**

Students have opportunities to explore traditional, contemporary and emerging technological achievements in the countries of the Asia region. Students may explore Australia's rich and ongoing engagement with the peoples and countries of Asia to create appropriate products and services to meet personal, community, national, regional and global needs.

### **Sustainability**

Students take action to create more sustainable patterns of living. Students can develop knowledge, understanding and skills necessary to design for effective sustainability.

Students focus on the knowledge, understanding and skills necessary to choose technologies and systems with regard to costs and benefits. They evaluate the extent to which the process and designed solutions embrace sustainability. Students reflect on past and current practices, and assess new and emerging technologies from a sustainability perspective.

## Unit 3

### Unit description

Students extend their understanding of design aesthetics through the application of the elements and principles of design and the use of creative and critical thinking strategies. Students work with an open and self-directed design brief to manage a project to design products to meet needs. Students investigate a range of materials and analyse the molecular structure, relating material characteristics and properties, and methods of processing and finishing, appropriate to their application and use.

Students identify and manage risks, and select and use appropriate methods for communicating ideas and design development. Students develop competence with production processes and learn to manage projects to determined design specifications.

### Defined contexts

Three different contexts have been defined in this course:

- Metal
- Textiles
- Wood.

The course units in each context have different codes.

Students can enrol in more than one context in this course but they can only sit one external examination for the course.

Students study the unit common content and the content of their chosen defined context.

### Unit content

An understanding of the Year 11 content is assumed knowledge for students in Year 12. It is recommended that students studying Unit 3 and Unit 4 have completed Unit 1 and Unit 2.

This unit includes the knowledge, understandings and skills described below. This is the examinable content.

#### Common content

##### Design

##### Design fundamentals and skills

- investigate
  - target audience/market, demand, niche market design needs, values and trends
  - performance criteria related to needs, values and beliefs of the developer and end user
  - historical, social, cultural and political sources of design inspiration
  - design fundamentals and factors affecting design
    - aesthetics
    - function
    - safety
    - cost
    - environmental impact and considerations
    - sustainability issues
    - ergonomics
    - anthropometric data

- devise
  - using communication and documentation techniques
    - sketching and drawing
    - rendering
    - annotating drawings
    - sampling
    - modelling
  - applying elements and principles of design where applicable in context
    - line                      ○ colour                      ○ rhythm                      ○ dominance
    - shape                      ○ tone                      ○ radiation                      ○ proportion
    - form                      ○ repetition                      ○ harmony                      ○ balance
    - texture                      ○ gradation                      ○ contrast                      ○ unity
  - applying rapid concept development techniques to generate a variety of design ideas
  - design development
    - collate best ideas that have been developed using annotated hand or computer-generated graphics – front, back views and detailed sketches as necessary
    - review and justify best ideas using design brief and performance criteria
    - 2D illustrations – working/technical drawings
    - 3D illustration – presentation drawings
    - inspiration/concept/storyboard development and presentation
  - production plan
    - materials list
    - estimated and actual costing for all materials and components
    - production plan, including time line
- evaluate
  - product against design brief, initial design and performance criteria related to needs, values and beliefs of the developer and end user
  - design and production processes, making recommendations for improvement

## Use of technology

### Skills and techniques

- ICT, folio development and communication skills
  - client and market research techniques
  - client presentation techniques
  - photography – ongoing record of progress and processes used and final product
  - documenting presentations and evaluations
- context appropriate drawing and relevant technical information to produce the final product to demonstrate:
  - sketching rapid concept developments
  - 3D presentation drawings
  - rendering techniques
  - 2D working drawings or using templates
  - inspiration/concept or storyboard development and presentation
  - design and making specification sheets

- workroom/studio terminology appropriate to context
- operate machinery and tools appropriate to context

## **Safety**

- correct use of personal protective equipment (PPE) where applicable
- conduct risk assessment for using specific tools and equipment
- demonstrate occupational safety and health (OSH) practices appropriate to tasks being undertaken in workshops
- apply proactive measures for risk management in the workshop/studio
- recognise need and purpose of materials safety data (MSD) with regard to storage and handling of hazardous substances appropriate to situation

## **Production management**

- manage independently production processes
  - maintain a production plan in order to manage processes and meet time constraints
  - adapt planned actions, equipment and resources to complete production
  - apply production techniques that reduce material wastage
  - consider client feedback, and modify production processes accordingly
  - document and record changes to materials lists and/or changes to actual cost of materials
- diary, journal and folio note entries, including
  - ongoing evaluation of production processes and techniques
  - use of photography and notes to record ongoing progress/decision changes made to the project

## **Metal context content**

### **Materials**

#### **Nature and properties of materials**

- metal types and classification
  - ferrous – iron, steel
  - nonferrous – aluminium, copper
- alloys
  - brass
  - stainless steel
- metal form and structure
  - characteristics of metals
    - physical
    - structural
    - atomic
    - appearance
- how atomic (crystalline/grain) structure of steel contributes to the physical properties



- heat treatment of metals
  - hardening
  - tempering
  - annealing
  - quenching
  - normalising
- discuss the effects of working/forming metals
  - hot working – rolling, forging, extrusion
  - cold working – rolling, forging, extrusion
- relationship between a metal's atomic structure and physical/mechanical properties to justify selection of materials for a manufactured product

### **Materials in context**

- factors that have affected manufacturing processes
  - human factors
  - automation
  - ethical issues
- impact production, processing and use of metals has had on society and the environment
  - historical impacts
  - current impacts

### **Use of technology**

#### **Skills and techniques**

- investigate, test, select and apply appropriate construction techniques for manufacturing products
  - cutting
  - joining
  - shaping
  - fixing
  - clamping
  - finishing
- operate a metal lathe and MIG welder
- investigate the use of CAD/CNC technologies in the metals industry
- investigate, test, select and apply appropriate metals decoration, embellishment and manipulation techniques

### **Textiles context content**

#### **Materials**

#### **Nature and properties of materials**

- fibre types and classification
  - natural fibres
    - cellulosic – cotton, linen
    - protein – wool, silk
  - manufactured fibres
    - regenerated – rayon, acetate, lyocell
    - synthetic – polyester, nylon, acrylic, elastomeric

- detailed study of fibre blends
  - cotton/polyester blend
  - nylon/elastomeric blend
- fibre morphology and structure
  - physical characteristics, microscopic appearance, amorphous, crystalline, monomer, polymer, polymerisation
  - how molecular and morphological structure contribute to the properties of fibres
- discuss yarn structures
  - spun staple
  - filament
  - novelty yarns
- fabric structures
  - woven – warp, weft, selvedge
  - knitted – course, wale
  - non-woven – felt, web
- fabric types and classifications
  - woven – plain, satin, twill, jacquard, pile
  - knit – warp knit, weft knit
  - non-woven – felt, interfacings
- investigate at least two finishing techniques applied to fabrics
  - finishes that enhance appearance
  - finishes that improve dimensional stability
  - finishes that protect from the environment
- apply fabric testing techniques to determine performance and suitability to end use/purpose
  - aesthetic properties
  - physical properties
  - chemical properties
- relationship between a textile's structure, properties, and end use to justify selection of materials for a manufactured product

**Materials in context**

- factors that have affected manufacturing processes
  - human factors
  - automation
  - ethical issues
- impact production, processing and use of textiles has had on society and the environment
  - historical impact
  - current impact

## Use of technology

### Skills and techniques

- investigate, test, select and apply appropriate construction techniques for manufacturing products
  - marking out
  - cutting
  - shaping
  - joining
  - closures
  - finishing
- operate a sewing machine and overlocker
- investigate the use of CAD/CNC technologies in the textile industry
- investigate, test, select and apply appropriate fabric decoration, embellishment and manipulation techniques

## Wood context content

### Materials

#### Nature and properties of materials

- wood types and classification
  - natural wood
    - hardwood – jarrah, Australian oak
    - soft wood – radiata pine, Douglas fir
  - man-made board
    - plywood – interior, exterior, marine
    - medium density fibreboards – plain, veneered
    - particle board
- wood form and structure
  - characteristics of hardwoods and softwoods
    - physical
    - structural
    - microscopic/cellular
    - appearance
  - how cellular structure of hardwoods and softwoods contributes to the properties of timber
- discuss wood structure
  - cambium layer
  - sapwood (xylem)
  - bast (phloem)
  - heartwood
  - growth rings – early wood, latewood
  - medullary rays
- conversion of timber
  - live sawing
  - back sawing
  - quarter sawing
  - seasoning
  - defects caused by seasoning

- relationship between a timber's structure, properties, and end use to justify selection of materials for a manufactured product
- investigate appropriate application/use of various adhesives for timber
  - PVA
  - epoxy
  - cyanoacrylate
  - latex-based/rubber-based

### **Materials in context**

- factors that have affected manufacturing processes
  - human factors
  - automation
  - ethical issues
- impact production, processing and use of timber has had on society and the environment
  - historical impacts
  - current impacts

### **Use of technology**

#### **Skills and techniques**

- investigate, test, select and apply appropriate construction techniques for manufacturing products
  - marking out
  - cutting
  - shaping
  - clamping
  - joining
  - gluing
  - sanding
- demonstrate procedures for setting up, adjusting and operating all machinery used in the production of a project
- operate a router and table saw
- investigate the use of CAD/CNC technologies in the furniture/cabinet making industry
- investigate, test, select and apply appropriate timber finishing application techniques

# Unit 4

## Unit description

Students investigate and analyse cultural and social factors which may have influenced historical and contemporary design. Students extend their understanding of design aesthetics by using creative and critical thinking strategies. They examine critically current products and explore how emerging materials and technologies may affect, and be incorporated into, the design and development of future products.

Students incorporate a wide range of design concepts and apply sophisticated conceptualisation skills and production processes to realising design ideas that reflect their personal influences in combination with the style and tastes of a target audience/market.

## Defined contexts

Three different contexts have been defined in this course:

- Metal
- Textiles
- Wood.

The course units in each context have different codes.

Students can enrol in more than one context in this course but they can only sit one external examination for the course.

Students study the unit common content and the content of their chosen defined context.

## Unit content

This unit builds on the content covered in Unit 3.

This unit includes the knowledge, understandings and skills described below. This is the examinable content.

### Common content

#### Design

##### Design fundamentals and skills

- investigate
  - target audience/market, demand, niche market design needs, values and trends
  - performance criteria related to needs, values and beliefs of the developer and end user
  - historical, social, cultural and political sources of design inspiration
  - design fundamentals and factors affecting design
    - aesthetics
    - function
    - safety
    - cost
    - environmental impact and considerations
    - sustainability issues
    - ergonomics
    - anthropometric data

- devise
  - using communication and documentation techniques
    - sketching and drawing
    - rendering
    - annotating drawings
    - sampling
    - modelling
  - apply elements and principles of design where applicable in context
  - apply rapid concept development techniques to generate a variety of design ideas
  - design development
    - collate best ideas that have been developed using annotated hand or computer-generated graphics – front, back views and detailed sketches as necessary
    - review and justification of best ideas using design brief and performance criteria
    - 2D illustrations – working/technical drawings
    - 3D illustrations – presentation drawings
    - inspiration/concept/storyboard development and presentation
    - describe design specifications appropriate to context
  - production plan
    - materials list
    - estimated and actual costing for all materials/components
    - production plan, including time line
- justify selection of materials against comprehensive design needs as well as the functional and aesthetic properties of materials
- evaluate
  - product against design brief, initial design and performance criteria related to needs, values and beliefs of the developer and end user
  - design and production processes making recommendations for improvement

## Use of technology

### Skills and techniques

- ICT, folio and communication skills in:
  - client and market research techniques
  - client presentation techniques
  - photography, for ongoing record of progress and processes used, in creating final product
- apply graphics skills in:
  - sketching, including rapid concept development
  - 3D presentation drawings
  - rendering techniques
  - 2D working drawings or using templates
  - inspiration/concept or storyboard development and presentation
- produce specification sheets
- apply methods of testing materials and techniques as required
- use design and production procedures to integrate materials

- apply skills in reading, interpreting and adapting plan/patterns/templates appropriate to context
- independently operate machinery and tools appropriate to context
- use clear, detailed presentation skills to set out, develop and present a folio featuring all elements of the design process

### **Safety**

- correct use of personal protective equipment (PPE) where applicable
- occupational safety and health (OSH) practices appropriate to tasks being undertaken in workshops
- apply proactive measures for risk management in the workshop/studio
- recognise the need and purpose of materials safety data (MSD) with regards to storage and handling of hazardous substances
- discuss the consequences of hazardous operations and identify and manage risks in and around the workshop/studio
- examine OSH issues and legal implications associated with designing and producing material products for the consumer market

### **Production management**

- manage independently production processes
  - maintain a production plan to manage processes to meet time constraints
  - adapt planned actions, equipment and resources to complete production
  - apply production techniques that reduce material wastage
  - consider client feedback, and modify production processes accordingly
  - document and record changes to materials lists and/or changes to actual cost of materials
- use regular journal, diary and folio entries, including:
  - ongoing evaluation of production processes and techniques
  - use of photography and notes to record ongoing progress and changes made to the project

## **Metal context content**

### **Materials**

#### **Nature and properties of materials**

- analyse metal properties using metal testing and available materials data and specifications to determine performance and suitability to end user
- review and analyse test data related to the physical and mechanical properties to meet design needs for a metal product
- characteristics of at least one metal innovation and emerging technology
  - light weight metals
  - specialty alloys
  - composites

- finishing processes applied to enhance metals
  - finishes that enhance appearance
  - finishes that protect from the environment
- determine performance and suitability to end use/purpose by applying metal testing techniques for:
  - tensile strength
  - indentation/hardness
  - shear
  - static bending
- investigate and identify thread types and processes

### **Materials in context**

- influence of globalisation on the local, national and international metal industries
- research and analyse relationships between product innovation, lifestyle choices, and consumer demand
- explore green design principles and the life cycle of a steel product
  - efficient use of energy and materials
  - pollution and waste reduction
  - minimising waste at the end of the life of a product

### **Use of technology**

#### **Skills and techniques**

- investigate, test, select and apply appropriate construction techniques for manufacturing products
  - marking out
  - cutting
  - shaping
  - clamping
  - joining
  - fixing
  - finishing
- operate independently a metal lathe and welding equipment
- investigate new technologies and new production processes in the metal fabrication industry
- investigate, test, select and apply appropriate metals decoration, embellishment and manipulation techniques

### **Textiles context content**

#### **Materials**

##### **Nature and properties of materials**

- analyse fibre or fabric properties to determine performance and suitability to end user
- apply fabric testing techniques to determine performance and suitability to end use/purpose
  - aesthetic properties
  - physical properties
  - chemical properties
- review and analyse test data in relation to design needs for a textile product



- characteristics of at least one textile innovation and emerging technology
  - bamboo
  - microfibre
  - washable webs
  - nanotechnology
  - computer linked sewing machines
  - seamless technology
- finishing processes applied to enhance fabrics
  - finishes that enhance appearance
  - finishes to enhance dimensional stability
  - finishes that protect from the environment

### **Materials in context**

- influence of globalisation on the local, national and international textile industries
- research and analyse relationships between product innovation, lifestyle choices, and consumer demand
- explore green design principles and the life cycle of a textile product in relation to:
  - efficient use of energy and materials
  - pollution and waste reduction
  - minimising waste at the end of the life of a product

### **Use of technology**

#### **Skills and techniques**

- investigate, test, select and apply appropriate construction techniques for manufacturing products
  - marking out
  - cutting
  - shaping
  - joining
  - closures
  - finishing
- independently operate a sewing machine and overlocker
- investigate new technologies and new production processes in the textile industry
- investigate, test, select and apply appropriate fabric decoration, embellishment and manipulation techniques

### **Wood context content**

#### **Materials**

##### **Nature and properties of materials**

- analyse timber properties using timber testing and available materials data and specifications to determine performance and suitability to end user
- review and analyse test data related to the physical and mechanical properties to meet design needs for a timber product
- characteristics of at least one timber innovation and emerging technology
  - biodegradable materials
  - composite and laminate materials
  - fast growing timbers – paulownia, bamboo

- finishing processes applied to enhance timber
  - finishes that enhance appearance
  - finishes that protect from the environment
- apply timber testing techniques to determine performance and suitability to end use/purpose
  - hardness
  - stiffness/elasticity
  - density
  - workability: planning, sawing, chiselling

### **Materials in context**

- influence of globalisation on the local, national and international timber industries
- research and analyse relationships between product innovation, lifestyle choices, and consumer demand
- explore green design principles and the life cycle of a timber product in relation to:
  - efficient use of energy and materials
  - pollution and waste reduction
  - minimising waste at the end of the life of a product

### **Use of technology**

#### **Skills and techniques**

- investigate, test, select and apply appropriate construction techniques for manufacturing products
  - marking out
  - cutting
  - shaping
  - clamping
  - joining
  - gluing
  - sanding
- demonstrate procedures for setting up, adjusting and operating all machinery used in the production of a product
- independently operate a router and table saw
- investigate new technologies and new production processes in the furniture/cabinet making industry
- investigate, test, select and apply appropriate timber decoration, embellishment and manipulation techniques

## School-based assessment

The Western Australian Certificate of Education (WACE) Manual contains essential information on principles, policies and procedures for school-based assessment that needs to be read in conjunction with this syllabus.

Teachers design school-based assessment tasks to meet the needs of students. The tables below provide details of the assessment types for the Materials Design and Technology ATAR Year 12 syllabus and the weighting for each assessment type.

### Assessment table practical component – Year 12

Type of assessment	Weighting	SCSA practical mark	Combined mark weighting
<p><b>Design (practical)</b></p> <p>Devising, where students conduct and communicate through a design process the development of solutions to a design problem.</p> <p>Students are assessed on how they:</p> <ul style="list-style-type: none"> <li>devise, develop and modify design concepts throughout the technology process, applying elements and principles of design</li> <li>apply graphics skills</li> <li>present annotated drawings, images or multimedia expressions of design ideas.</li> </ul> <p>Types of evidence can include: concept sketches, hand or computer-generated graphics, 2D and/or 3D illustrations, photographic images, working/technical drawings, portfolio using a range of communication strategies.</p>	30%		
<p><b>Production</b></p> <p>Planning and manufacturing project(s) where students control, evaluate and manage processes.</p> <p>Students are assessed on their:</p> <ul style="list-style-type: none"> <li>materials list of all components for the designed item with accurate cost calculations</li> <li>management and organisation of materials and equipment</li> <li>understanding, confidence and competence when using skills in manufacturing processes and when managing production plans including the safe operation of equipment and procedures.</li> </ul> <p>Types of evidence can include: observation checklists and evaluation tools (self or peer), photographic images, journal entries, and on-balance judgements.</p>	50%	100%	50%
<p><b>Final product evaluation</b></p> <p>Typically conducted at the end of semester and/or unit and assessed against the planned design brief.</p> <p>Students are assessed on their:</p> <ul style="list-style-type: none"> <li>manufactured finished product in terms of quality and finish</li> <li>summary of evaluation of final product against design brief, initial design and/or performance criteria related to needs, values and beliefs of the developer and end user.</li> </ul>	20%		

### Assessment table written component – Year 12

Type of assessment	Weighting	SCSA written mark	Combined mark weighting
<p><b>Design (written)</b> Design process in which students conduct and communicate a design proposal and investigation. Students are assessed on how they:</p> <ul style="list-style-type: none"> <li>develop and present a statement of intent or design proposal</li> <li>apply research strategies to source, investigate, analyse and evaluate relevant images, with referenced data and information</li> <li>apply design fundamentals related to proposed solutions to meet client needs and the design problem or situation</li> <li>document research and evaluate existing products during the design process</li> </ul> <p>Types of evidence can include: annotated images, observation checklists, evaluation methods (self or peer), portfolio, journal entries, design proposals and project proposals using a range of written communication strategies.</p>	40%	100%	50%
<p><b>Response</b> Students apply their knowledge and skills in responding to a series of stimuli or prompts in the following formats: assignment papers, essays, ICT visual responses and/or product evaluation reports.</p>	20%		
<p><b>Written examination</b> Typically conducted at the end of each semester and/or unit and reflecting the written examination design brief for this syllabus.</p>	40%		

Teachers are required to use the assessment table to develop an assessment outline for the pair of units.

The assessment outline must:

- include a set of assessment tasks
- include a general description of each task
- indicate the unit content to be assessed
- indicate a weighting for each task and each assessment type
- include the approximate timing of each task (for example, the week the task is conducted, or the issue and submission dates for an extended task).

In the assessment outline for the pair of units, each assessment type must be included at least twice.

The set of assessment tasks must provide a representative sampling of the content for Unit 3 and Unit 4.

Assessment tasks not administered under test/controlled conditions require appropriate validation/authentication processes.

**Combined mark weightings for the Materials Design and Technology course is:**

- 50% written
- 50% practical

## Grading

Schools report student achievement in terms of the following grades:

Grade	Interpretation
<b>A</b>	Excellent achievement
<b>B</b>	High achievement
<b>C</b>	Satisfactory achievement
<b>D</b>	Limited achievement
<b>E</b>	Very low achievement

The teacher prepares a ranked list and assigns the student a grade for the pair of units. The grade is based on the student's overall performance as judged by reference to a set of pre-determined standards. These standards are defined by grade descriptions and annotated work samples. The grade descriptions for the Materials Design and Technology ATAR Year 12 syllabus are provided in Appendix 1. They can also be accessed, together with annotated work samples, through the Guide to Grades link on the course page of the Authority website at [www.scsa.wa.edu.au](http://www.scsa.wa.edu.au)

To be assigned a grade, a student must have had the opportunity to complete the education program, including the assessment program (unless the school accepts that there are exceptional and justifiable circumstances).

Refer to the WACE Manual for further information about the use of a ranked list in the process of assigning grades.

## **ATAR course examination**

All students enrolled in the Materials Design and Technology ATAR Year 12 course are required to sit the ATAR course examination. The examination is based on a representative sampling of the content for Unit 3 and Unit 4. Details of the ATAR course examination are prescribed in the examination design brief on the following page.

Refer to the WACE Manual for further information.

## Practical (portfolio) examination design brief – Year 12

### Provided by the candidate

A signed Declaration of authenticity

SUBMISSION	SUPPORTING INFORMATION
<p><b>Portfolio</b> 100% of the practical examination</p>	<p>The candidate is required to submit a portfolio that documents the development of a completed design process. The material, including images in the portfolio, should demonstrate the development from the initial design brief through to the finished product, and show the quality of the final product.</p> <p>The portfolio must provide evidence of the candidate’s ability to:</p> <ul style="list-style-type: none"> <li>• apply design fundamentals and use designing skills to create or modify products, processes, systems, services or environments to meet human needs and realise opportunities</li> <li>• understand the key stages of the technology process</li> <li>• apply technology skills to produce a quality product.</li> </ul>

## Written examination design brief – Year 12

### Time allowed

Reading time before commencing work: ten minutes

Working time for paper: two and a half hours

### Permissible items

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters

Special items: up to three calculators, which do not have the capacity to create or store programmes or text, are permitted in this ATAR course examination

SECTION	SUPPORTING INFORMATION
<p><b>Section One</b></p> <p><b>Short answer</b></p> <p>15% of the written examination</p> <p>2–4 questions</p> <p>Suggested working time: 20 minutes</p>	<p>The candidate is required to answer questions that focus on content that is common across contexts. These questions can contain multiple parts.</p>
<p><b>Section Two</b></p> <p><b>Extended answer</b></p> <p>25% of the written examination</p> <p>2–4 questions</p> <p>Suggested working time: 40 minutes</p>	<p>The candidate must complete all questions in this section.</p> <p>The candidate is required to answer questions that focus on the content that is common across all contexts.</p> <p>The candidate can be required to analyse and evaluate issues based on stimulus materials and produce sketches, labelled drawings or scaled drawings, where appropriate.</p> <p>Questions can require candidates to refer to stimulus material, including: photographs, research data, case studies, survey results, written texts, templates, tables and/or diagrams.</p> <p>The questions can be scaffolded.</p>
<p><b>Section Three</b></p> <p>60% of the written examination</p> <p>This section has three contexts:</p> <ul style="list-style-type: none"> <li>• Metal</li> <li>• Textiles</li> <li>• Wood.</li> </ul> <p>Each context has 4–6 context specific questions. Each context has the same number of questions.</p> <p>Suggested working time: 90 minutes</p>	<p>The candidate is required to answer questions in their context they have studied: Metal or Textiles or Wood.</p> <p>The candidate can be required to analyse and discuss issues or processes, produce designs, sketches and scaled drawings where appropriate, and/or to label diagrams or images.</p> <p>Questions can require candidates to refer to stimulus material, including: photographs, research data, case studies, survey results, written texts, templates, tables and/or diagrams.</p> <p>Questions can be sectionalised or require an extended answer.</p>



## Appendix 1 – Grade descriptions Year 12

A

### Design

Independently investigates the interlinked relationships between selected design criteria, the principles and fundamentals of design, and factors that affect the design.

Completes each stage of the design process to devise and generate solutions and processes to the specifications of end user or client.

Presents documentation displaying accurate terminology, and accurate and detailed information about the topic/s under investigation; draws from a target audience/market, an established performance criteria, and sources of inspiration.

Investigates and thoroughly analyses design considerations.

Prepares fully-developed, dimensioned working drawings, including the use of 2D and 3D illustrations where applicable in the context.

Selects materials appropriate to design considerations, justifying choices against an analysis of materials' properties, as appropriate in context.

Provides a detailed and accurate production plan that includes time management and production management strategies.

Presents a comprehensive evaluation of the final design product against design criteria.

### Production

Independently implements a detailed set of plans using correct operational procedures to complete a product.

Uses complex production techniques, including appropriate workplace behaviours and practices, fine adjustment of equipment to suit purpose and the application of relevant production management to manipulate materials.

Provides documentary evidence of regular, ongoing evaluation of processes and implements changes and modifications derived from this evaluation.

Effectively manages time and the working environment while independently undertaking production procedures.

Independently organises and uses tools and equipment to achieve the requirements of production with concern for the safety of self and others.

Presents a completed product achieving an excellent evaluation against the selected design criteria.

### Response

Independently researches, selects and presents information using a variety of formats.

Uses appropriate technical language and terminology to provide accurate, detailed explanations of major issues within a task.

Presents a clear, accurate and extensive analysis of materials, displaying understandings of classifications, properties and interpretations of new materials, referring to relevant data.

Uses detailed examples or case studies to demonstrate a clear understanding of technologies through analysis of the impacts that materials and technologies have had on society and the environment.

Identifies a range of societal impacts and benefits of sustainable systems and includes comprehensive conclusions and personal interpretations, referencing all sourced data.

Exhibits a highly competent understanding of personal safety by applying and consistently demonstrating occupational safety and health practices.

## B

**Design**

Independently completes the investigation of each stage of the design process, the principles and fundamentals of design, and factors that affect the design, to devise and generate solutions and processes to the specifications of end user or client.

Uses appropriate terminology to present documentation displaying accurate information of the subject area and to investigate target audience/market, established performance criteria and other sources of inspiration.

Analyses design considerations.

Prepares fully-developed, dimensioned working drawings, including the use of 2D and 3D illustrations where applicable in the context.

Tests and compares materials, and selects suitable materials after consideration of the design needs.

Provides a detailed production plan that includes time and production management strategies.

Presents an evaluation of the final design product against design criteria.

**Production**

Implements a detailed set of plans and uses correct operational procedures to complete a product.

Uses complex production techniques, including appropriate workplace practices, adjustment of equipment to suit purpose and the application of production management to manipulate materials.

Provides documentary evidence of ongoing evaluation of processes and, with minimal assistance, implements changes and modifications derived from this evaluation.

Manages time and the working environment while undertaking production procedures.

Requires minimal guidance to organise tools and equipment, and uses them with concern for the requirements of production and the safety of self and others.

Presents a completed product achieving a high evaluation against the selected design criteria.

**Response**

Independently researches, selects and presents information using a variety of formats.

Uses technical language and terminology for descriptions of the major issues within a task.

Presents a clear analysis of materials, displaying an awareness of classifications, properties and interpretations of new materials, referring to relevant data.

Demonstrates an understanding of technologies, describing the impacts that materials and technologies have had on society and the environment, and includes conclusions with explanations, while clearly referencing sourced data.

Exhibits a competent understanding of personal safety by applying and demonstrating occupational safety and health practices.

C

**Design**

With assistance, chooses selected design criteria, and uses the design process, with consideration of the principles and fundamentals of design, and factors that affect the design, to devise and develop satisfactory solutions and processes to specifications of end user or client.

Presents documentation displaying relevant information of the subject area and using appropriate terminology to investigate target audience/market, established performance criteria and other sources of inspiration and design considerations.

Prepares dimensioned working drawings, including the use of 2D and 3D illustrations where applicable in the context.

Makes materials selection appropriate to design considerations.

Presents a sequence of manufacture that includes simple time management and production planning.

Presents evidence of evaluation of the final design against design criteria.

**Production**

With assistance, follows set of plans and uses correct operational procedures to complete a product.

With direction, uses production techniques, including safe workplace practices and adjustment of equipment to suit purpose and follow relevant production management to manipulate materials.

Provides documentary evidence of occasional ongoing evaluation of processes, requiring direction to implement changes and modifications derived from this evaluation.

Requires assistance to organise tools and equipment, and guidance with production management to undertake safe production procedures.

Presents a completed product achieving a satisfactory evaluation against the selected design criteria.

**Response**

Provides evidence of independent selection of information using appropriate formats.

Uses suitable technical language and terminology to outline some of the issues within a task.

Presents a brief analysis of materials, and displays an awareness of new materials and their uses.

Displays a satisfactory understanding of the impacts of materials and technologies on society and the environment, including some personal opinions with relevant referencing.

Exhibits a competent awareness and understanding of personal safety.

D

**Design**

With assistance, uses some elements of the design process to plan production of design task, including basic ideas and a single solution.

Develops documentation that displays little accurate information about the subject area and uses minimal appropriate terminology.

Completes superficial investigations of design considerations.

Presents partially-completed, partially-dimensioned working drawings.

With assistance, prepares a list of selected materials.

Provides a brief sequence of manufacture and a simple evaluation of the final product.

**Production**

With regular assistance, implements a simple, highly-scaffolded set of plans and requires direction to use correct operational procedures to produce a product; requires direction and regular supervision to use workplace production techniques.

Provides little or no documentary evidence of ongoing evaluation of processes and relies on teacher suggestions to implement changes and modifications.

Requires assistance to organise tools and equipment; uses tools with little concern for the safety of self and others.

Requires regular supervision with time management to undertake simple production procedures.

Presents a near-completed product below a satisfactory standard.

**Response**

Presents some superficial research containing limited and/or irrelevant information.

Requires assistance to identify issues within a task and uses basic technical language and general terminology.

Lists, in limited detail, the classifications and properties of materials, displaying limited awareness of new materials and their uses.

Displays little understanding of the impact of technology on society and the environment, with few concluding statements and little or no referencing.

Exhibits a basic awareness of personal safety.

E

Does not meet the requirements of a D grade and/or has completed insufficient assessment tasks to be assigned a higher grade.