For Performance Measurement

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL (ZIMSEC)

ORDINARY LEVEL SYLLABUS
2013 – 2017

Metalwork (6045)

1.0 PREAMBLE

This syllabus is intended to provide a course in metalwork which fosters the development of both manual and intellectual skills. The approach to the subject which is advocated in this syllabus is problem centred and tries to involve pupils in planning and designing their practical work. This approach encourages the acquisition of technical skills and knowledge, leading to self-reliance, which are relevant to the requirements of trade and industry in Zimbabwe.

2.0 AIMS

The aims of the syllabus are to:

2.1 give pupils an elementary technical course to prepare them to cope with the technical side of their environment;

2.2 give pupils an understanding of economic and social factors in the world of industry and work;

2.3 encourage a sense of self-reliance and commitment to community development;

2.4 develop in pupils a positive attitude towards work (determination, tenacity, open-mindedness, flexibility, adaptability, co-operation) so that they can meet the requirements of their future professions;

2.5 promote the development of curiosity, enquiry, initiative, ingenuity, resourcefulness and discrimination;

2.6 develop a wide range of communication skills central to designing;

2.7 foster awareness, understanding and a degree of expertise in creative thinking;

2.8 encourage technological awareness, foster attitudes of co-operation and social responsibility, and develop abilities to improve the quality of the environment;

2.9 promote the acquisition of a wide variety of skills necessary when working with metals;

2.10 encourage students to acquire knowledge applicable to working with metals;

2.11 enable pupils to use their knowledge and skills to solve technical problems through a process of designing, making and evaluating the results;

2.12 stimulate the exercising of value judgements of an aesthetic, technical, cultural and moral nature

3.0 ASSESSMENT OBJECTIVES

By the end of the course, pupils should be able to:

3.1 demonstrate knowledge of all safety regulations relevant to the work in the metal workshop;

3.2 produce useful articles out of various metals using basic hand tools and machines;

3.3 join metals using a variety of techniques;

3.4 perform basic sheetmetal and forgework operations;

3.5 demonstrate the maintenance of basic hand tools and equipment in the workshop;

3.6 calculate the price of an article based on the cost of material and the time for work;

3.7 give an outline of the production of ferrous metals, the properties of metals and the methods of improving their properties;

3.8 analyse problems and design solutions to them by making use of the facilities in the metal workshop;

3.9 communicate their ideas by means of sketching and drawing;

3.10 interpret and critically analyse design ideas presented as a sketch or drawing;

3.11 evaluate results of their work, assessing the technical quality of design and the level of craftmanship.

SPECIFICATION GRID

Assessment Objectives	Paper 1 Theory/Drawing	Paper 2 Practical	Paper 3 Project
3.1	*		*
3.2		*	*
3.3	*	*	*
3.4	*		*
3.5	*		
3.6	*		*
3.7	*		
3.8	*		*
3.9	*		*
3.10	*	*	*
3.11			*
Weighting	40%	40%	20%

OBJECTIVES/COMPONENTS	PAPER 1	PAPER 2	PAPER 3	AVERAGE %
Knowledge with understanding	45%	40%	15%	33%
Practical skills and their application	20%	50%	45%	38%
Decision making and judgement	35%	10%	40%	29%
TOTALS	100%	100%	100%	100%

4.0 NOTES FOR THE GUIDANCE OF TEACHERS: THE DESIGN PROCESS

This syllabus is to be taught in a problem solving and pupil centred way.

In theory lessons pupils should have a chance to inspect or examine tools, machines and other equipment related to the topic or to carry out small experiments using the facilities available.

During practical lessons, a problem solving, pupil centred approach requires the participation of pupils in the design of the articles. Though the degree of participation will increase as the course progresses, teachers should try to implement this idea from the beginning.

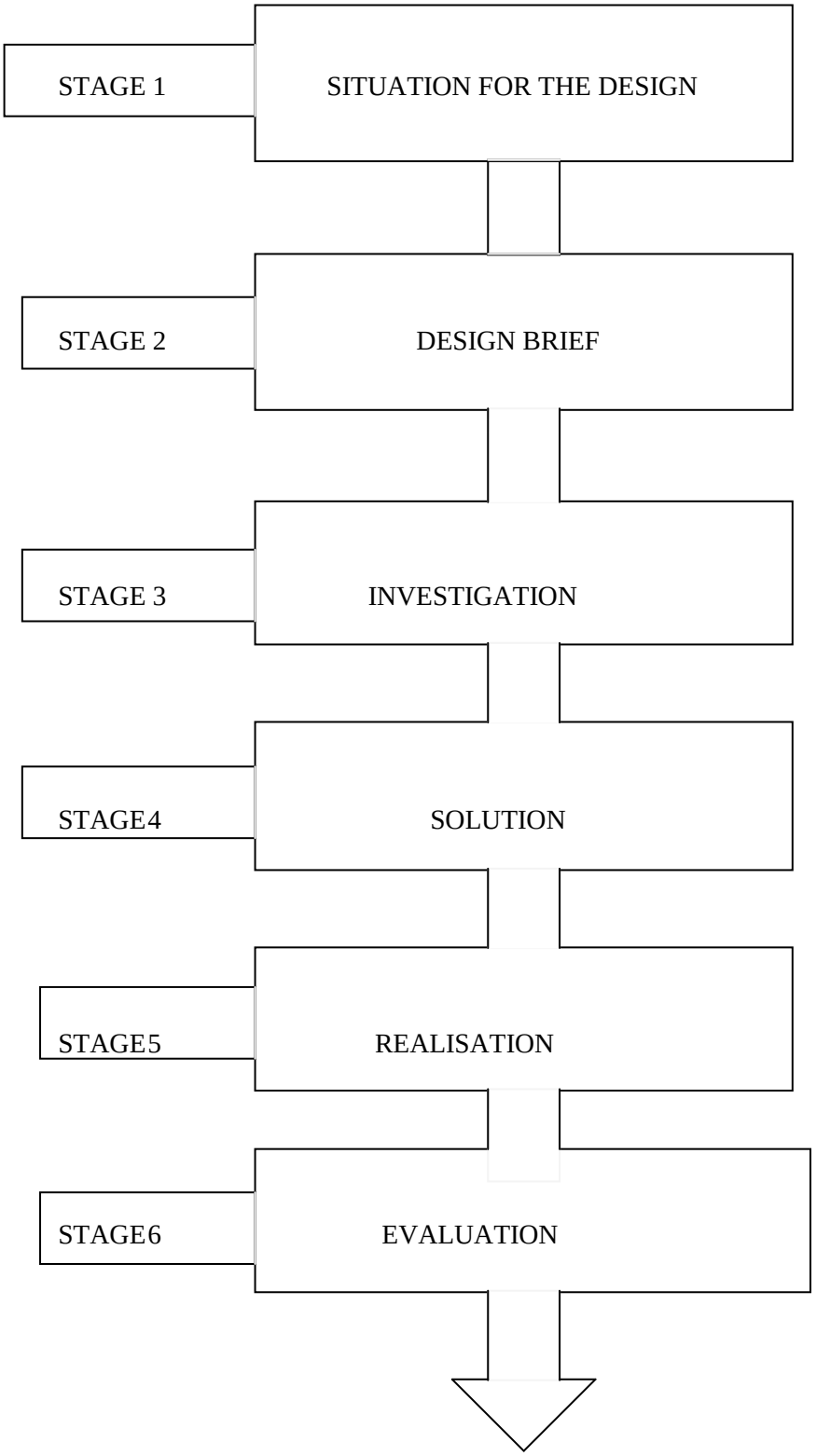
During drawing lessons, a problem solving and design orientated approach is preferred to the mere teaching of drawing skills. In this context, design is meant as a problem solving process, following a pattern of design brief. Analysis of the problem, synthesis of a solution, realisation of that solution and evaluation of the work done.

In order to enable pupils to solve design problems, especially in the course work, they should gain a sound knowledge of methods of construction in metalwork, mainly through thorough examination of tools and machinery in the workshop and their way of functioning. Pupils should be able to apply this knowledge by transferring it to new situations.

Workshop calculations should be an integral part of every practical project carried out rather than being treated in isolation.

Wherever possible, group work should be encouraged both in theory and practical work.

THE DESIGN PROCESS



5.0 CONTENT

5.1 Materials

5.1.1. Manufacture of ferrous metals from the ore to the finished material including cast iron, mild steel, tool steel.

5.1.2. Identification, properties and use of common ferrous, non-ferrous metals and alloys, to include:

cast iron, mild steel, alloy steel, tool steel, copper. aluminium, zinc, tin, lead, aluminium alloy, brass, bronze.

Testing of materials (simple workshop tests only, e.g. identification by colour, weight, sound, bending, cutting, grinding and reaction of heat treatment).

5.1.3. Simple heat treatment as applied to the materials in the workshop: annealing, normalizing, hardening, tempering, case hardening.

5.1.4. Identification of the following non-metallic materials: wood, plastics, rubber, fabrics. Working knowledge of these materials as far as necessary for their use in the metal workshop.

5.2 Safety

Awareness of all common safety precautions relevant to work in the school workshop, to include:

the appropriate clothing and behaviour in the workshop;
maintaining order both on the bench and on the floor;
the safe use of all available tools and machinery;
correct storage and handling of dangerous liquids and gases.

5.3 Benchwork

5.3.1. Marking out and measuring

Knowledge of construction, use and maintenance of all common marking out, measuring and testing tools, including surface gauge, vernier calipers and micrometer.

5.3.2. Hand tools

Knowledge of construction, use and maintenance of all common hand tools in the metal workshop.

5.3.3. Thread cutting

Cutting of internal and external threads by hand.

5.3.4. Joining metals

Bolts, nuts, screws and locking devices.
Riveting, including the use of tubular rivets.
Soft soldering, silver soldering, brazing.
Basics of gas and arc welding.

5.3.5. Metal finishes

Application of different types of finishes, e.g. painting, oil blacking.

5.4 Machine Work

5.4.1. Drilling

Knowledge of construction of pedestal drill/bench drill.
Correct use of pedestal drill/bench drill.
Drilling using twist drills.
Countersinking and counter boring.
Speeds and feeds for drilling.
Friction and heat.
Application of coolants and lubricants.

5.4.2. Grinding

Knowledge of construction of pedestal grinder/bench grinder.
Correct and safe use of the machine in grinding of simple tools (e.g. chisels, scribers. centre punches).

5.5 Forgework

Maintenance of the forge fire.
Working temperatures for steel.
Basic forging processes: drawing down, flaring, bending and twisting.

5.6 Sheet Metalwork

5.6.1. Basic sheetmetal processes

Folding, bending, joining sheets using different joints including folded and grooved seam, circular folded and circular overfolded seam/knocked up joint.
Preparation of safe and wired edges.

5.6.2. Beaten metalwork processes

Hollowing and sinking.

5.7 Drawing and Design

5.7.1. Drawing

Use of drawing instruments.
Basic geometric constructions.
Free hand sketching in orthographic (first or third angle) and isometric projection.
Scale drawings.
Sections.
Common conventional symbols.
Dimensioning.
Introduction to assembly drawings, including title block and parts list.
Development of prism, cylinder and right angled cone.

5.7.2. Design

Knowledge of construction of tools and machinery usually found in a school workshop, to include:

how parts can be joined (screws, rivets, pins, keys);
how different types of motion are created and transformed (levers, pulleys, gears, cams);
how friction and the resulting wear and tear can be reduced (simple brushes and bearing, use of special materials, lubrication);
choice of appropriate material.

5.8 Workshop Calculations

Price calculations for different articles.
Cost of materials.
Time of work and cost of labour.
Cost of machining (calculation of time for machining is not required).

5.9 Options

Out of the following options, each pupil has to offer one as part of his/her design project. It is up to the school to decide, according to the facilities available, whether one, two or three different options can be offered to the students.

5.9.1. Machine work

This must involve basic operations, and care and maintenance on one or more of the following machines: centre lathe, milling machine, shaping machine.

Centre lathe - tool sharpening, three jaw chuck, parallel turning, knurling, parting off, drilling, taper turning.

Milling machine - setting of work in a vice and on the table, fitting of cutters, use of side, face and slotting cutters.

Shaping machine - setting of work in a vice and on the table, use of clapper box, principles of quick return mechanism.

5.9.2. Sheet metalwork and welding in general

This must involve more advanced techniques in shaping and joining sheets and other material to produce a desired article. Development of right cones and pyramids, oblique prisms, right cylinders, oblique cylinders and intersection of these shapes.

Basic principles of gas and electric arc welding of mild steel.

5.9.3. Forgework

Articles must show the pupil's ability to master more advanced techniques in forgework: up setting, hot cutting, fullering, swaging, punching, drifting, scrolling, forge welding.

6.0 SCHEME OF ASSESSMENT

Three papers will be set:

PAPER 1 Theory, Drawing and Design (3 hrs) (40%)

Paper 1 contains three sections.

Section A (Theory 15%) will contain four structured questions based on the compulsory parts of the syllabus.

Section B (Theory 5%) will contain questions on the options 5.9. There will be two questions in each option from which candidates will answer one question from one option.

Section C (Drawing and Design 20%) will contain a two part question based on the design and drawing of a metal construction within the experience of the candidates.

PAPER 2 Practical (3 hrs plus 10 min. reading time). (40%)

This paper will be based on bench work, including drilling.

Candidates will be required to work from dimensioned sketches, written descriptions or from scale drawings.
Paper 1 and Paper 2 will be marked externally.

PAPER 3 Design Project (20%)Course

Coursework will be set in the form of a design brief set by ZIMSEC. The course work consists of 2 components: the design log-book and the completed article.

Coursework projects can be designed for use in the house, in horticulture/ agriculture, in a workshop or for decorative purposes.

The design log-book must contain a series of sketches, drawings, models, notes etc. to show the development of the design process, including the pupil's evaluation of his/her work.

Advance information for the design project will be sent by ZIMSEC, Harare, during the third term of Form Three; the project is to be carried out during the first and second terms of Form Four.

This work will be marked by teachers and moderated by Coursework Assessors appointed by ZIMSEC. Teachers will be provided with a marking scheme when the design brief is circulated to schools.