Summary

Topic 4 - Raw Material to Final Product

Subject	Year	Start date	Duration
Design Technology	IB1	Week 3, March	6 weeks 23 hours

Course Part

Topic 4 - Core Topic

Description

The areas of study within this topic are:

- Properties of materials
- Metals and metallic alloys
- Timber
- Glass
- Plastics
- Textiles
- Composites
- Scales of production
- Manufacturing processes
- Production systems
- Robots in automated production

Inquiry & Purpose

Inquiry / Higher Order Questions

Type	Inquiry Questions
Content-based	Why would high speed steel be used for an aircraft turbine?

Curriculum

Aims

Enable students, through the overarching theme of the nature of design, to develop:

An ability to explore concepts, ideas and issues with personal, local and global significance to acquire in-depth knowledge and understanding of design and technology

An ability to understand and express ideas confidently and creatively using a variety of communication techniques through collaboration with others

Objectives

Demonstrate knowledge and understanding of

facts, concepts, principles and terminology

design methodology and technology

methods of communicating and presenting technological information

Apply and use

facts, concepts, principles and terminology

design methodology and technology

methods of communicating and presenting technological information

Construct, analyse and evaluate

methods, techniques and products

Syllabus Content

Core

4. Final production

4.1 Properties of materials

Physical properties: mass, weight, volume, density, electrical resistivity, thermal conductivity, thermal expansion and hardness

Mechanical properties: tensile and compressive strength, stiffness, toughness, ductility, elasticity, plasticity, Young's modulus, stress and strain

Aesthetic characteristics: taste, smell, appearance and texture

Properties of smart materials: piezoelectricity, shape memory, photochromicity, magneto-rheostatic, electro-rheostatic and thermoelectricity

4.2a Metals and metallic alloys

Extracting metal from ore

Grain size

Modifying physical properties by alloying, work hardening and tempering

Design criteria for super alloys

Recovery and disposal of metals and metallic alloys

4.2b Timber

Characteristics of natural timber: hardwood and softwood

Characteristics of man-made timbers

Treating and finishing timbers

Recovery and disposal of timbers

4.2c Glass

- Characteristics of glass
- Applications of glass
- Recovery and disposal of glass

4.2d Plastics

- Raw materials for plastics
- Structure of thermoplastics
- Structure of thermosetting plastics
- Temperature and recycling thermoplastics
- Recovery and disposal of plastics

4.2e Textiles

- Raw materials for textiles
- Properties of natural fibres
- Properties of synthetic fibres
- Conversion of fibres to yarns
- Conversion of yarns into fabrics: weaving, knitting, lacemaking, and felting
- Recovery and disposal of textiles

4.2f Composites

- Form: fibres/sheet/particles and matrix
- Process: weaving, moulding, pultrusion and lamination
- Composition and structure of composites: concrete, engineered wood, plywood, particleboard, fibreglass, Kevlar®, carbon-reinforced plastic, laminated veneer lumber (LVL)

4.3 Scales of production

- One-off, batch production and continuous flow
- Mass customization

4.4 Manufacturing processes

- Additive techniques: paper-based rapid prototyping, laminated object manufacture (LOM), stereolithography
- Wasting/subtractive techniques: cutting, machining, turning and abrading
- Shaping techniques: moulding, thermoforming, laminating, casting, knitting, weaving
- Joining techniques: permanent and temporary, fastening, adhering, fusing

4.5 Production systems

- Craft production

Mechanized production

Automated production

Assembly line production

Mass production

Mass customization

Computer numerical control (CNC)

Production system selection criteria

Design for manufacture (DfM): design for materials, design for process, design for assembly, design for disassembly

Adapting designs for DfM

4.6 Robots in automated production

Primary characteristics of robots: work envelope and load capacity

Single-task robots

Multi-task robots

Teams of robots

Machine to machine (M2M)

Concepts

- Physical properties: mass, weight, volume, density, electrical resistivity, thermal conductivity, thermal expansion and hardness
- Mechanical properties: tensile and compressive strength, stiffness, toughness, ductility, elasticity, plasticity, Young's modulus, stress and strain
- Aesthetic characteristics: taste, smell, appearance and texture
- Properties of smart materials: piezoelectricity, shape memory, photochromicity, magneto-rheostatic, electro-rheostatic and thermoelectricity
- Extracting metal from ore
- Grain size
- Modifying physical properties by alloying, work hardening and tempering
- Design criteria for super alloys
- Recovery and disposal of metals and metallic alloys
- Characteristics of natural timber: hardwood and softwood
- Characteristics of man-made timbers
- Treating and finishing timbers
- Recovery and disposal of timbers
- Characteristics of glass
- Applications of glass
- Recovery and disposal of glass
- Raw materials for plastics
- Structure of thermoplastics
- Structure of thermosetting plastics
- Temperature and recycling thermoplastics
- Recovery and disposal of plastics
- Raw materials for textiles

- Properties of natural fibres
- Properties of synthetic fibres
- Conversion of fibres to yarns
- Conversion of yarns into fabrics: weaving, knitting, lacemaking, and felting
- Recovery and disposal of textiles
- Form: fibres/sheet/particles and matrix
- Process: weaving, moulding, pultrusion and lamination
- Composition and structure of composites: concrete, engineered wood, plywood, particleboard, fibreglass, Kevlar®, carbon-reinforced plastic, laminated veneer lumber (LVL)
- One-off, batch production and continuous flow
- Mass customization
- Additive techniques: paper-based rapid prototyping, laminated object manufacture (LOM), stereolithography
- Wasting/subtractive techniques: cutting, machining, turning and abrading
- Shaping techniques: moulding, thermoforming, laminating, casting, knitting, weaving
- Joining techniques: permanent and temporary, fastening, adhering, fusing
- Craft production
- Mechanized production
- Automated production
- Assembly line production
- Mass production
- Mass customization
- Computer numerical control (CNC)
- Production system selection criteria
- Design for manufacture (DfM): design for materials, design for process, design for assembly, design for disassembly
- Adapting designs for DfM
- Primary characteristics of robots: work envelope and load capacity
- Single-task robots
- Multi-task robots
- Teams of robots
- Machine to machine (M2M)

ATL Skills

Approaches to Learning

Thinking

- In this unit, we will

  ask open questions

  set students a task which required higher-order thinking skills (such as analysis or evaluation)

Research

- In this unit, we will

  require students to practise effective online search skills (for example, use of Booleans and search limiters)

  provide opportunities for students to reflect on how they determine the quality of a source, or analyse contradictory sources

  require students to record their search for sources in steps (types of search engines, search terms, and so on)

Developing IB Learners

Learner Profile

Inquirers

Communicators

Assessment

Assessment criteria

SL Criteria
External Assessment

Paper 2

A: Data-based and short-answer questions on the core material

B: Extended-response question on the core material

HL Criteria
External Assessment

Paper 2

A: Data-based and short-answer questions on the core material

B: Extended-response question on the core material

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