

METALWORK

1. PREAMBLE

The examination is designed to test candidates' skill in basic design and practical work; their knowledge of tools, equipment and materials, and understanding of those areas of creative thinking which can be expressed and developed through planning, manufacturing and working primarily on metals as part of general education. The test will also equip candidates in the fundamentals of manufacturing to pursue higher education in science and technology.

2. OBJECTIVES

Candidates will be expected to:

- (a) observe safe working practices in the workshop.
- (b) demonstrate knowledge and understanding of tools, materials and equipment.
- (c) adopt basic processes for the care, repair and maintenance of hand and machine tools.
- (d) develop their ability in identifying, analyzing and evaluating problems.
- (e) apply their knowledge of processes and materials to the solution of problems.
- (f) apply the principle of logical planning in the manufacture of items in the workshop.
- (g) demonstrate basic skills of good craftsmanship.

3. SCHEME OF EXAMINATION

The examination will consist of two papers – Paper 1 and 2, both of which must be taken.

Paper 1: This will be a practical test of three hours duration. It will consist of two (2) questions out of which candidates will be expected to answer one (1). Ten (10) minutes shall be given prior to the commencement of the examination for the study of the drawings. Candidates will be required to make a test piece for which the appropriate drawings will be supplied. Schools will supply the materials needed. The paper carries 100 marks.

Paper 2: This paper will be a 2½ hours theory paper consisting of two sections - A and B and will cover all aspects of the syllabus.

Section A (Objective): This will consist of 40 compulsory multiple choice (objective) questions to be answered in one (1) hour for 40 marks.

Section B (Essay-type): This will consist of five(5) essay-type questions out of which candidates will be expected to answer four (4) questions in 1½ hours. This section carries 60 marks. All questions carry equal marks.

4. **DETAILED SYLLABUS**

TOPIC	THEORY	PRACTICAL
<u>1. GENERAL SAFETY IN THE WORKSHOP</u>		
.1 Potential Sources of Accidents	Potential sources of accidents. Measures to avoid accidents.	
1.2 Personal Safety	Safety clothings: goggles, apron, gloves, boots with hard toe caps, helmet. Safety rules in the workshop.	
<u>2. DESIGNING AND MAKING</u>		
2.1 Identifying the Problem	Problem areas: market, classroom, lorry park, workshop. Problem definition: benefits to be derived from finding solution(s) to the problem identified.	
2.2 Generating Possible Solutions	Investigation procedures and possible solutions: interviews, observation, visits, reading journals, books, photographs, sketches of solution alternatives. Generation of possible solution. Selecting the most solution by: simplicity/complexity, availability of materials and cost.	Produce a folio and realise the artifact
2.3 Making the Artifact	Making the artifact: operational sequence and cutting list. Selection of appropriate tools and materials. Making the artifact.	
2.4 Evaluating and Modifying the Artifact	Evaluation of the completed artifact.	

3. BENCHWORK AND HAND TOOLS

Identification, sketching and labelling, uses, care and maintenance.

3.1 Measuring Tools

Measuring tools: linear and angular .

Identify, sketch and label the parts.

3.2 Marking-out Tools

Steel rule, angle plate and scribe, etc.

3.3 Holding Devices

Bench vice, hand vice, G-clamp, chuck, etc.

3.4 Cutting Tools

Cold chisels and hacksaw.

3.5 Striking Tools

Engineers' hammers, mallets.

3.6 Driving and Removing Tools

Screwdrivers, spanners, drifts, etc.

4. FILES AND FILING

Files

Types, grades, cuts and terms (pinning and deburring). Processes. Care and maintenance. Difference between cross and draw filing.

5. HACKSAW AND SAWING

Types of frame, blade and teeth. Selection of blade.

6. SHEET METALWORK

6.1 Basic Tools and Equipment

Identification, tools and equipment. Sketching and labelling. Uses and handling.

6.2 Joints in Sheet Metalwork

Self secured joints (seams). Design and making an artifact.

Design and make an artifact in sheet metalwork.

7. METAL JOINING

7.1 Soft Soldering	Tools and equipment. Types of joints and processes.	Design and make an artifact involving soft soldering.
7.2 Hard Soldering	Tools and equipment. Types of joints and processes. Procedure for making hard soldered joints.	
7.3 Gas and Electric Arc Welding	Welding equipment, welding operation, welding flames. Welding techniques and safety.	
7.4 Riveting	Tools and equipment, types of rivets and joints.	
<u>8. MATERIALS</u>		
8.1 Ferrous Metals	Production, types, Identification and uses.	Identification - file test and grinding test.
8.2 Non-Ferrous Metals	Types, properties and uses.	
8.3 Non-Ferrous Alloys	Types, composition, characteristics and uses.	
8.4 Alloy Steels	Types and uses	
8.5 Plastics	Types (thermosetting and thermoplastic) Example of each type. Properties and uses.	Design and make an artifact involving the use of plastics.
<u>9. HAND FORGING</u>		
	Tools, equipment and operations. Safety, care and maintenance.	Design and make an artifact involving hand forging operation.
<u>10. MACHINE TOOLS</u>		
10.1 Off-Hand Grinding Machines	Types (pedestal and bench). Parts and functions. Grinding terms. Safety precautions.	Students to be trained to grind cutting tools, e.g chisels, tool bits and drills.

10.2 Centre Lathe	Parts, cutting tools, operations, tools setting and maintenance.	Design and produce an artifact.
10.3 Shaping Machines	Parts, cutting tools, operations and maintenance.	Design and produce an artifact.
10.4 Milling Machines	Types, parts, cutters and operations.	
10.1 Drilling Machines and Tools	Types, parts, operations, faults and safety precautions in drilling.	
<u>11. CUTTING FLUIDS</u>		
Coolants and Lubricants	Types of coolants and lubricants. Functions and purposes.	Choice of cutting fluid for a particular metal operation.
<u>12. FOUNDRY WORK</u>		
Sand Casting	Tools, equipment and materials. Processes - pattern making, moulding, melting and pouring and dismantling and fettling. Defects and safety precautions.	
<u>13. BEATEN METALWORK</u>	Tools and equipment. Processes	Design and produce an artifact.
<u>14. SCREW THREADS</u>	Types and thread uses. Types of dies and taps.	Production of bolts and nuts.
<u>15. HEAT TREATMENT</u>	Processes and application.	Heat treatment of artifacts.
<u>16. FINISHES</u>	Types and application.	Application of finishes on projects.

