

Design and Technology Syllabus T

Singapore-Cambridge General Certificate of Education Normal (Technical) Level (2019) (Syllabus 7053)

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INTRODUCTION

This syllabus is designed to lead to an examination for that part of the school curriculum identified as Design and Technology (D&T). It offers an examination for pupils who have followed a course of study that emphasises designing involving research, reasoned application of knowledge and skills in the areas of design and technology.

The main sections in the syllabus document are:

- Aims
- Assessment Objectives
- Subject Content
- The Examination

AIMS

The following aims of the syllabus describe the educational intent of D&T for the GCE examination. The aims are the major guiding influence in the syllabus implementation. They are not listed in order of priority. The aims of the D&T syllabus are to enable pupils to:

- foster positive values and attitudes for enterprise, creativity and innovation through design-and-make activities
- harness their innate curiosity and ability to create through design-and-make activities
- develop the quality of tenacity through continuous refinement of their ideas towards a viable solution within a given timeframe
- exercise judgements of an aesthetic, technical and economic nature
- develop an awareness of design in social, cultural and environmental areas
- acquire knowledge and skills beyond that as stipulated in the syllabus through the contexts of the design-and-make activities.

In achieving these aims, pupils also develop safe working habits.

ASSESSMENT OBJECTIVES

The three assessment objectives in D&T are:

- A Knowledge with understanding
- B Design problem solving
- C Realisation

The assessment objectives are designed to reflect the syllabus aims and to act as the reference against which the assessment will be made. Each assessment objective is associated with a list of activities which candidates should be able to carry out.

Candidates should be able to:

A KNOWLEDGE WITH UNDERSTANDING

1. demonstrate the ability to apply appropriate knowledge of materials, processes and technological areas
2. extend from their own knowledge and experience towards creating an innovative design solution

B DESIGN PROBLEM SOLVING

3. plan and manage a design project using available resources leading to its completion within a given timeframe
4. identify clearly a situation for which a design solution is required
5. investigate, gather, record and synthesise relevant information from various sources
6. analyse a need and develop ideas by considering relevant human, functional, aesthetic and technological factors through the use of appropriate thinking skills
7. generate ideas using appropriate methods
8. refine ideas through ongoing testing and evaluation prior to realisation
9. apply appropriate communication methods

C REALISATION

10. organise the work procedures involved in the realisation of a design solution
11. realise a design solution in appropriate material(s) using suitable techniques.

ASSESSMENT GRID

The assessment objectives are weighted to give an indication of their relative importance. They are not intended to provide a precise statement of the number of marks allocated to particular assessment objectives.

Paper	Assessment Objectives			Total
	A Knowledge With Understanding	B Design Problem Solving	C Realisation	
1 (Written Examination)	22%	8%	–	30%
2 (Design Project)	10%	20%	40%	70%
Overall	32%	28%	40%	100%

SUBJECT CONTENT

To meet the requirements of this examination all candidates should have a good understanding of the Design Method before embarking on the Design Project. They will also need to acquire design techniques and strategies, and have working knowledge of plastics, metal, wood, basic electricity and electronics and simple mechanisms. It is expected that the Design Project will require further research and specialisation. With this in mind, the syllabus aims to encourage the inclusion of other materials and technologies where appropriate. Teachers should involve pupils in dialogue whenever possible.

The subject content is organised into three sections, namely:

- Section 1 Design
- Section 2 Technological Areas
- Section 3 Materials and Practical Processes

The order of the topics that follows is not to be taken as the order to be taught. Teaching of the topics should take an integrative approach to support design activities to help candidates appreciate the application of the related knowledge and skills at the various design stages.

Only Sections 1 and 2 will be examined in the Paper 1 Written Examination.

SECTION 1 DESIGN

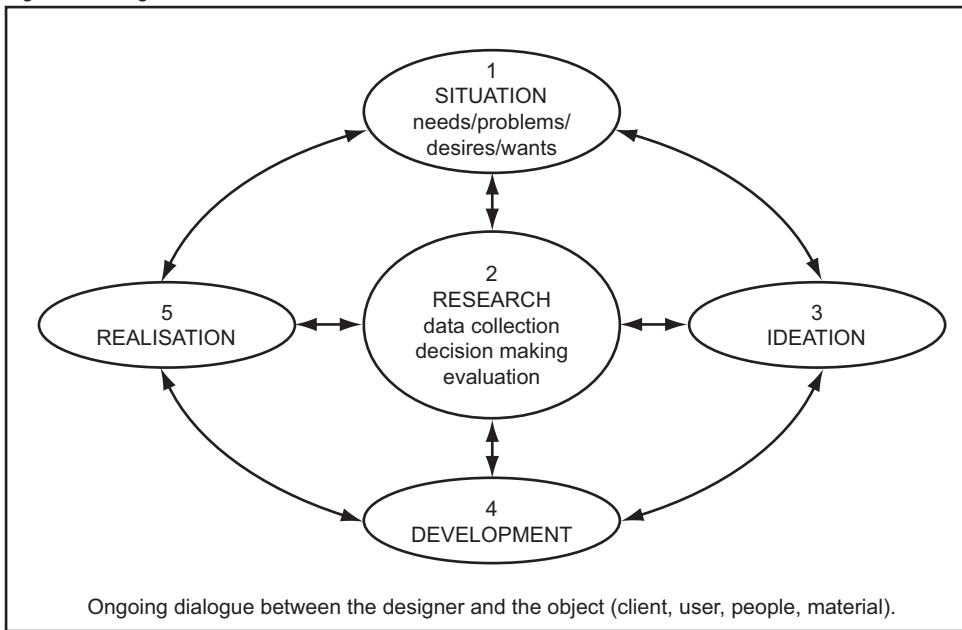
This area of study is concerned with candidates:

- acquiring and applying thinking skills and tools
- developing the ability to visualise, explore, develop, present and communicate their ideas
- making design decisions through purposeful design tasks. Such tasks should be strategically planned by integrating related topics with the aim of developing good design conceptualisation and development skills among the candidates.

1. Design Method

Designing is concerned with creating change and is undertaken in many different ways. Design, as a unique way of thinking and acting, involves planning with meaningful intention and purpose. Broadly and simply defined, designing comprises rational thought processes undertaken in a somewhat logical sequence and all this is nested within a holistic fabric of critical and creative thinking processes that also involves intuitive responses. For this examination, design is concerned with situations which are primarily centred on meaningfully identified needs, problems, desires and/or wants calling for solutions that can be realised through manufactured artefacts. The solutions may be arrived at through diverse methods but each will include the statement of a brief, ideation, development and realisation that require conscious efforts in research, investigation and on-going evaluation of information and data collected and decisions made. A convenient model to help pupils engage in design activity is shown in Fig. 1.

Figure 1 Design Model

**Fig. 1**

Note: The numbering of the design stages is meant as a guide.

The arrows show that designing is not always a linear process and that it is dynamic in nature requiring frequent and careful looping back to other stages of the design model in a holistic manner. The designer is engaged in multiple actions of switching back and forth between a thinking-questioning-evaluating mode and a doing-acting mode. For example when formulating the design brief and specifications resulting from research work, further research and investigative work may be needed to confirm, clarify or focus decision-making, etc. When developing the chosen solution one may be faced with difficulty in trying to meet the identified needs. There is a need therefore to revisit, e.g. the ideation stage to reconsider solution for development or to re-look at the situation identified.

An important design action that must take place in the process of designing is the ongoing dialogue between the designer and the object (client, user, people and material). This is an integral part of designing and is crucial to the successful execution of any design outcome.

Essential to designing is the ability to use appropriate 2D and 3D graphical techniques in design communication. There is also often a need to model in other ways so as to visualise a possible solution or part solution. Quick model making can be used to help in the process of decision making during the design or development stage.

Upon thorough and thoughtful development of the final design proposal with respect to the identified needs, the last stage is the realisation of the artefact. This stage calls for logical planning of the practical making processes. During realisation, evaluation and refinement of the final design proposal should not be ruled out, with the aim of achieving an optimal design solution.

Topics/Contents	Candidates should be able to:
2. Project Management	
<ul style="list-style-type: none"> • Project Scheduling 	<ul style="list-style-type: none"> • plan for a project taking into consideration the stages of work and resources required • monitor and where necessary make adjustments to the plan to ensure completion of the project within the timeframe
3. Research	
<ul style="list-style-type: none"> • Information Gathering • Information Analysis <ul style="list-style-type: none"> – compare and contrast – classify – use of checklist 	<ul style="list-style-type: none"> • gather data upon which the proposed design solutions may be based • summarise and present findings for decision making
4. Need Definition	
<ul style="list-style-type: none"> • Needs Analysis <ul style="list-style-type: none"> – mood board – product analysis • Design Brief • Identifying Constraints 	<ul style="list-style-type: none"> • explore design opportunities • write a design brief • write design specifications
5. Idea Generation and Development	
<ul style="list-style-type: none"> • Brainstorming • SCAMPER • Relay Thinking 	<ul style="list-style-type: none"> • gather and use information on products, materials and technologies related to the identified design needs and opportunities • generate and record ideas using a range of techniques • develop the proposed solution in the areas of functionality, aesthetic and ergonomics • refine design solutions through ongoing evaluation • evaluate the feasibility of design solutions with the aid of models or mock ups
6. Realisation Plan	
<ul style="list-style-type: none"> • Working drawings <ul style="list-style-type: none"> – isometric drawings – orthographic projection • Flow Chart • Production Schedule 	<ul style="list-style-type: none"> • produce plans for the realisation of the final proposed solution within the time frame through <ul style="list-style-type: none"> – working drawings, with the accompanying material list, according to drawing standards and conventions – a flow chart showing the sequence of realisation – a work schedule to monitor progress
7. Evaluation	
<ul style="list-style-type: none"> • Appraisal against Needs, Design Brief and Specification • PMI (plus, minus, interesting) • Design Modelling 	<ul style="list-style-type: none"> • evaluate existing products to identify design opportunities • refine the proposed design solution with design brief and specification as framework • make necessary changes during the realisation stage leading to a workable final product • assess the impact of the product on the intended users

Topics/Contents	Candidates should be able to:
8. Design & Technology in Society	<ul style="list-style-type: none"> • be aware of the effects of rapid developments in technology on the individual and the society • be aware of the role of designers and technologists in industry and society • learn about issues in design related to society, culture and the environment
9. Design Communication	<ul style="list-style-type: none"> • appreciate the use of design elements and principles to communicate design ideas and design aesthetics • use quick freehand sketching techniques to explore and develop ideas • show ideas and describe methods of construction by using pictorial drawing, exploded and sectional views where applicable • produce orthographic drawings through the use of conventional drafting method and/or Computer Aided Design (CAD) • use models and mock-ups as a means of testing the feasibility of a solution
10. Anthropometry and Ergonomics	<ul style="list-style-type: none"> • apply relevant ergonomics factors and anthropometric data when designing

SECTION 2 TECHNOLOGICAL AREAS

This area of study allows candidates to acquire basic knowledge and understanding of Basic Electricity and Electronics and Simple Mechanisms. Candidates should, where appropriate, be given the opportunity to keep abreast of developments in these areas and to apply the knowledge in their projects.

Candidates are required to study the two technological areas on which questions will be set in Paper 1.

Topics/Contents	Candidates should be able to:
11. Basic Electricity and Electronics <ul style="list-style-type: none"> • Basic Electricity • Common electronic components and their uses • Circuits for timer, sensing for light, moisture and temperature 	<ul style="list-style-type: none"> • show understanding of the roles electricity and electronics play in our everyday life • demonstrate the principles of basic electricity and electronics, specifically <ul style="list-style-type: none"> – connection of batteries in series/parallel, measurement of voltage, current, resistors and connection of resistors in series/parallel – switches, magnets, electromagnets, relays, bulbs, insulators, conductors, capacitors, circuit boards, integrated circuits, semiconductors, diodes, transistors, thermistors, sensitive switching circuits, e.g. light sensitive circuits, water-sensitive circuits, temperature sensitive circuits • construct projects incorporating simple electrical and electronic circuits using soldering iron, de-soldering tool, wire-stripper, wire-cutter, long-nose pliers, multimeter
12. Simple Mechanisms <ul style="list-style-type: none"> • Common mechanisms/systems 	<ul style="list-style-type: none"> • show awareness of the working principles of common mechanisms/systems found in machines and devices, e.g. levers, linkages, pulleys (open drive, crossed drive), cams, gears (gear wheel, bevel gears, worm and gear wheel), cranks (handle; crank and slider), rack and pinion, ratchet and pawl, spring loaded mechanism (compression, tension, torsion, flat spring) • show awareness of uses of mechanical fasteners (set screws, cap screws, split pins, bolts and nuts) • apply, where possible and appropriate, knowledge in this area within projects

SECTION 3 MATERIALS AND PRACTICAL PROCESSES

This area of study is concerned with developing candidates' ability to:

- select appropriate processes for setting/marking out, shaping, joining and assembly, and finishing with respect to the materials used
- demonstrate the correct use of hand tools, equipment and machine
- show a concern for economy in the use of materials, components, time, energy and other resources.

Candidates should have a working knowledge of wood, metal, plastics and basic modelling materials to enable them to realise their final design proposals. The scope should cover basic practical processes involving hand tools, equipment and machines. The habit of safe working is to be encouraged throughout the programme.

Topics/Contents	Candidates should be able to:
13. Resistant Materials <ul style="list-style-type: none"> • Types of Common Wood, Metals and Plastics and their Uses • Forms of Materials Available • Selection of Materials 	<ul style="list-style-type: none"> • understand the classification and properties of materials with respect to the uses • make the right selection of materials for use • demonstrate knowledge of available material forms, types, sizes • show awareness of issues related to sustainability with respect to materials usage
14. Smart Materials <ul style="list-style-type: none"> • Shape-memory alloys and plastics • Piezoelectric materials • Fibre-optic sensors 	<ul style="list-style-type: none"> • show awareness of smart materials and their applications
15. Setting/Marking Out <ul style="list-style-type: none"> • Basic tools for marking out on metals, plastics and wood 	<ul style="list-style-type: none"> • measure and/or mark out work so that subsequent operations can be carried out successfully, accurately and speedily using the appropriate tools
16. Shaping <ul style="list-style-type: none"> • By Wastage and by Deformation and Reformation <ul style="list-style-type: none"> – Hand tools – Machines 	<ul style="list-style-type: none"> • select and use appropriate methods to produce the desired shape, form or contour • form the required shapes, form or contour with the aid of moulds, formers and dies or adhesives
17. Joining and Assembly <ul style="list-style-type: none"> • Adhesives • Jointing • Jigs and Formers • Knock-down fittings • Mechanical fasteners 	<ul style="list-style-type: none"> • use various methods of fabricating and fitting to assemble parts of a product or structure, permanently and temporarily, so as to provide the necessary movement for it to carry out its task, with the aid of holding devices, formers or jigs • show awareness of uses of mechanical fasteners (set screws, cap screws, split pins, bolts and nuts)
18. Finishing <ul style="list-style-type: none"> • Abrasives • Types of Finishes • Finishing Techniques 	<ul style="list-style-type: none"> • be aware of different types of finishes available for both interior and exterior use and special finishes available that will prevent corrosion or stains, or withstand heat or liquids • prepare and apply surface treatment necessary for the material to perform its designed role most satisfactorily

THE EXAMINATION

PAPER 1 1-hr Written Examination [30% of the total marks for the subject]

This will be a formal timed examination in which candidates will be required to show their knowledge and understanding of the topics in Sections 1 and 2, namely Design and Technological Areas. Candidates will be expected to call upon their experience of designing via the design process-in-action. They are free to make use of colour and other media for the communication of ideas in their answers. This timed paper will be dispatched to the examining authority for marking.

Part A *[40% of the total marks for the paper – 20 out of 50 marks]*
Five questions requiring short answers will be set based mainly on the Technological Areas.

Part B *[60% of the total marks of the paper – 30 out of 50 marks]*
 Candidates are required to answer **two out of three** questions which will test candidates' competency mainly on Design and the Technological Areas.

PAPER 2 Design Project [70% of the total marks for the subject]

Schools will be informed of the Project Brief set by the examining authority in January of the examination year. Candidates are required to personally identify a design opportunity based on the given project brief or a brief of their choice.

The Design Project is to be completed by candidates for submission to the centre by a date set by the examining authority. It is to be marked internally using the given criteria. See pages 12–16 for the project requirement, assessment guide and criteria. Centres with more than one assessor will have to carry out internal moderation to ensure accuracy and consistency in marking. Assessment for the Design Project should be made on the assessment form which will be provided by the examining authority. There will be external moderation by Moderators.

All centres will be required to send a selection of marked work to the examining authority for the purpose of external moderation. Instructions for the despatch of the selected Design Projects from centres and the completed assessment forms will be sent to centres in due course.

The Design Project comprises two interrelated components:

Part A The Design Journal

Part B Final Presentation

Part A *The Design Journal*

The Design Journal is a complete documentation of all design activities related to the Design Project brief carried out by the candidates. It is to reflect the candidate's personal response to the design process of planning, research and exploration, formulation of brief and specifications, design proposals and on-going evaluation. This may take the form of research materials, notes, doodles, sketches, calculations, decision making, etc. Candidates are strongly discouraged from re-working their Journal for submission. Models and mock-ups may also be included as part of the Design Journal, where appropriate.

Format: A3-size sheets that are securely fastened/A3-size sketch pads and models/mock-ups, as appropriate.

Part B *Final Presentation: Presentation Boards and Artefact*

The Final Presentation is to show the quality of the final design proposal: details, functionality, innovation and desirability.

The candidate is expected to demonstrate his/her:

- (a) graphic design skills to communicate succinctly the final design proposal through the presentation boards
- (b) workmanship and sensitive use of materials and appropriate construction methods through the realisation of the final design proposal.

Format for Presentation Boards: Maximum two A2-size boards, single-side

NOTE: Candidates are required to make use of at least one of the three resistant materials and a technological area within the syllabus in their design solution. Other materials and technological areas may be included, where appropriate. Oral presentation is not a requirement.

ASSESSMENT OF PAPER 2 (DESIGN PROJECT)

The criteria upon which the marking scheme will be built include:

the extent and quality of research; the ability to plan, execute and monitor the progress of the Design Project; the ability to record critical information, identify situations, investigate needs; idea conceptualisation and development showing creative and analytical thought in response to the need being addressed; quality of the design proposal; overall practical skills management in the realisation of the artefact.

		Marks
Part A	The Design Journal	
	Planning and Monitoring	5
	Research	10
	Idea Conceptualisation and Development	15
	Total (Part A)	30
Part B	Final Presentation: Presentation Boards and Artefact	
	Need Definition, Design Brief and Specification	10
	Presentation Drawing	20
	Working Drawing	20
	Artefact	50
	Quality of Proposed Design Solution	10
	Total (Part B)	110
	TOTAL (Paper 2)	140

TEACHERS' GUIDE TO ASSESSMENT

The assessment is to reflect:

- the candidate's engagement in arriving at a design proposal in response to the need confronted
- the quality of the design proposal
- the overall management of practical skills in the realisation of the artefact.

NOTE: Teachers are not precluded from acting as advisers to their candidates.

The following guidance is intended to assist teachers in the assessment of the Design Project.

PART A – The Design Journal

The candidate will be expected to show evidence of use of relevant information, conceptualisation and development of the design proposal through investigation, doodles, sketches, models or mock-ups, decision making and ongoing evaluation leading to the final design proposal.

Candidates should

- | | |
|--|--|
| Planning and Monitoring | <ul style="list-style-type: none"> • produce a plan for the execution of the Design Project that makes the best use of time and various resources, taking into consideration of testing, ongoing evaluation and modifications to the design proposal leading to the realisation of the artefact. The plan might be in the form of a flow diagram and a time-schedule showing various stages of design work adequate for monitoring to complete the Design Project within the given timeframe. |
| Research | <ul style="list-style-type: none"> • seek out information from various resources, discriminating in selection and use of information at various stages of design work to make informed decisions. Testing and evaluation as part of investigative research could take the form of models and/or mock-ups. |
| Idea Conceptualisation and Development | <ul style="list-style-type: none"> • show ability to conceptualise ideas and possible solutions from the investigation and research made. These may be in the form of developmental sketches with appropriate annotations to capture the thought flow, and/or models or mock-ups. |

PART B – Final Presentation

The candidate will be expected to communicate the intent of the final design proposal, its function, details, and its effectiveness and desirability with respect to the need identified.

Candidates should

- | | |
|---|---|
| Need Definition, Design Brief and Specification | <ul style="list-style-type: none"> • state clearly the situation for design, design brief and specification resulting from the research into the given project brief. |
| Presentation Drawing | <ul style="list-style-type: none"> • illustrate the contextual use of the final design proposal using appropriate graphical techniques. |
| Working Drawing | <ul style="list-style-type: none"> • produce working drawings using the proper convention and standards. |
| Artefact | <ul style="list-style-type: none"> • demonstrate an ability to manipulate materials sensitively and apply technologies with accuracy of workmanship and quality of finish. |
| Quality of Proposed Solution | <ul style="list-style-type: none"> • show that he/she has responded to the aesthetic and technical requirements of the design brief and specification and demonstrated originality and inventiveness in the design solution. |

CRITERIA FOR THE ASSESSMENT OF PAPER 2 THE DESIGN PROJECT [Total 140 marks]

Criteria	Max Mk	Level 1	Level 2	Level 3	Level 4
Part A – The Design Journal [30 marks]					
Planning and Monitoring	5	1 Need ongoing guidance to plan and to ensure progress in work. Planning is superficial.	2 Considerable guidance needed to plan and monitor progress in work. Plan shows broad stages.	3–4 Some guidance needed to prepare a plan showing timed main stages that allows for monitoring of work progress.	5 Able to prepare plan and to work from plan making the best use of time and resources.
Research	10	1–2 Little or no use of the information gathered for decision making.	3–5 Some research with relevant information used for decision making.	6–8 Adequate research on main aspects of design project for decision making.	9–10 Thorough research carried out on most aspects of the design project to support decision making.
Idea Conceptualisation and Development	15	1–3 Little evidence of development of concept. <i>[Concept based on existing idea. No change in idea.]</i>	4–7 Aspects of concept explored with some evidence of refinement. <i>[Decisions made. Process not evident]</i>	8–11 Concept developed in some aspects key to the need identified through doodles, annotated sketches and mock ups via on-going evaluation.	12–15 Good concept well developed with regards to functionality, aesthetics, ergonomics, materials, production methods, etc. through doodles, annotated sketches and mock ups via on-going evaluation.
Part B – Final Presentation: Presentation Boards and Artefact [110 marks]					
Need Definition, Design Brief and Specification	10	1–2 Unclear or general information on need, design brief and specifications.	3–5 A statement of need identified, design brief and some relevant factors established in response to project brief.	6–8 Clear definition of need identified, design brief and important factors established in response to project brief.	9–10 Clear definition of critical need identified, design brief and important factors established in response to project brief.
Presentation Drawing	20	1–5 Lacking on both quality and detail.	6–10 Competent graphic presentation but lacking detail.	11–15 Competent graphic presentation with sufficient detail on design solution.	16–20 Competent graphic presentation with all detail showing contextual use of design solution.
Working Drawing	20	1–5 Working drawing with materials list showing no or little details.	6–10 Working drawing with materials list showing main requirements.	11–15 Detailed working drawing with materials list.	16–20 Detailed working drawing with materials list. Drawing standards adhered to.
Artefact	50	1–12 Limited skill control with major inaccuracy and blemishes.	13–25 Average skill control with minor inaccuracy and blemishes.	26–37 Good skill control with good accuracy and some blemishes.	38–50 Excellent skill control with good accuracy and little blemishes.
Quality of Proposed Design Solution	10	1–2 Similar to existing idea with little attempt to value add.	3–5 A plausible solution.	6–8 An effective solution.	9–10 A desirable solution that simplifies or introduces a new way of doing things and is likely to sustain user interest.