2.1 Core technical principles (AS and A level)

The following technical principles apply to all endorsed areas

Learners are required to develop knowledge and understanding of:

Content	Amplification

(a) How manufactured products typically involve multiple materials, processes and techniques and that designers need to be able to discriminate between them and select them appropriately for use, experimenting in order to improve, refine and realise a design	• The complexity and inter-relationship between parts/components/materials in a manufactured product
	• Selection of materials and components based on defined criteria such as price and performance
	• Investigation, team work (including brainstorming), research, modelling, prototyping and trialling
	• The process of innovation - collaborative and commercial approaches; the development of innovative product solutions (solutions showing innovative use of materials and/or manufacturing processes)
	• Techniques including inversion, morphological analysis, analogy and lateral thinking
	• Analysis and exploration of the needs of users
	• Reverse engineering, to include historical influences, technological performance and components, functional success and aesthetic detailing, or other techniques for:
	  • product analysis
	  • performance modelling and prototyping
	  • the influence of equipment on product manufacture in a range of materials
	  • interaction of new technologies and design needs especially on material and fabric development

(b) The requirements for product design, development and manufacture, including: fitness for purpose; meeting the criteria of specifications; accuracy of production	• The generation, development and expression of ideas to meet stated requirements • Development of aesthetic values • Fitness for purpose • User centred design: the investigation and analysis of a problem within a context, the needs wants and values of users to define a design specification • Writing appropriate and effective specifications • The generation of specific, measurable performance criteria to inform designing and evaluating • Communication of ideas and solutions in appropriate contexts using a variety of media, such as freehand sketching, formal working and presentation drawings, 2D and 3D modelling, ICT generated images

(c) Appropriate use of digital technologies; aesthetics; ergonomics and anthropometrics; the use of media, communication and presentation techniques, including drawing and sketching, and writing reports to record, explain and communicate their design decisions, providing sufficient information to enable others to interpret their design intentions	• Use of Computer Aided Design (CAD) both in formative and summative stages of designing, • Presenting ideas and design possibilities in appropriate formats such freehand sketching, formal working or presentation drawings, CAD/ICT generated images and solid modelling • Recording and explaining design decisions • Communicating information unambiguously to enable others to interpret design intentions, using appropriate conventions and technical language, digital or conventional pictures/images • The importance of ergonomics and anthropometrics to the designer, manufacturer and user
(d) Digital design and digital manufacture, including computer aided design (CAD)/computer aided manufacturing (CAM), modelling and simulation	• Software programs and the transfer of information to run Computer Aided Manufacture (CAM) machines, e.g. laser cutters, micro-routers, embroidery machines, Computer Numerical Control (CNC) lathes and milling machines • The benefits and limitations of computer controlled machines, to include Computer Aided Design (CAD), CAM, Computer-Integrated Manufacturing (CIM), digital media, including visualisations, rendering and photo-quality imaging/modelling
(e) Safe working practices, including identifying hazards and understanding the need for risk assessments	• Working accurately, creatively, innovatively and imaginatively with materials, components, appropriate technologies, tools, processes and resources to achieve high quality products which match their specification • Commercial working practices and responsibilities and their application to project work • Five-step risk assessment (identify hazard, who might be harmed and how, evaluate potential for risk, record, review if details change) • Provision of equipment, training and signage
(f) How skills and knowledge from other subject areas, including mathematics and science, inform decisions in design and the application or development of technology.	• How skills and knowledge from subjects such as mathematics, physics, chemistry and computer science can be utilised to support problem solving, including the application of technology

2.2 Core technical principles (A level)

The following technical principles apply to all endorsed areas

Learners are required to develop knowledge and understanding of:

Content	Amplification
(a) The main features of manufacturing industries, including stages of production, quality assurance and quality control, modern manufacturing methods and systems when combining or processing materials, sustainability, and services to the customer including legal requirements	• Principles of industrial manufacturing systems across a range of scales of production to include mass, batch, one-off • Staffing needs, allocation of costs, Just in Time (JIT) manufacture and commercial liability • Bought-in, standardised part assembly, sub-contracting • The use of different levels of production taking into account economic decisions • Unit / one-off (including prototyping), modular/batch and high volume production • Sustainability issues, resource management and influencing the future • The need to offer product support and customer services, and take account of consumer group opinions in a competitive market • The impact of legislation / regulations related to product design, manufacture and retail
(b) The regulatory and legislative framework for health and safety and the impact on designing and making	• How the regulatory and legislative framework in the Health and Safety at Work Act (HASAW) sets out duties of employees and employers in manufacturing environments, including: o Control of Substances Hazardous to Health (COSHH) o Personal Protective Equipment at Work Regulations (PPE)
(c) The use of feasibility studies on the practicability of proposed solutions to problems	• The benefits of feasibility studies to find out the extent to which factors such as likely demand, cost of manufacture, availability of materials and competitors' products will influence the commercial viability of a product
(d) Design for manufacturing, repair or maintenance, and product life	• Developing initial design briefs and specifications that may need a specific focus such as: manufacturing, maintenance and product life.
(e) How to achieve an optimum use of materials and components by taking into account the relationship between material cost, form, and manufacturing processes, and the scale of production	• When designing products, designers need to be aware and consider the relationship between material cost, form, manufacturing processes; the scale of production; the environmental factors affecting disposal of waste

(f) The implications of intellectual property, registered designs, registered trademarks, copyright, design rights and patents	• Intellectual Property - Patents, Registered Designs, Design Right, Registered Trade Marks, Copyright and the protection afforded by each • The importance and impact of international standards on the design of products, including British Standards Institute (BSI) and International Organization for Standardization (ISO)

(g) The role of marketing, enterprise, innovation and collaboration in the development of products	• Needs and demands of consumers, technology-push and market-pull
	• The totally new (radical) product and the product which has been subjected to improvements over time (incremental)
	• Marketing strategies and how market research is conducted
	• The process of market research and its place in the process of innovation
	• The market environment, who buys, lifestyle changes, market segmentation
	• Technological trends and how market research is conducted
	• The four Ps
	  • Product
	  • Price and how it is determined
	  • Place and how products are distributed
	  • Promotion of the product
	• How the digital world affects the four Ps