

Summary

Internal Assessment Current



Subject	Year	Start date	Duration
Design Technology	IB1	Week 3, April	31 weeks

Course Part

Curriculum

Aims

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

A sense of curiosity as they acquire the skills necessary for independent and lifelong learning and action through inquiry into the technological world around them

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

Initiative in applying thinking skills critically and creatively to identify and resolve complex social and technological problems through reasoned ethical decision-making

Objectives

Demonstrate knowledge and understanding of

facts, concepts, principles and terminology

design methodology and technology

methods of communicating and presenting technological information

Demonstrate the appropriate research, experimentation, modelling and personal skills necessary to carry out innovative, insightful, ethical and effective designing

Apply and use

facts, concepts, principles and terminology

design methodology and technology

methods of communicating and presenting technological information

Construct, analyse and evaluate

design briefs, problems, specifications and plans

methods, techniques and products

data, information and technological explanations

Syllabus Content

Core

1. Human factors and ergonomics

1.1a Anthropometrics

Anthropometric data: static and dynamic data, structural and functional data

Primary data versus secondary data

Percentiles and percentile ranges

Range of sizes versus adjustability

Clearance, reach and adjustability

1.1b Psychological factors

Psychological factor data

Human information processing systems

Effect of environmental factors

Alertness

Perception

1.1c Physiological factors

Physiological factor data

Comfort and fatigue

Biomechanics

2. Resource management and sustainable production

2.1 Resources and reserves

Renewable and non-renewable resources

Reserves

Renewability

2.2 Waste mitigation strategies

Re-use

Recycle

Repair

Recondition

Re-engineer

Pollution/waste

Methodologies for waste reduction and designing out waste

Dematerialization

Product recovery strategies at end of life/disposal

Circular economy—the use of waste as a resource within a closed loop system

2.3 Energy utilization, storage and distribution

Embodied energy

Distributing energy: national and international grid systems

Local combined heat and power (CHP)

Systems for individual energy generation

Quantification and mitigation of carbon emissions

Batteries, capacitors and capacities considering relative cost, efficiency, environmental impact and reliability

2.4 Clean technology

Drivers for cleaning up manufacturing: promoting positive impacts; ensuring neutral impact or minimizing negative impacts through conserving natural resources; reducing pollution and use of energy; reducing wastage of energy and resources

International legislation and targets for reducing pollution and waste

End-of-pipe technologies

Incremental and radical solutions

System level solutions

2.5 Green design

Strategies for green design (incremental and radical)

Green legislation

Timescale to implement green design

Drivers for green design (consumer pressure and legislation)

Design objectives for green products

Strategies for designing green products

The prevention principle

The precautionary principle

2.6 Eco-design

Timescale for implementing eco-design

The “cradle to grave” and “cradle to cradle” philosophy

Life cycle analysis (LCA)

LCA stages: pre-production; production; distribution including packaging; utilization and disposal

Environmental considerations

Environmental impact assessment matrix

Product life cycle stages: the role of the designer, manufacturer and user

The major considerations of the United Nations Environmental Programme Manual on Eco-design

“Design for the environment” software

Converging technologies

3. Modelling

3.1 Conceptual modelling

The role of conceptual modelling in design

Conceptual modelling tools and skills

3.2 Graphical modelling

2D and 3D graphical models

Perspective, projection and scale drawings

Sketching versus formal drawing techniques

Part and assembly drawings

3.3 Physical modelling

Scale models

Aesthetic models

Mock-ups

Prototypes

Instrumented models

3.4 Computer-aided design (CAD)

Types of CAD software

Surface and solid models

Data modelling including statistical modelling

Virtual prototyping

Bottom-up and top-down modelling

Digital humans: motion capture, haptic technology, virtual reality (VR), and animation

Finite element analysis (FEA)

3.5 Rapid prototyping

Stereolithography

Laminated object manufacturing (LOM)

Fused deposition modelling (FDM)

Selective laser sintering (SLS)

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)

5. Innovation and design

5.1 Invention

Drivers for invention

The lone inventor

Intellectual property (IP)

Strategies for protecting IP: patents, trademarks, design protection, copyright.

First to market

Shelved technologies

5.2 Innovation

Invention and innovation

Categories of innovation: sustaining innovation, disruptive innovation, process innovation

Innovation strategies for design: architectural innovation, modular innovation, configurational innovation

Innovation strategies for markets: diffusion and suppression

5.3 Strategies for innovation

Act of insight

Adaptation

Technology transfer

Analogy

Chance

Technology push

Market pull

5.4 Stakeholders in invention and innovation

The inventor, the product champion, the entrepreneur

The inventor as a product champion and/or entrepreneur

A multidisciplinary approach to innovation

5.5 Product life cycle

Key stages of the product life cycle: launch, growth, maturity, decline

Obsolescence: planned, style (fashion), functional, technological

Predictability of the product life cycle

Product versioning/generations

5.6 Rogers' characteristics of innovation and consumers

Diffusion and innovation

The impact of Rogers' characteristics on consumer adoption of an innovation

Social roots of consumerism

The influence of social media on the diffusion of innovation

The influence of trends and the media on consumer choice

Categories of consumers in relation to technology adoption

5.7 Innovation, design and marketing specifications

Target markets

Target audiences

Market analysis

User need

Competition

Research methods

Design specifications

6. Classic design

6.1 Characteristics of classic design

Image

Status and culture

Obsolescence

Mass production

Ubiquitous/omnipresence

Dominant design

6.2 Classic design, function and form

Form versus function

Retro-styling

Conflict and compromise

Practical function versus psychological function

Additional higher level

7. User-centred design (UCD)

7.1 User-centred design (UCD)

The designer needs to have a deep understanding of the user, task and the environment.

The process is iterative, led by the user and developed through user-centred evaluation.

The product must address the whole user experience.

UCD design teams are multidisciplinary.

The five stages of UCD: research, concept, design, implementation, launch

Inclusive design

7.2 Usability

Usability objectives

Enhanced usability

Characteristics of good user-product interfaces

Population stereotypes

7.3 Strategies for user research

User population

Classification of users

The use of personae, secondary personae and anti-personae in user research

Scenarios provide physical and social context for different personae

Use case

7.4 Strategies for user-centred design (UCD)

Field research

Method of extremes

Observation, interviews and focus groups

Questionnaires

Affinity diagramming

Participatory design, prototype and usability testing sessions

Natural environments and usability laboratories

Testing houses versus usability laboratories

7.5 Beyond usability—designing for pleasure and emotion

The four-pleasure framework: socio-pleasure, physio-pleasure, psycho-pleasure and ideo-pleasure

Design for emotion

The attract/converse/transact (ACT) model

8. Sustainability

8.1 Sustainable development

Triple bottom line sustainability: environmental, economic and social

Decoupling: disconnecting economic growth and environmental impact so that one no longer depends on the other

The use of international and national laws to promote sustainable development

Sustainability reporting

Product stewardship

8.2 Sustainable consumption

Consumer attitudes and behaviours towards sustainability: eco-warriors, eco-champions, eco-fans, eco-phobes

Eco-labelling and energy labelling schemes

Creating a market for sustainable products: pricing considerations, stimulating demand for green products, production of green products

Pressure groups

Lifestyle and ethical consumerism

Implications of take-back legislation for designers, manufacturers and consumers

8.3 Sustainable design

Green design versus sustainable design

Datschefski's five principles of sustainable design: cyclic, solar, safe, efficient, social

8.4 Sustainable innovation

Complexity and timescale of sustainable innovation

Top-down strategies

Bottom-up strategies

Government intervention in innovation

Macro energy sustainability

Micro energy sustainability

Energy security

9. Innovation and markets

9.1 Corporate strategies

Pioneering strategy

Imitative strategy

Market development

Product development

Market penetration

Product diversification

Hybrid approaches

The relative success of pioneering and innovative strategies

Corporate social responsibility

9.2 Market sectors and segments

Categories of market sectors

The influence of market sectors

Classifications of consumer market segments: income, profession, age, family, values, behaviour

The development of a product family

9.3 Marketing mix

Marketing mix - the 4Ps: product, place, price, promotion

Product: standardization of products

Place: implications of internet selling for a company in relation to its supply chain and distribution network

Strategies of setting price: cost-plus, demand pricing, competitor-based pricing, product line pricing, psychological pricing

Promotion: advertising, publicity, personal selling

9.4 Market research

Purpose of market research

Consumers' reaction to technology and green design, and subsequent impact on design development and market segmentation

Market research strategies

9.5 Branding

Brand loyalty

How brands appeal to different market segments

The difference between a trademark and registered design

The implications for a company of positive and negative publicity on brand image

Contribution of packaging to brand identity

Effects of product branding

Evaluating the global impact of branding

10. Commercial production

10.1 Just in time (JIT) and just in case (JIC)

Just in case (JIC)

Just in time (JIT)

10.2 Lean production

Characteristics of lean production

Principles of lean production

Value stream mapping

Workflow analysis

Product family

Role of the workforce

Kaizen

Lead time

The 5 Ss: sorting, stabilizing, shining, standardizing, sustaining the practice

The 7 wastes: overproduction, waiting, transporting, inappropriate processing, unnecessary inventory, unnecessary/excess motion, defects

10.3 Computer integrated manufacturing (CIM)

Elements of CIM: design, planning, purchasing, cost accounting, inventory control, distribution

CIM and scales of production

10.4 Quality management

Quality control (QC)

Statistical process control (SPC)

Quality assurance (QA)

10.5 Economic viability

Cost-effectiveness

Value for money

Costing versus pricing: fixed costs, variable costs, cost analysis, break-even

Pricing strategies: price-minus strategy, retail price, wholesale price, typical manufacturing price, target costs, return on investment, unit cost, sales volume, financial return

ATL Skills

Approaches to Learning



Thinking

- In this unit, we will

ask students to formulate a reasoned argument to support their opinion or conclusion

reward a new personal understanding, solution or approach to an issue

help students to make their thinking more visible (for example, by using a strategy such as a thinking routine)

require students to take an unfamiliar viewpoint into account when formulating arguments



Communication

- In this unit, we will

provide opportunities for students to read and understand different types of texts

encourage or require students to plan a response before they begin

ask students to formulate arguments clearly and coherently



Self-management

- In this unit, we will

set deadlines for students to meet

require students to revise and improve on work previously submitted

give students feedback on their approach to a task

model positive skills and behaviours such as being well organized and punctual

help students to learn from failures or mistakes

create an atmosphere where students do not think they have to get everything right first time



Research

- In this unit, we will

require students to formulate/construct a focused research question (either in class or in a homework assignment)

reward or encourage correct citing and referencing

assign a task that required students to use the library

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

give students advice on (or provide an opportunity for students to practise) narrowing the scope of a task to make it more manageable



Developing IB Learners

☆ Learner Profile



Inquirers



Knowledgeable



Thinkers



Communicators



Risk-takers (Courageous)



Reflective



Assessment



Assessment criteria

SL Criteria

Internal Assessment

A: Analysis of a design opportunity

B: Conceptual design

C: Development of a detailed design

Description