

DESIGN AND TECHNOLOGY (Alternative Syllabus)

AIMS

To enable candidates to achieve technology literacy through the development of:

1. technological knowledge and understanding;
2. communicating and problem-solving capability;
3. technological capability;
4. understanding and awareness of the relationship between technology and society.

OBJECTIVES

Candidates are expected to be able:

1. to investigate, use and understand products, systems and environments that have been developed in their society;
2. to apply comprehensive techniques in tackling design problems, presenting ideas and generating solutions;
3. to consider and apply various technologies, including information technology in testing, producing and evaluating products and systems;
4. to choose and use appropriate materials, tools and equipment skilfully and safely;
5. to feel empowered to contribute to a technological society.

THE EXAMINATION

The examination will consist of two papers.

Paper 1 (2½ hours) (70%)

This paper will examine candidates' abilities to solve a set design problem based on given criteria, and their abilities to understand the application of technology, materials, tools and equipment, and techniques and processes in relation to solving practical design problems.

The paper will contain 6 questions. Question 1 will be compulsory. Candidates will be required to answer 3 of the remaining 5 questions.

Paper 2 (30%)

This paper will examine the candidates' abilities to solve a specific design problem over a given period of time.

This part of the examination will involve candidates in a design-make-evaluate project extending over approximately 30-35 hours of practical time.

A multi-material approach is encouraged.

The project will involve the candidates in investigating a given design problem; identifying salient features; providing a solution to the problem by considering possible alternatives; selecting the appropriate solution; and planning and carrying out, in practical terms, the development of the chosen solution.

Candidates will be required to submit the project together with a design folder. The folder should show the development of the chosen project; i.e. research, investigation

and analysis of various alternative design solutions, planning procedures, working drawings and a final evaluation of the project.

A list of design projects will be given to candidates during the year prior to the examination. Candidates should attempt one project only.

THE SYLLABUS

Topics

Explanatory Notes

1. Technology Development & Society

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|----------------------------|--|
| 1.1 Technology Time-line | The development of technology: <ul style="list-style-type: none">– in the past– at present Predict the future development of technology |
| 1.2 Technology and Society | The impact of modern technology on society: <ul style="list-style-type: none">– environment– transportation– communication– manufacturing <p>The ways and beliefs people promote or constraint technological developments in local, national and international settings</p> <p>Examples of how technology can influence our:</p> <ul style="list-style-type: none">– business/industry– daily life |

2. Design and Communication

- | | |
|------------------------------|--|
| 2.1 Evolution of Design | <ul style="list-style-type: none">– materials– products/systems– technology (tools and processes) |
| 2.2 The process of designing | Design process–linear and cyclic <ul style="list-style-type: none">– identification of needs and creation of needs– design brief and specification– investigation– proposed solutions– analysis– finalised solution– realisation– evaluation and modification |

Topics

Explanatory Notes

- 2.3 Design documentation and presentation
- verbal presentation
 - graphical presentation (e.g. portfolio including text and computer graphics)
 - 3D presentation (e.g. 3D model)
- 2.4 Design considerations
- Human factors in design
- ergonomics–static and dynamic
 - psychological
 - anthropometrics
 - user/product interface
 - safety
- Aesthetics and Function
- design fundamentals
 - design for environment/green design
 - designing for senses
 - design for special needs (e.g. elderly)
 - choice of materials
 - copyright

3. Investigation of Technological Areas

- 3.1 Control Technology
- Understand system electronics
- concept of input, process & output
 - input & sensors : light, temperature, push button, micro switch & switch
 - logic gates for decision making : AND, OR, NOT
 - output & control devices : LED, bulb, buzzer, relay & motor
- Construction of application circuits using electronic system modules
- light controlled switch
 - temperature alarm
- Application of multivibrator circuits
the function & control of a monostable multivibrator circuit (e.g. trigger and timer circuit for a hand dryer)
- Computer control
- basic concept of computer interface: input & output (I/O) ports (e.g. parallel port &

Topics

Explanatory Notes

- serial port), interface card/device
- characteristics of real world signals, analogue signals & digital signals
- types of sensors, transducers & actuators in computer control projects
- data logging & data analysis using computer software

Pneumatic control

- compressed air : supply, unit, control & safety
- pneumatic components : 2-port & 3-port valves, solenoid-operated valve, single & double acting cylinders
- cylinder operation & control

3.2 Information Technology

Use of computer as an IT tool

- understand the basic components of a computer : input, output & process
- basic operation of graphical based operating system (e.g. MS Windows)
- manipulation of user files : open, save, copy, move and delete

Manipulation of multimedia elements in the computer

- properties of text, clipart, graphics & charts, image
- processing of multimedia elements : create, capture, edit & integrate

Introduction to the Internet

- web page browsing – D&T related web sites
- search of information using search engines

3.3 Materials Technology

Types and nature of materials

- metals & alloys: nonferrous metals, ferrous metals & steel
- timber: natural and prepared & processed timber (e.g. MDF)
- polymers: thermoplastics, thermosets
- composite materials

Material properties and testing

- physical properties : density, melting point

Topics

Explanatory Notes

- thermal properties : thermal expansion, thermal conductivity
 - electrical properties : electrical conductivity & resistivity
 - mechanical properties : tensile strength, compressive strength, hardness, ductility, plasticity and malleability
 - material testing: tensile testing of metals, moisture content testing of wood, hardness testing of plastic
- 3.4 Production and Process Technology
- Health and safety in school workshops
- dress & clothing
 - working attitude
 - working environment
 - use and storage of tools & equipment
 - machine operation
 - electrical safety
 - handling of chemical & chemical waste
- Processing of materials
- material removal processes : sawing, drilling, turning, milling, shaping
 - material forming processes : bending, casting, laminating
 - material joining processes:
 - permanent (soldering, welding, cement, glue, nail, rivets, dowels)
 - temporary (knock-down construction, screws, studs, bolts & nuts)
 - material finishing processes : veneering, painting polishing, buffing
- Machine tools and equipment
- drilling machine : basic principle, operation, change of speed
 - woodworking lathe : turning between centres, faceplate turning, boring, turning tools
 - metalworking lathe : facing, parallel turning, short taper turning, drilling, knurling, parting-off
 - the advantages of using jigs & fixtures in production
 - construction of simple jigs & fixtures

Topics

Explanatory Notes

Computer Aided Design & Drafting (CADD)

- advantages of using CADD
- construction of 2D & 3D objects using CADD software

Introduction to Computer Aided Manufacturing (CAM) using Computer Numerical Control (CNC) technology

- advantages and disadvantage of CAM
- basic principle & operation of a CNC machine : tools & tooling, machine operation, CAD/CAM interface
- simple robotics : degrees of freedom, actuator, basic programming

Introduction to industrial manufacturing processes

- injection moulding
- blow moulding
- die casting
- vacuum forming

3.5 Structures and Mechanisms

Structures

- purposes of structure : transmission of forces, equilibrium, stability (triangulation & struts – simple support, hinge support and cantilever) & strength
- types of structures : mass structure, framed structure & shell
- properties of force : magnitude, direction, point of application
- knowledge of the appropriate use of materials in relation to different structures & the forces acting upon : compression, tension & bending

Mechanisms and motions

- typical mechanical components in a machine : lever or crank, wheel & gears, cam, screw
- levers & linkages : load, effort, mechanical advantage, velocity ratio
- rotary motion : gear ratio, gear wheel speed, chain & belt drive

Topics

Explanatory Notes

- converting rotary to linear motion : cam-follower & crank mechanism
- simple pulley system, screw jack